Chapter 7 ROCKET ASSISTED TAKE-OFF UNIT

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Description

1. R.A.T.O. units can be fitted to Valiant aircraft that are structurally altered in accordance with Mod. 1756 (*Vol.* 2, *Leaflet* G.81), one unit being suspended from an electro-mechanical release unit No. 2 Mk. 1, Ref. No. 26SR/13780 (*Book* 3, *Sect.* 7, *Chap.* 2), retained in a housing fitted into falsework rib 45 of each inner plane (*fig.* 1), and crutched by adjustable arms to a predetermined position. The structural alterations include strengthening the engine doors and falsework panels (*fig.* 3) to permit the extra loading, and to provide crutching points and facilities for fitting the release unit housings.

2. The unit is the Super Sprite Mk. 10101, a self-contained, jettisonable, recoverable, liquid propellant, assisted take-off unit, intended to provide additional thrust for large aircraft operating in tropical conditions or from airfields at high altitudes or with limited runways (*A.P.*4664A). It is controlled electrically (*Book* 2, *Sect.* 5, *Chap.* 3, *Group* 5) from the cabin for both firing and normal or emergency release (*Sect.* 1, *Chap.* 1, *fig.* 5), emergency release being electro-mechanical through an actuator operating linkwork to depress the mechanical release plunger in the release unit.

3. The unit nacelle is provided with attachments (*fig.* 4 *and* 5) for securing it to the aircraft and, when in position at the inner-plane undersurface, it is braced by a pair of fixed crutches, and a pair of spring-loaded struts which engage cups on the inner plane. The engine thrust and side loads are transmitted to the aircraft by metal spigots engaging apertures in the inner-plane undersurface, electrical control being through a multicore cable to a 20-pole plug which disconnects from the unit when it is jettisoned. ◀This and other cables are carried in U-shaped conduits secured to the rear spar forward face, the lowest part of each conduit having two drain holes (Mod. 2912) to prevent accumulation of moisture at that point.▶

Fitting the E.M. release unit housing (*fig.* 2)

4. In fitting the electro-mechanical and emergency release actuator housings, it

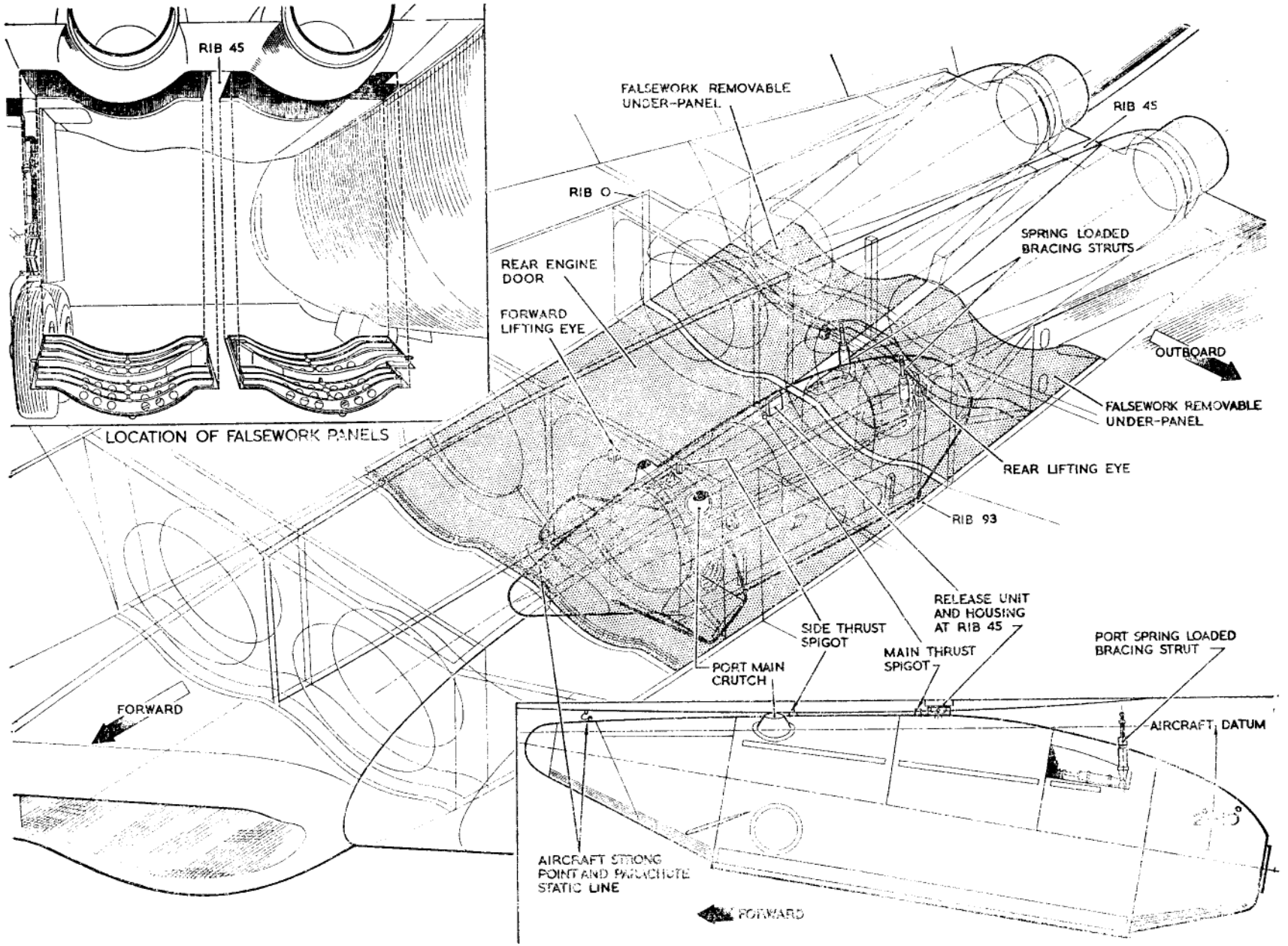

Fig. 1. R.A.T.O. unit location (port)

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should be noted that the two top E.M. release housing securing bolts also pass through and help to secure the emergency release actuator housing. For this reason they are longer than the lower bolts, the rear upper bolt being longer than the forward upper since it also passes through a boss in the upper housing.

5. For the release housing initial fitting, it will be necessary to feed in and connect the electrical supply cables to the release unit contact switch, at the same time making provision for subsequent housing removal for servicing. This is achieved by first connecting two 6 ft. cables to the switch and feeding them into the rib 45 tunnel and conduit, ensuring that when in position and before connecting the cable ends, approx. two feet of spare cable is available (*Book* 2, *Chap.* 3, *Group* 5). This will ensure that the housing may be lowered until the contact-switch securing pin can be withdrawn, after which the housing can be removed for servicing without damage to cables or connections.

6. To fit the housings (*fig.* 2), proceed as follows:—

(1) Remove the rear engine door (*Sect.* 3, *Chap.* 2, *para.* 43).

(2) Open the access panel on rib 45 inboard web.

(3) Offer up the housing, Ref. No. 26SR/13781, to the aperture in rib 45, with the mechanical release operating rod towards the inner plane trailing edge. With the housing not fully home and the release unit contact switch recess in the housing visible, insert the contact switch and secure it with the retaining pin which passes through the housing and switch.

(4) Fit a dummy unwired contact switch into the housing rear face recess, to serve as a seal against ingress of moisture and foreign matter.

(5) Push the housing into position and insert the two lower securing bolts to temporarily retain it.

(6) With the actuator in the fully-extended position, fit the actuator housing. This is retained in position by six bolts, the lower of which pass through and retain the release housing; tighten all securing bolts.

(7) Using the access panel on rib 45 web, unlock the mechanical release rod lock nut and release the fork-end from the actuator lever. Ensure that the actuator is still fully extended, slip the rod eye-end over the mechanical release-rod hook and adjust the rod until the fork-end can be reassembled to the lever, without tension on the release spring. Tighten the lock nut.

(8) Close and secure the rib web access panel.

(9) Using a $\frac{1}{2}$ in. B.S.F. spanner through the slot in the rear engine door (*fig.* 3) turn the suspension pin nut to withdraw the pin from the release unit opening.

(10) Refit the engine door. Turn the suspension pin nut to move the pin back into position in the release unit housing, ensuring that the door pin holes align correctly.

Note . . .

The suspension pin must not be overtightened. It is fully engaged when the complete hole is just visible.

(11) If it is not intended to fit the release unit, replace the rear engine door cover plate.

Removal is a reversal of operations (1) to (9), except that the release unit contact switch is not disconnected from the cable.

Fitting the E.M. release unit

7. The release unit, Ref. No. 26SR/13780, is an item of aircraft equipment normally carried only when R.A.T.O. units are fitted. To fit a release unit, proceed as follows:—

(1) Remove the blanking plate from the rear engine door, covering the R.A.T.O. unit main thrust spigot and release unit apertures.

(2) With access through the release unit aperture, ensure that the suspension pin and housing are clean. The pin is part of the electrical earth-return system; its protection and maintenance are important (*Book* 3, *Sect.* 7, *Chap.* 2, *para.* 9).

(3) Remove the suspension pin locking wire, and turn the nut until the pin is drawn clear of the housing.

Note . . .

The pin is keyed and moves axially only. Movement is limited, the nut being turned only until further movement requires use of undue force.

(4) Ensure that the release unit is clean and close the hooks.

(5) With the release held hooks-downward, and the mechanical release pin on the top surface towards the aircraft leading edge, insert the unit into the housing and push it home.

(6) Hold the unit in position and screw the suspension pin back through the

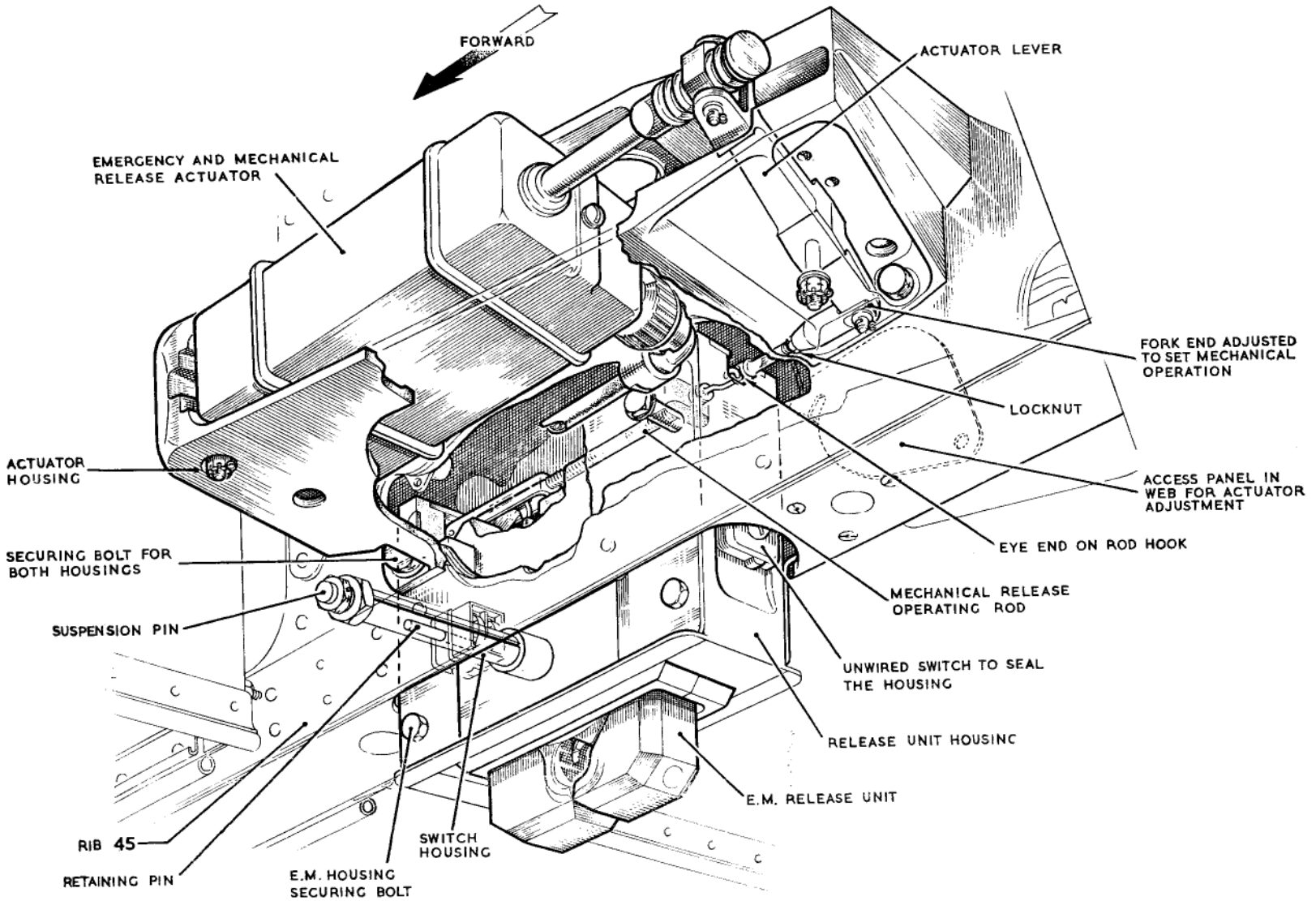

Fig. 2. Actuator and release housings

release unit centre boss and into the housing, turning the nut until a complete hole is just visible. Wire-lock the pin to the adjacent structure.

Tests after fitting the housing and release unit

8. After fitting and before use, the housing and release assembly must be electrically tested for function and insulation (*Book* 2, *Sect.* 5, *Chap.* 3, *App.* 2).

Installing the unit

9. For installation, R.A.T.O. units will be received at the aircraft on a standard chassis trolley, Ref. No. 4F/2019, secured to a lifting cradle, Ref. No. 46AA/600. The cradle is designed to give the unit a nose-up attitude of between 2 and 10 deg. during transportation, loading and assembly, in order to prevent spillage of High Test Peroxide (H.T.P.) from the tank into the nitrogen pipes if the unit is handled fully charged, and thus prevents possible damage to the valve seals with subsequent failure in operation. For detailed precautions in handling and transportation see A.P.4664A, Vol. 1, Part 1, Sect. 2. To install the unit proceed as follows:—

(1) Ensure that the aircraft is standing on level ground. and that the rear engine door and removable falsework under-panel are fitted securely.

(2) Remove the slip cover plate.

(3) Screw the four lifting eyes, Ref. No. 26SR/95428, into the threaded sockets in the inner-plane undersurface (*fig.* 4).

(4) Move the unit on its transporter into position under the inner plane, with stabilizer fins forward and the unit swinging link directly under the E.M. release unit. Chock the transporter trolley.

(5) Check that the slip is uncocked, i.e., jaws open, using the test box, Ref. No. 5G/560, plugged into the test socket and on the falsework rib aft of the rear spar. With the switch beside the socket held at RESET, an amber lamp will indicate that the electro-mechanical mechanism is safe.

Note . . .

Access to test point is by a detachable panel aft of the firing socket. If the jaws are closed, the slip can be uncocked by inserting the special shorting plug in the falsework firing socket and operating NORMAL JETTISON *on the cockpit switch. With the jaws open, remove the shorting plug.*

(6) Attach four winches to the lifting eyes (*fig.* 5) and pay out sufficient cable to allow the hooks to be attached to the cradle lifting shackles. The front cables pass inside the stabilizer guard rail.

Note . . .

The R.A.T.O. unit and cradle weigh approximately 2 200 *lb.; use of the correct hoists is important.*

(7) Connect the hoist cables to the cradle lifting shackles and tension the cables without applying lift. Remove the pins securing the cradle to the transporter trolley.

(8) Connect the cocking test box to its test point (*fig.* 4).

(9) Operating all four hoists simultaneously under instructions of a controller, raise the unit and cradle evenly in the nose-up attitude until it is near to the inner plane surface.

(10) Check that the side and main thrust spigots are aligned with the inner plane apertures, and the swinging link with the E.M. release unit.

(11) Continue hoisting, ensuring that the spigots enter their apertures and the swinging link engages the E.M. release unit, until the cocking test box RED lamp indicates that the unit is locked (jaws closed). During the final hoisting operation, ensure that the rubber seal around the swinging link enters the inner plane aperture without being trapped or buckled.

Note . . .

In addition to the lamp indication it is possible to hear the release unit lock with a sharp click as the jaws close.

(12) Check that the crutches are in contact with the inner plane surface. If they are not both correctly seated, it will be necessary to lower and realign the unit on rehoisting. When correct seating is assured, continue to wind all winches simultaneously and evenly until clutch slip indicates that the unit is fully home and correctly positioned.

(13) Disconnect the cocking test box.

(14) Release the straps securing the unit to the lifting cradle and operate the winches to lower the cradle approx. $\frac{1}{4}$ in. clear of the unit underside. In this position, rock the unit to check that it is correctly secured by the release unit.

(15) Hoist the cradle to its position in contact with the unit nacelle and remove each cable and hoist in turn, replacing them with safety chains (*fig.* 5) Pt. No. 70679 Sht. 1353 (front) and 70679 Sht. 1355 (rear).

(16) Slacken the knurled lock nuts on the spring-loaded bracing struts at the nacelle rear. Swing the struts into position and adjust finger-tight on the adjusters until their ball ends engage the inner-plane undersurface sockets. Turn the spring covers at the strut outer case lower ends until the slots in the end fittings can be seen.

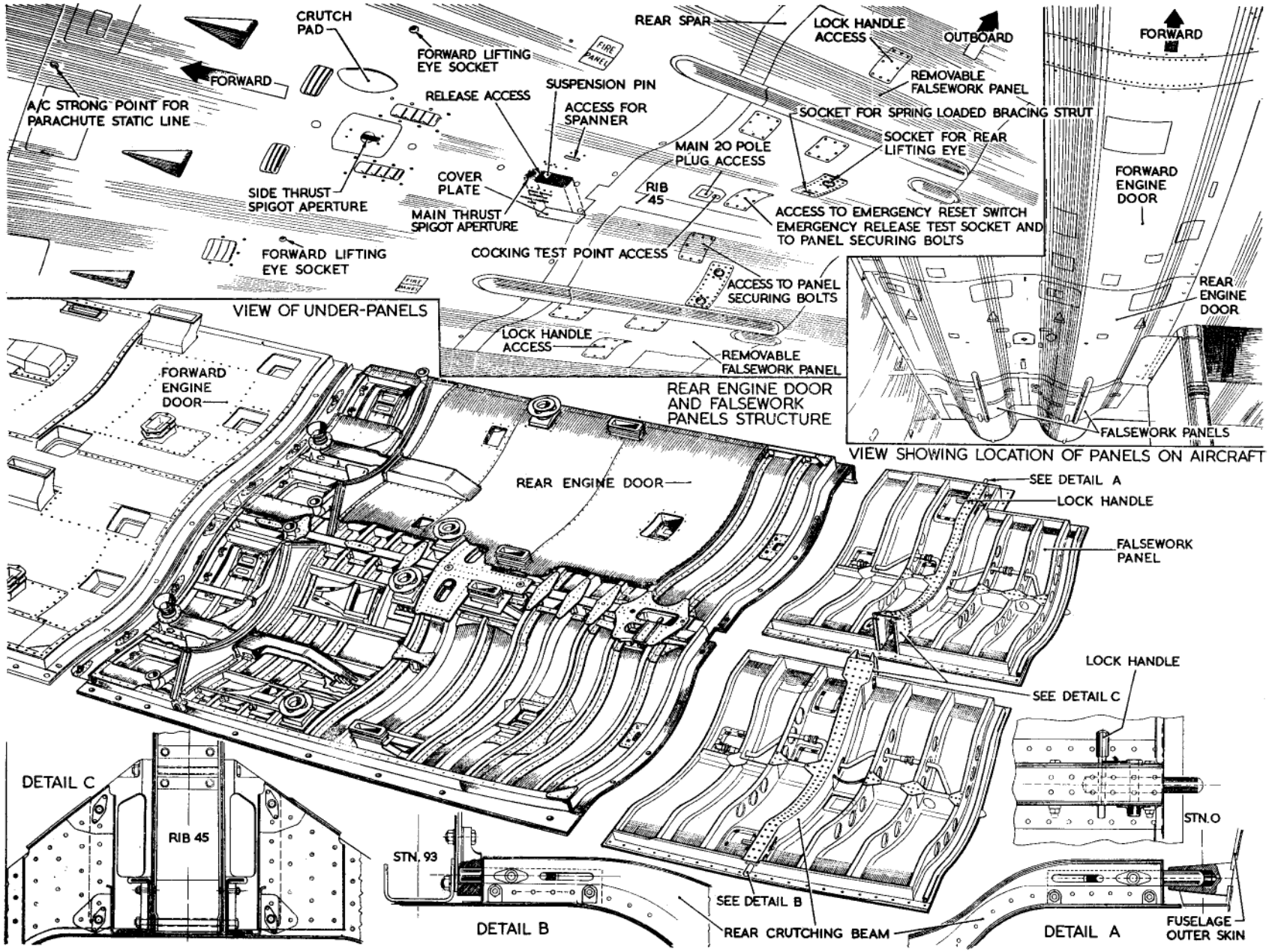

Fig. 3. Rear engine door and falsework panels

(17) Using parallel ¼ in. dia. tommy bars in the ball-end adjuster holes, and adjusting both struts simultaneously whilst watching the pin in the strut lower end slot, unscrew each ball end evenly until the scribed lines on the pin and the case are in alignment. At this setting the struts have predetermined spring loading.

(18) Check that the thrust spigots are located correctly in the inner plane fittings, the rubber seal is correctly positioned around the swinging link, and that the two crutches are seated firmly and correctly.

(19) On each strut, tighten the knurled lock nut finger-tight only, and wire-lock the nuts. Turn the spring covers around the strut lower ends until the holes in the cases are covered.

(20) Remove the tommy bars.

(21) Attach the parachute extractor gun static line to the aircraft strong point forward of the main crutches (*A.P.*4664A, *Vol.* 1, ***Part* 2, *Sect*, 1, *Chap.* 2, *fig.* 9).

Installation checks

10. In addition to the checks given in this Chapter and carried out prior to or during installation, checks given in A.P.4664A, Part 2, Sect. 1, Chap. 2 must be made prior to and after charging with nitrogen. Electrical checks must be in accordance with the procedure given in A.P.4377A, Book 2.

WARNING . . .

After charging, and until the nitrogen has been discharged or residual pressure released, the R.A.T.O. unit must be treated as being LIVE. Personnel should not pass across the rear of the unit. After fitting the main electrical control plug it is imperative that the master switch is NOT MOVED TO THE ON POSITION, and that the firing and jettison controls are not operated.

Preparation for flight

11. When checks have been made, in addition to those operations required to be carried out on the R.A.T.O. unit (A.P. 4664A), the following operations must be completed:—

(1) Fit the 20-pole main electrical plug to its socket. adjust and lock its support strut.

(2) Remove the safety chains, lower the lifting cradle on to the transporter and secure with the pins provided.

Note . . .

The cradle can be either manhandled, or the hoists reintroduced for the lowering operation.

(3) Move the transporter clear of the aircraft.

(4) Remove the lifting eyes from the inner plane screwed sockets.

Removing the unit

12. In normal operational conditions the Super Sprite R.A.T.O. unit is jettisoned from the aircraft after take off; the following removal procedure is given to cover cases of failure to fire, development of defects or for training purposes. It will also be necessary if, during installation, the crutches do not seat correctly (*para.* 9 (12)). When removing a unit, the standard procedure must always be followed, and all safety precautions taken; this includes treating the unit as *live*.

13. Where an operation is not described in detail, it will refer specifically to the R.A.T.O. unit and is covered in A.P.4664A, Vol. 1, Part 2, Sect. 1, Chap. 2 which must be referred to. In addition to the normal loading crew, an operator will be required in the pilots' cockpit to operate the jettison control. Efficient communication between cockpit and operation controller is essential. To remove the unit (the aircraft must be on reasonably level ground) proceed as follows, reference being made to fig. 4 and 5:—

(1) Unlock and disconnect the main electrical plug support strut, and disconnect the 20-pole plug from its socket.

(2) Discharge the nitrogen, or release any residual pressure in the system (*A.P.* 4664A).

(3) Fit the parachute extractor gun safety key (*A.P.*4664A).

(4) Fit the landing box door-release mechanism safety pin (*A.P.*4664A).

(5) Move the transporter and lifting cradle into position under the unit, ensure that the cradle is correctly positioned and chock the transporter wheels.

(6) Screw the lifting eyes into the inner plane sockets.

(7) Attach the hoists to the lifting eyes, pay out and attach the cables to the lifting cradles shackles, the front pair passing inside the stabilizer guard rail.

(8) Tension all cables equally, remove the pins securing the cradle to the transporter, and raise the cradle.

Note . . .

The cradle can also be manhandled into position and the hoist cables attached after it is secured to the unit.

(9) Tension all cables evenly and check that the weight of the unit is taken before unlocking the release unit.

(10) Vent the oxidant tank as necessary (*A.P.*4664*A*, *para.* 23 (14)).

(11) Disconnect the parachute extractor gun static line at the aircraft strong point.

(12) Unlock and slacken the knurled nuts on the spring-loaded bracing struts.

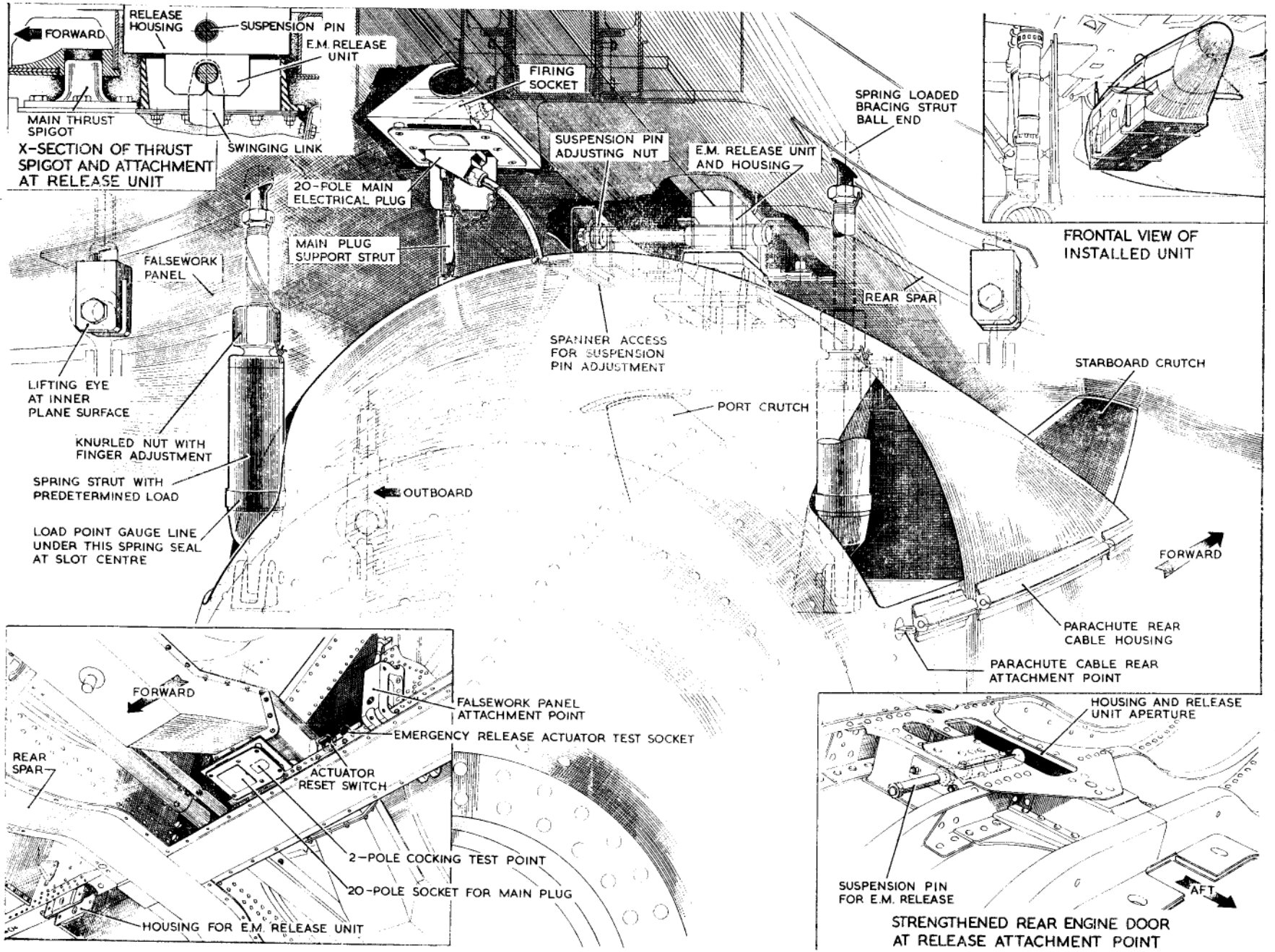

Fig. 4. Unit installation detail (port)

WARNING . . .

Care must be taken in disconnecting the bracing struts which fold into nacelle recesses under tension. In operation (13) it is necessary to maintain a firm grip on the struts until they are free and folded. Inattention to detail may lead to injury to personnel.

(13) Firmly gripping the spring-loaded bracing struts, insert the $\frac{1}{4}$ in. dia. tommy bars into the adjuster holes, and screw down the ball ends until the adjustment is finger-tight. Remove the tommy bars and screw the ball ends clear of the sockets. Maintaining a firm grip, lower the struts into the nacelle recesses.

(14) Strap the unit to the lifting cradle and ensure that the hoist cables are just in tension.

(15) Release the unit (*A.P.*4664A).

(16) Maintaining the nose-up attitude, and working to the controller's instruction, lower the unit to the transporter and secure it by inserting the pins.

(17) Disconnect the hoist cables from the cradle, wind in the cables and disconnect the hoists from the lifting eyes.

(18) Remove the lifting eyes from the inner plane sockets.

(19) Reset the release actuator (*A.P.* 4377A, *Book* 2).

(20) Move unit and transporter clear of the aircraft.

(21) Refit access panels and cover plates.

Table 1

Servicing tools and equipment

Ref. No.	Part No.	Description	Remarks
26SR/95428	70979 Sht. 165	Eye, lifting, Super Sprite	
26SR/95508	67479 Sht. 1177	Box, circuit test	
	70679 Sht. 1353	Safety chain, front	
	70679 Sht. 1355	Safety chain, rear	
4GC/5703	—	Hoist, a/c heavy components 5 cwt.	
4F/2019	—	Chassis standard	For transporting cradle c/w Super Sprite
46AA/600	T.79422	Cradle lifting, Super Sprite E.C.U.	
5G/560	—	Indicator, cocking test, 7-way	
1A/4106	—	Bar, tommy, $\frac{1}{4}$ in. dia.	
10G/20001	—	Equipment, intercommunication, aircraft servicing, Ultra, Type 36	For communication between cockpit and ground when the aircraft intercommunication is not available
10U/17229	—	Unit, loud speaking, Type 10007	
10K/20203	—	Unit, battery, power, Type 8997	

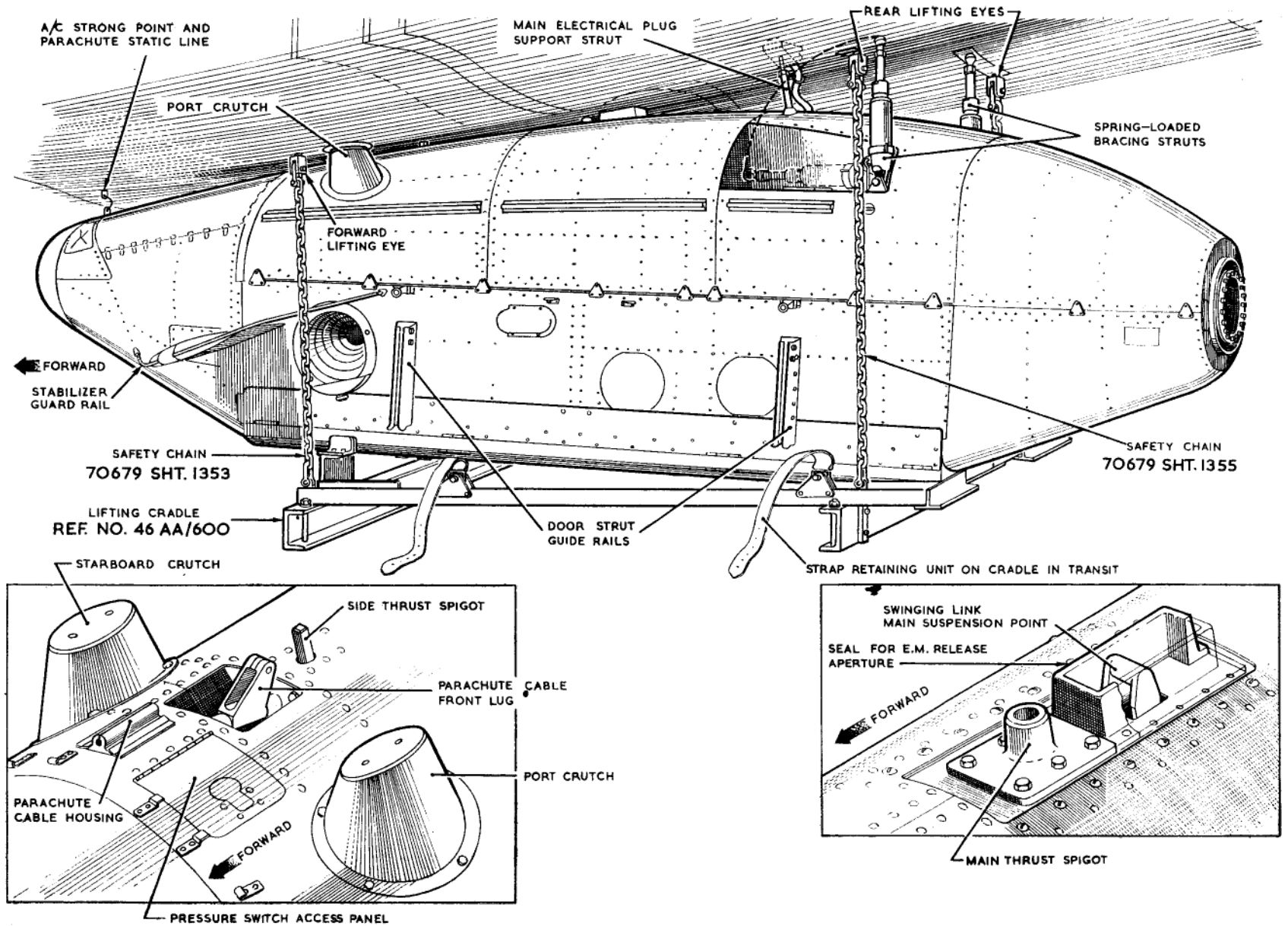

Fig. 5. Installed unit (port)

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