

AIRCREW EGRESS SYSTEM SPECIALIST

CHAPTER TWO

LIGHTNING MK 55 CANOPY

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CONTENTS

PARAS. 1 - 4	CANOPY MK 55
PARAS. 5 - 10	LOCKING MECHANISM
PARAS. 11 - 14	ACTUATING MECHANISM
PARAS. 15 - 23	JETTISONING MECHANISM

ILLUSTRATIONS

FIG. 1	CANOPY
FIG. 2	G.A. OF MECHANISM
FIG. 3	INTERNAL CONTROL HANDLE
FIG. 4	LOCKING MECHANISMS TORQUE SHAFT
FIG. 5	ACTION OF HINGE-RELEASE MECHANISM
FIG. 6	ACTION OF JACK END FITTING RELEASE MECHANISM
FIG. 7	JACK END FITTING RELEASE MECHANISM
FIG. 8	JETTISONING MECHANISM

Canopy Mk. 55

General Information

1. The canopy, which is hinged at the rear on bolts secured in the spine structure, is locked mechanically, actuated hydraulically, and can be jettisoned by a cartridge-operated firing unit. Provision is made for stand-by opening of the canopy in hydraulic or electrical failure, without resort to jettisoning action. Safety features incorporated in the operating mechanism ensure that the canopy is unlocked before either of the hydraulic controls can be operated.

Cockpit pressurization is maintained by a hollow rubber seal around the windscreen arch, rear bulkhead and the cockpit sills; when the canopy is locked the seal is inflated with air ducted from the main air system. For descriptive purposes the operating mechanism is sub-divided into locking, actuating and jettisoning.

Canopy

2. The canopy consists of a metal frame containing two double-skinned transparent panels, each moulded to form the side and top of the respective half. Two hinge arms, bolted to the canopy structure, extend aft and each incorporates a built-in release mechanism. The mechanism consists of a hook which grips a steel bush by pressure applied by an eccentrically-mounted catch. The adjustment is locked by a tab on the eccentric engaging one of seven radial slots in the hinge arm. Hinge bolts pass through the steel bushes to secure the canopy to the aircraft.
3. Hooks, housed in the cockpit sills, engage rollers in the base of the canopy sides to lock the canopy. Additional locking facilities are provided by three shoot-bolts, carried on control rods extending along each side and top member, which engage the windscreen arch. Four spigots on each side member, three on the base and one on the rear end, locate holes in fittings attached to the cockpit sills and rear bulkhead respectively, when the canopy is closed. Striking plates on the base of the side members are contacted by the canopy-jettisoning jacks during jettisoning. Three lifting points in the top member, indicated by LIFT stencils on the top surface, provide for the attachment of a sling; when not in use the points are closed by screwed plugs. To facilitate cleaning of the transparent panel interspaces, two holes, one in each inner panel, are sealed by removable plugs located just aft of the lighting assembly.
4. Two flexible pipes, located inboard of each hinge arm, interconnect the interspaces de-misting pipes on the canopy, to associated unions on the rear bulkhead; the pipes incorporate pull-out type end fittings. A cockpit lighting assembly attached to the underside of the top member, incorporates the high intensity lighting switch and two associated lamps and an emergency floodlamp. An I.F.F. aerial is sited on the top surface of the canopy structure at the aft end. The cables of the latter three services are coupled to the rear bulkhead by pull-out type connectors. Two lugs, attached to the base of the torsion box structure at the rear end, provide for the connection of the ejection seat delay cables.

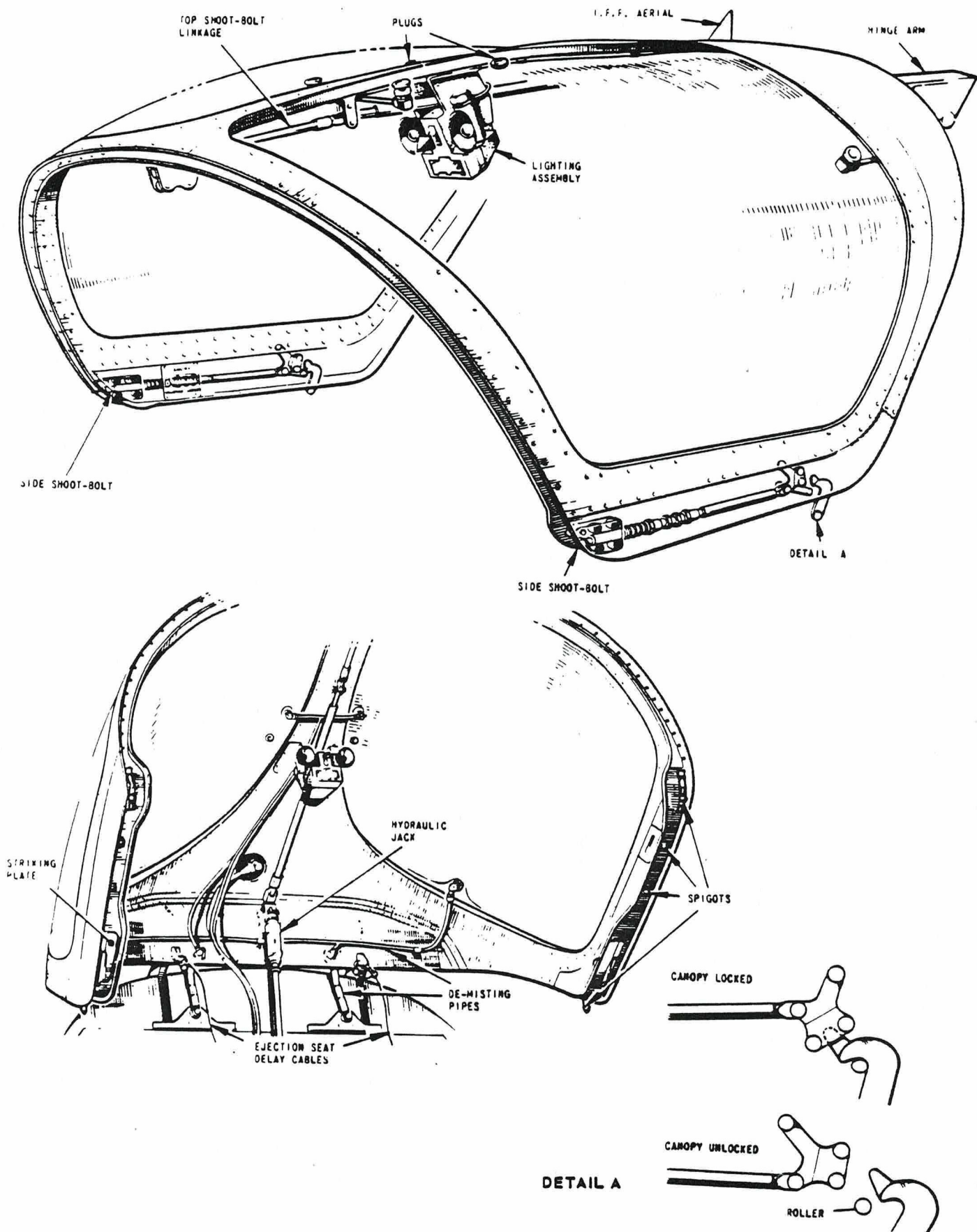


FIG.1 CANOPY

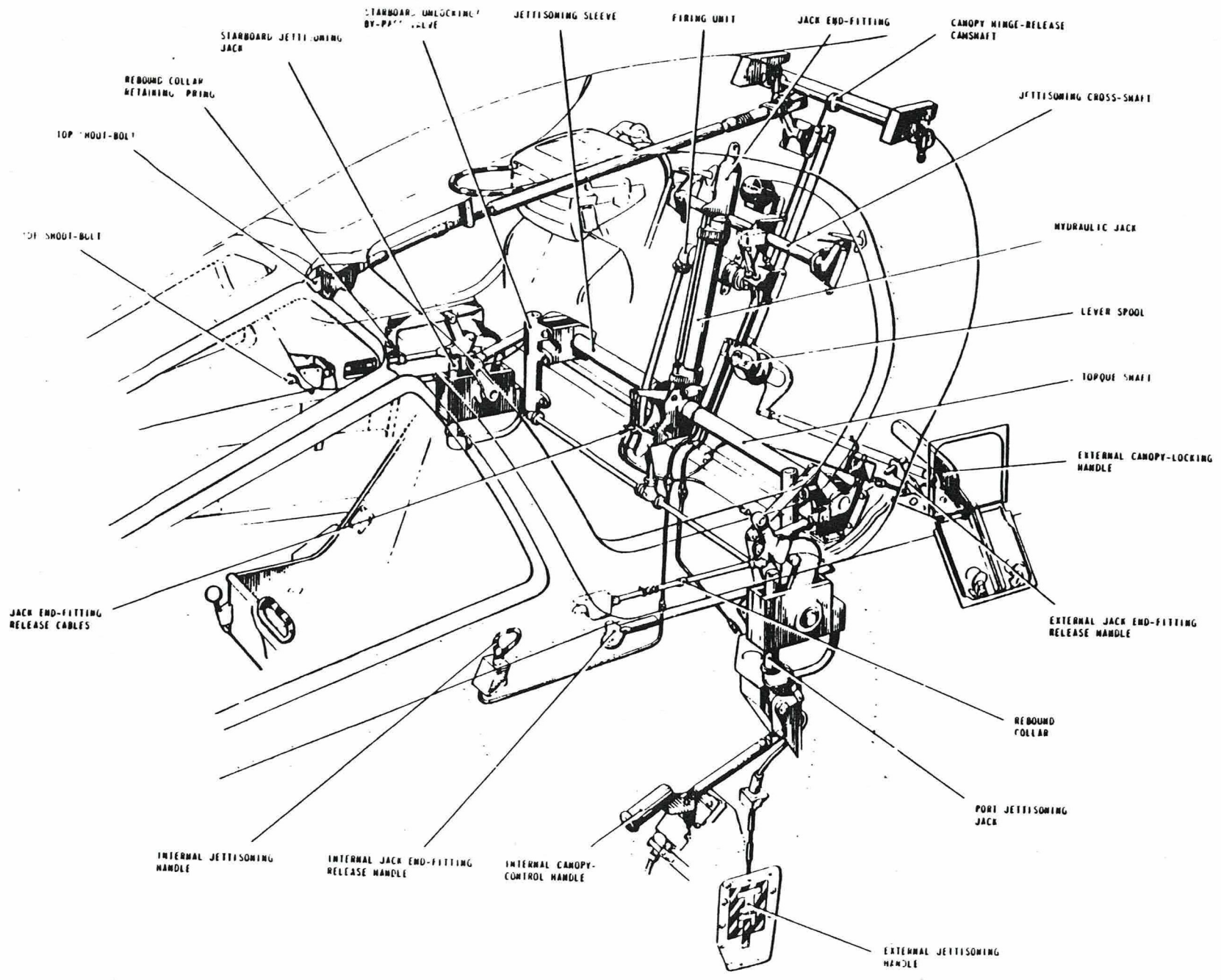


FIG.2 G.A. OF MECHANISMS

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## Locking Mechanism

### General Information

5. Locking and unlocking of the canopy is based on a torque shaft to which rotary movement is imparted, through rod and lever linkages, by either of two interconnected handles, one inside and one outside the cockpit. The canopy can also be unlocked, through the torque shaft, by operation of the jettisoning unit. Torque shaft movement, through additional rods and levers, engages or disengages the locking hooks in the cockpit sills with rollers in the base of the canopy sides. Movement of the locking hooks causes a spur, on the top of the hooks, to engage yokes at the aft end of the side shoot-bolts linkages, moving the shoot-bolts to the locked or unlocked position as selected. The top shoot-bolt operates simultaneously but through a separate linkage; a lever spool passing through the rear bulkhead is connected at its forward end to a lever on the torque shaft. On the aft end of the spool one lever is connected to the external handle; a second lever is connected to a lever assembly at the top of the rear bulkhead to move the top shoot-bolt to the desired position. All three shoot-bolts are spring-loaded to the unlocked position, and, to guard against spring or acceleration forces unlocking the canopy, the links connecting the lock levers to the locking hook shafts are adjusted on assembly to give an over-centre lock of 0.10 in.

### Warning Indicators

6. Visual warning that the canopy is unlocked is given by illumination of an indicator on the auxiliary warnings panel which is operated by striker arms on the torque shaft contacting microswitches mounted on the rear bulkhead. Mechanical indicators on the canopy sides, adjacent to the side shoot-bolts, indicate the LOCKED or UNLOCKED positions of the shoot-bolts. When canopy OPEN or CLOSED is selected, by use of either the internal or external switches, a Klaxon buzzer on the rear bulkhead sounds a warning which persists, until the selector switch is allowed to return to the 'off' position.

### Torque Shaft

7. A main shaft, the starboard half fitted inside a jettisoning sleeve, with levers sited about shaft and sleeve, comprises the torque shaft assembly. The whole assembly is supported in ball races, the housings being bolted to the rear bulkhead. The main shaft is free to rotate within the jettisoning sleeve which is used only during jettisoning operations. During normal operation of the canopy locking mechanism, the main shaft is rotated by means of either control handle, the internal handle being linked via the port locking-hook shaft to a lever on a fixed sleeve at the port end of the main shaft; this sleeve also carries a hook-lock lever and a microswitch striker arm which are duplicated on a fixed sleeve at the starboard end of the main shaft. Fitted on the main shaft and jettisoning sleeve, adjacent to the fixed sleeves, are jettisoning lever assemblies which are independent of main shaft rotation. The outboard end of each lever assembly terminates in a dog which is in contact with a mating dog on the fixed sleeves when the canopy is in the locked position.

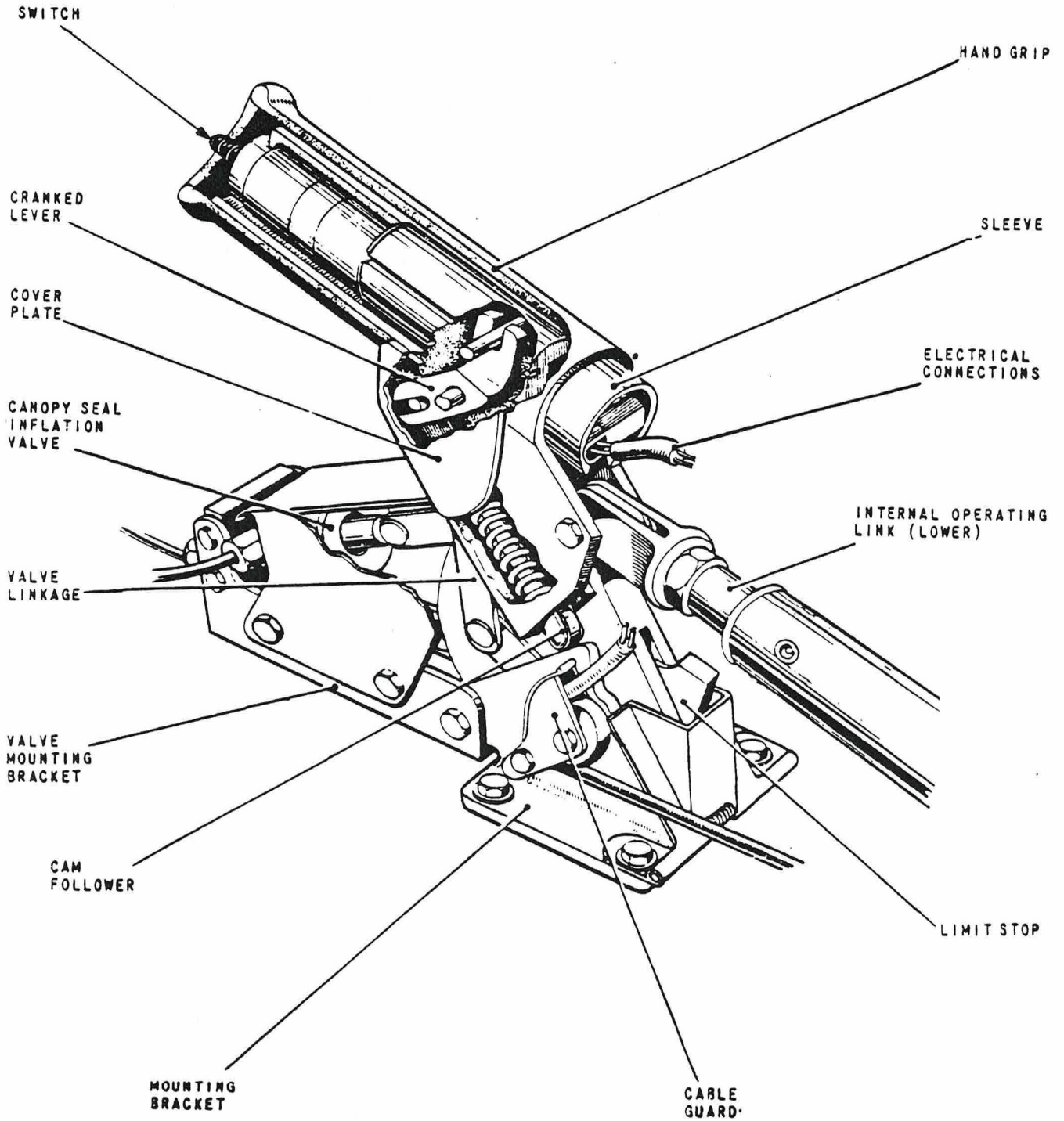


FIG.3 INTERNAL CONTROL HANDLE

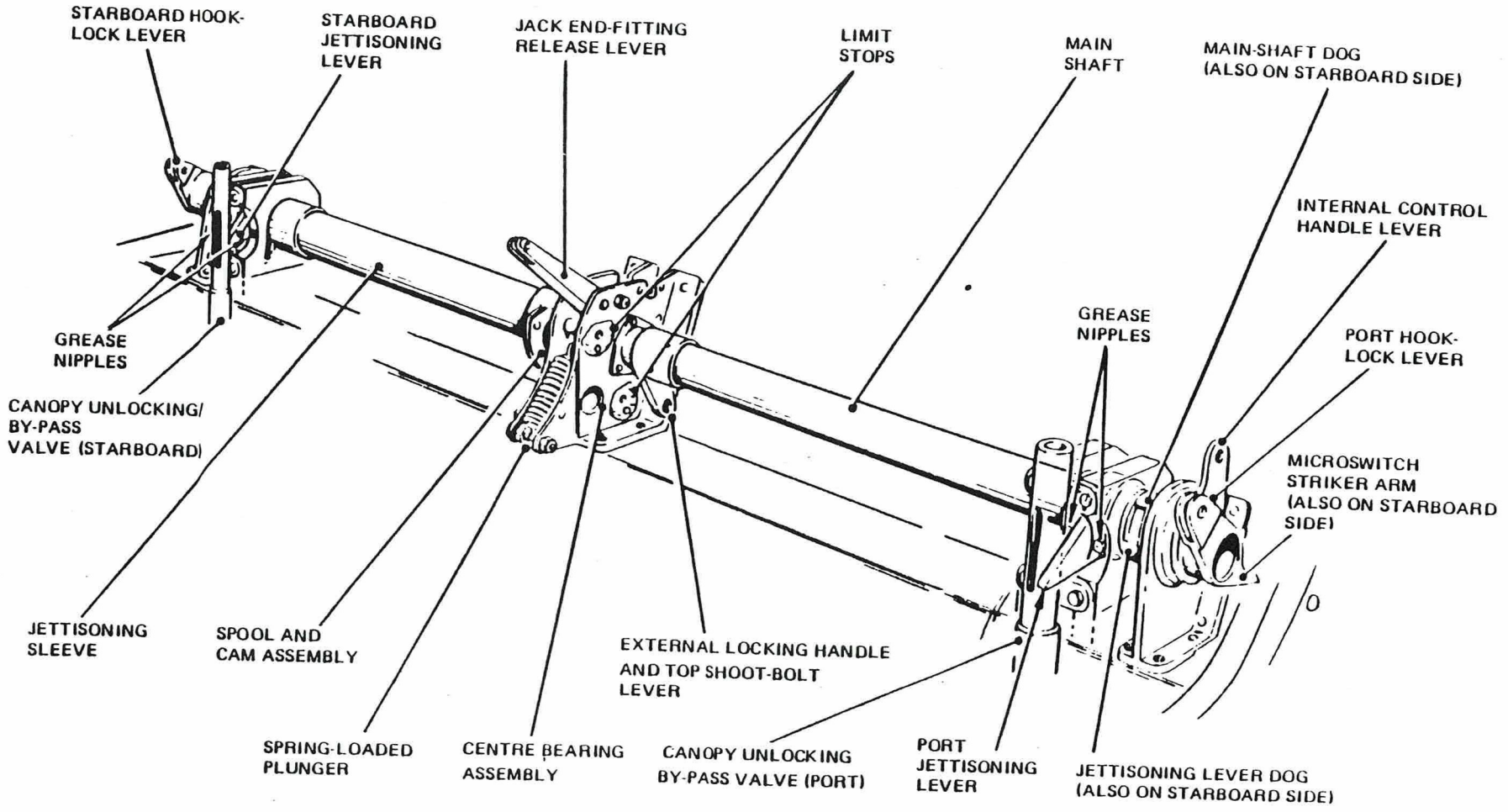
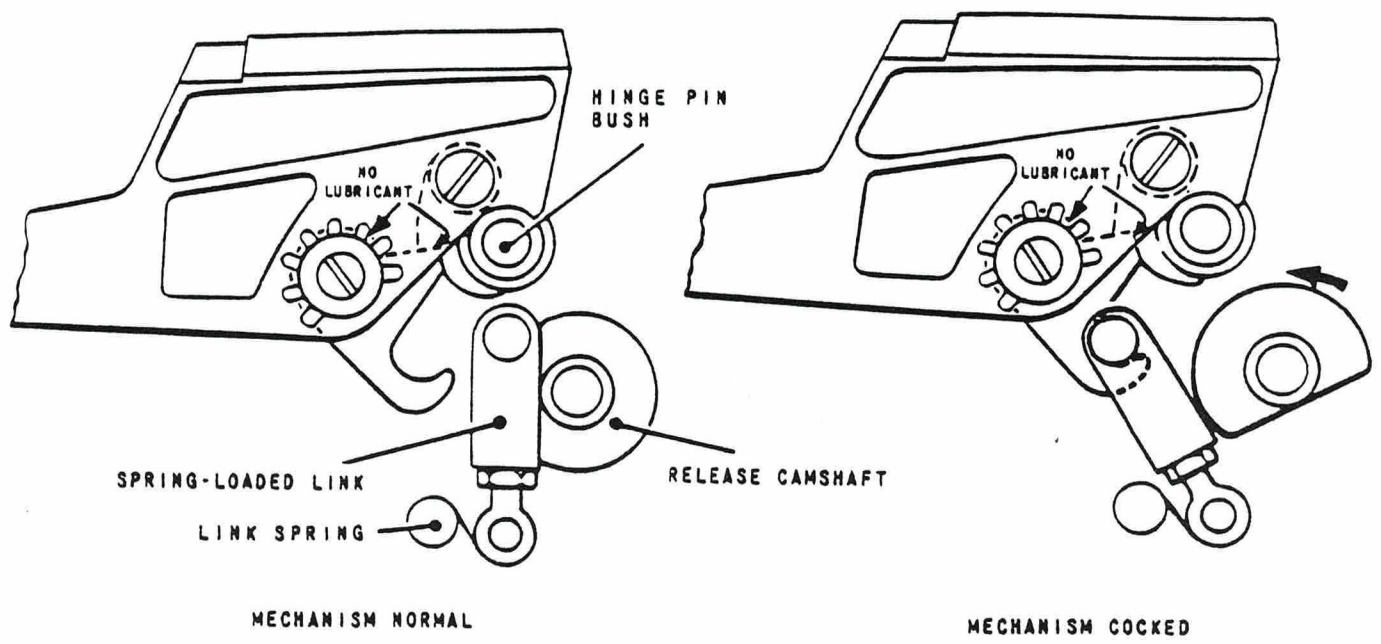


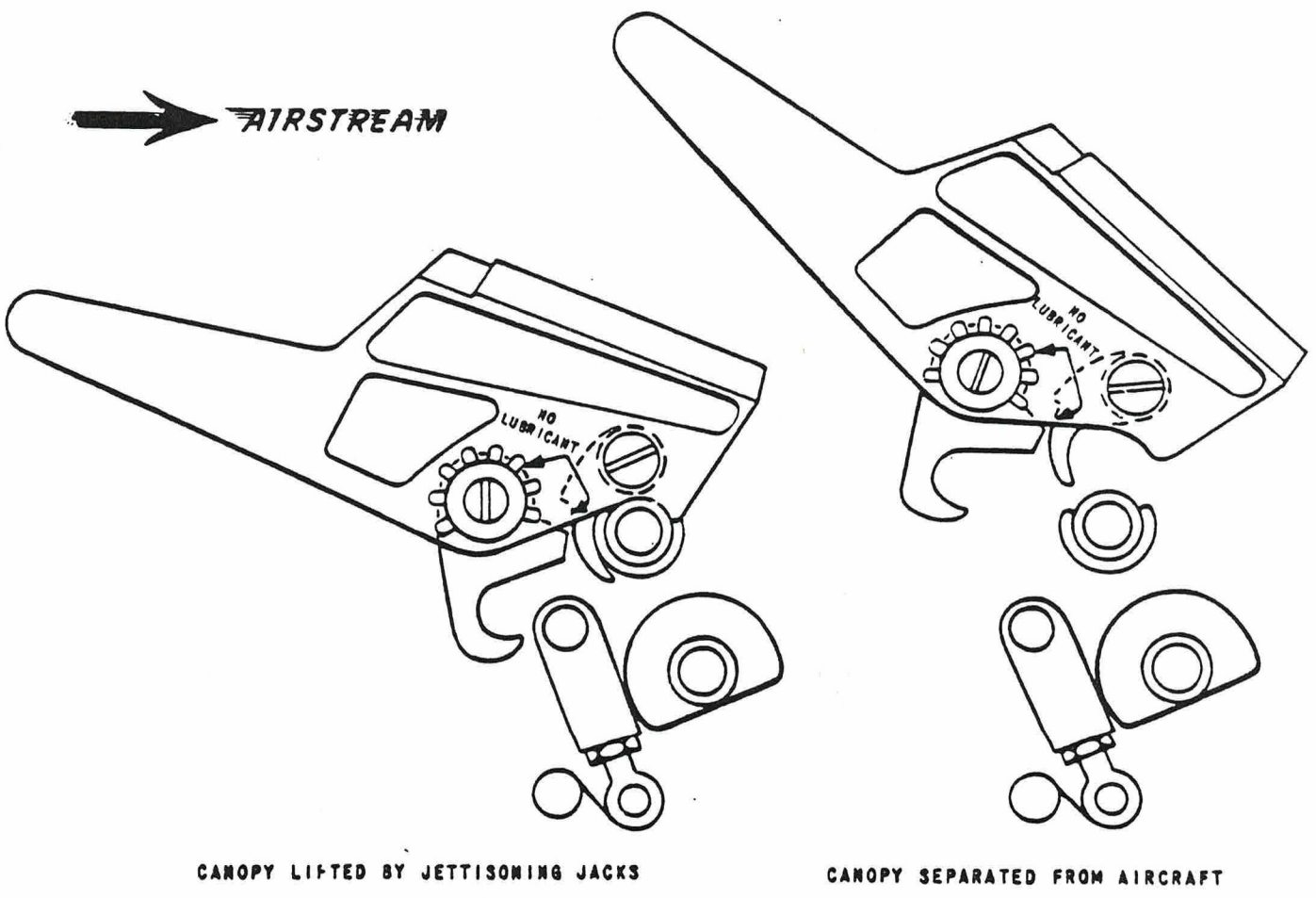
FIG.4 LOCKING MECHANISMS TORQUE SHAFT

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**FIG.5 ACTION OF HINGE-RELEASE MECHANISM**

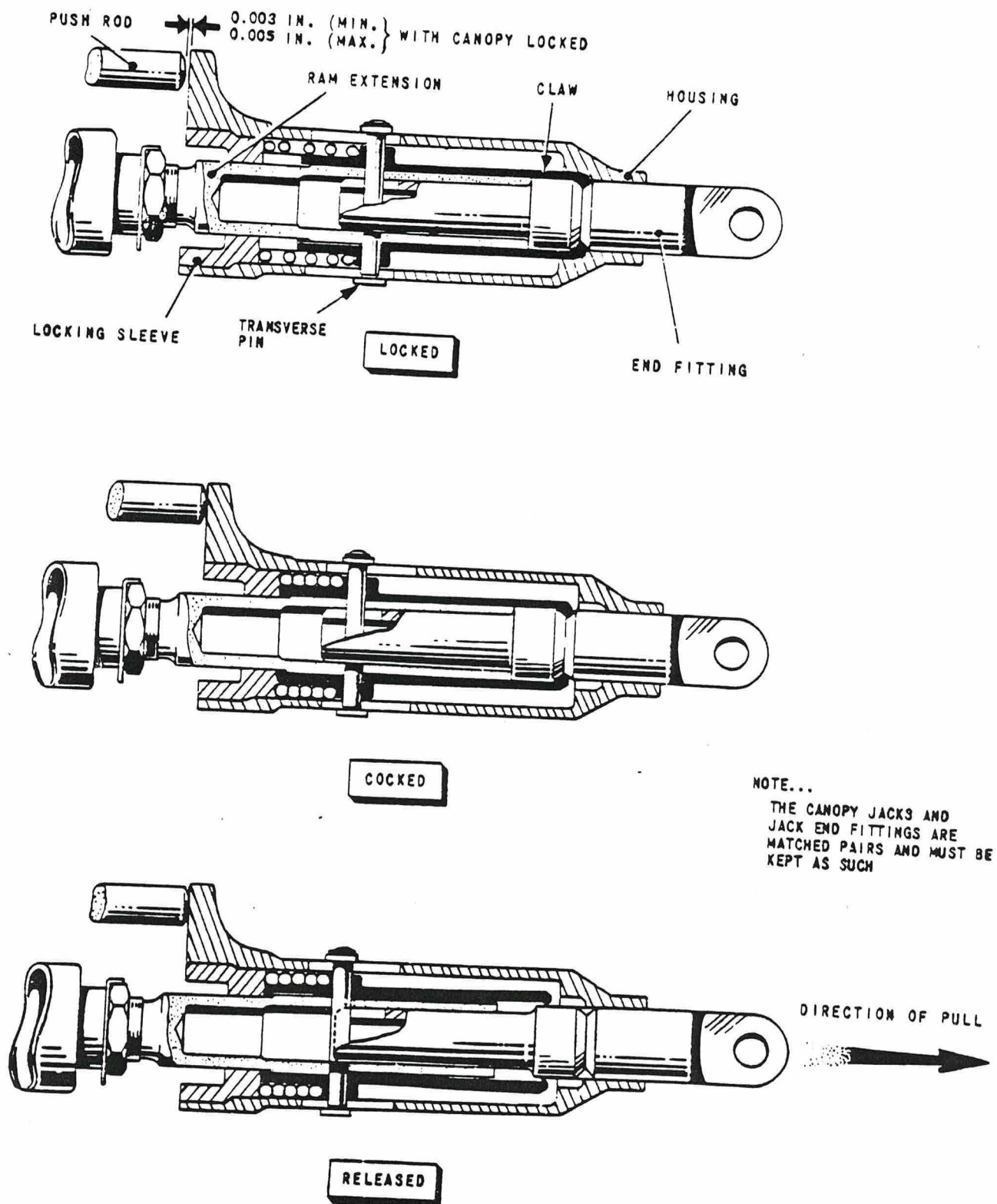


FIG.6 ACTION OF JACK END FITTING RELEASE MECHANISM

8. The top shoot-bolt lever, fitted almost half-way along the main shaft is connected to the external locking handle by rods and the lever spool which passes through the rear bulkhead, enabling the canopy locking mechanism to be operated from outside the cockpit. Fitted to the inboard end of the jettisoning sleeve is a spool and cam assembly for jettisoning operations. A stop lever, operating inside the centre bearing assembly and fitted to the main shaft, contacts two adjustable stops to keep shaft rotation within pre-determined limits. Connected to the stop lever is a spring loaded plunger, which, being fully compressed mid-way through its arc of movement, exerts itself fully at both extremes of the arc to provide a positive lock in the canopy locked or unlocked position. With the jettisoning levers in the unoperated position, shear wire (18 S.W.G. soft aluminium) positioned horizontally across each outer-bearing bracket assembly, prevents inadvertent rotation of the levers.

#### Internal Controls

9. The canopy controls inside the cockpit consist of a canopy control handle with an integral three-position switch. The hollow control handle, bolted to the rear bulkhead between the port ejection seat and port console, contains a retractable sleeve which carries the three position switch controlling the canopy hydraulic system. The sleeve is actuated by a cranked lever transmitting motion from a cam follower which bears on the machined profile of the handle mounting bracket. The sleeve is extended, and the switch exposed, only when the control handle is pulled up to unlock the canopy. A sprung protection flap attached to the mounting bracket below the limit stop, prevents ingress of dirt to the control mechanism.

#### External Controls

10. The external controls, accessible through a hinged panel in the port side of the spine immediately behind the cockpit, consist of a canopy locking handle, a three position switch controlling the canopy hydraulic system and a canopy jack end fitting release handle. The canopy locking handle is pulled outwards to unlock the canopy; this action exposes the three position switch.

#### Actuating Mechanism

#### General Information

11. The canopy is raised or lowered by a hydraulic jack connected between the torque shaft centre bearing bracket and the canopy. The jack is powered by the services system, through an electro-hydraulic selector controlled by either of two switches. The control switches are spring loaded to the centre 'off' position so that any intermediate position of the canopy, between fully open and fully closed, may be selected. When a selection is made, a Klaxon buzzer, mounted on the rear bulkhead, is energized so that any movement of the canopy is accompanied by an audible warning. For jettisoning or stand-by opening, the jack incorporates a device by which the end fitting may be detached.

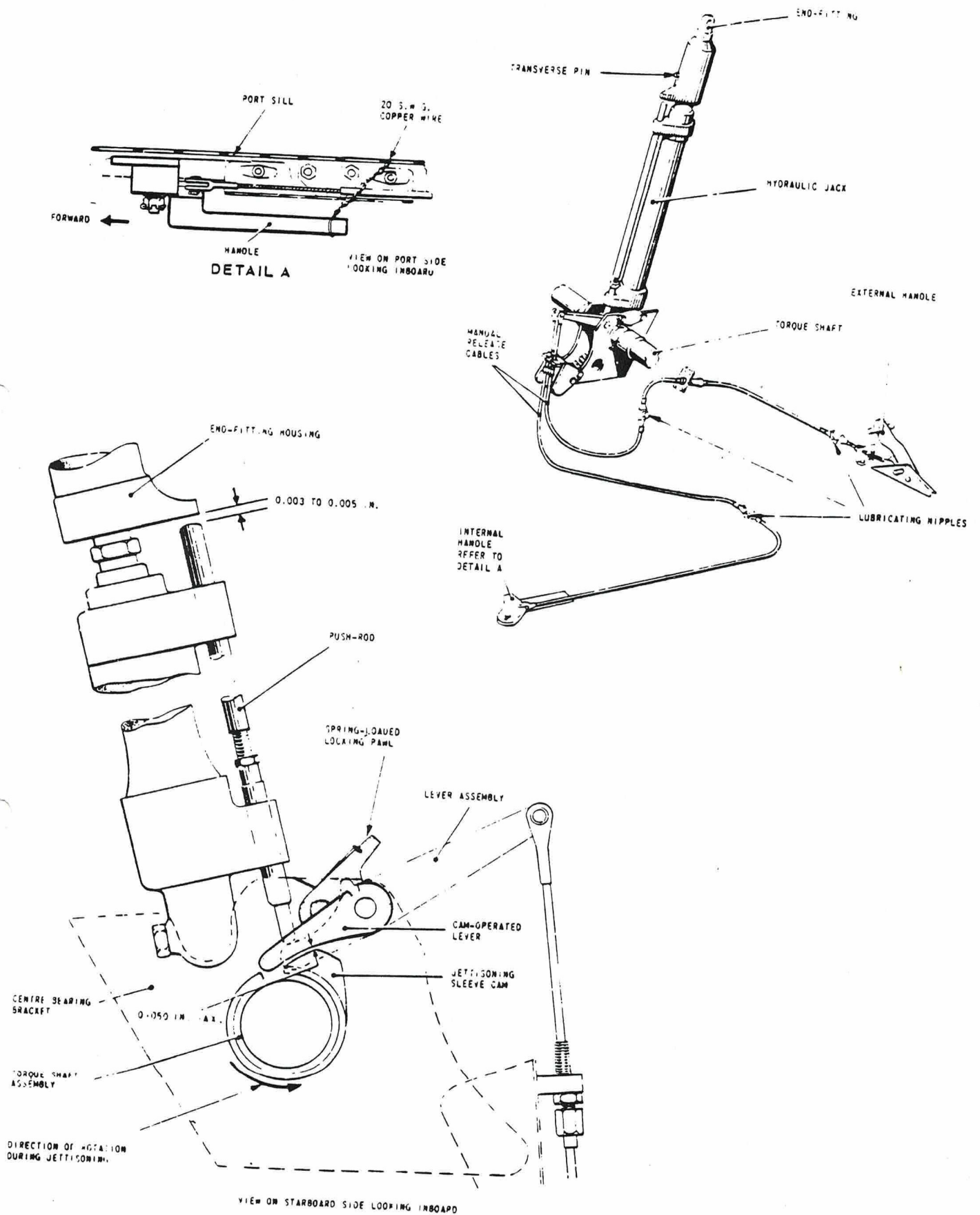


FIG.7 JACK END FITTING RELEASE MECHANISM

## Jack

12. Hydraulic pressure is admitted to the jack through a swivel coupling embodying two attachment plates through which the jack is bolted to the torque shaft bracket. Guides formed on the jack body carry a push-rod for cocking the end fitting release mechanism. The end fitting has a reduced diameter, which slides inside the ram extension, and a peripheral groove in the large diameter. A four-segment spring claw, screwed to the ram extension, engages the groove and is held in engagement by a spring loaded housing, preventing the end fitting being withdrawn. A pin through the ram extension engages two slots in the housing, and fastens the two components together. The slots permit limited axial movement of the housing relative to the ram.

## Jack End Fitting Release

13. The fixed sleeve, attached to the jettisoning sleeve, adjacent to the torque shaft centre bearing bracket, carries a cam which, when the jettisoning sleeve is rotated, lifts a lever connected by a shaft to a lever assembly in the centre bearing bracket. The lever assembly which can also be operated by the internal and external end fitting release handles, lifts the push rod attached to the jack and slides the housing up the end fitting against spring pressure. After sufficient movement of the housing the spring claw is freed of restraint. If an axial load is then applied to the end fitting from the canopy, either manually or by the jettisoning jacks, the claw segments are deflected outward by the sloping faces of the peripheral groove, releasing the end fitting from the ram. The claw recovers its shape after the end fitting has left the jack. The lever assembly is locked in the operated position by a spring loaded locking pawl on the side of the bearing bracket engaging a hole in the shaft of the cam operated lever. After operation of the release mechanism the lever must be reset.

## Stand-By Opening

14. In hydraulic or electrical failure the canopy may be opened manually after operating either of two canopy jack-release handles connected by cables to the end fitting release mechanism and subsequently operating either of the locking mechanism handles. The canopy can then be pushed or pulled open as the case may be. The release handles are situated, one beneath the port sill and the other alongside the external locking handle; the internal handle is held in the unoperated position by thin copper wire. After operation the mechanism must be reset.

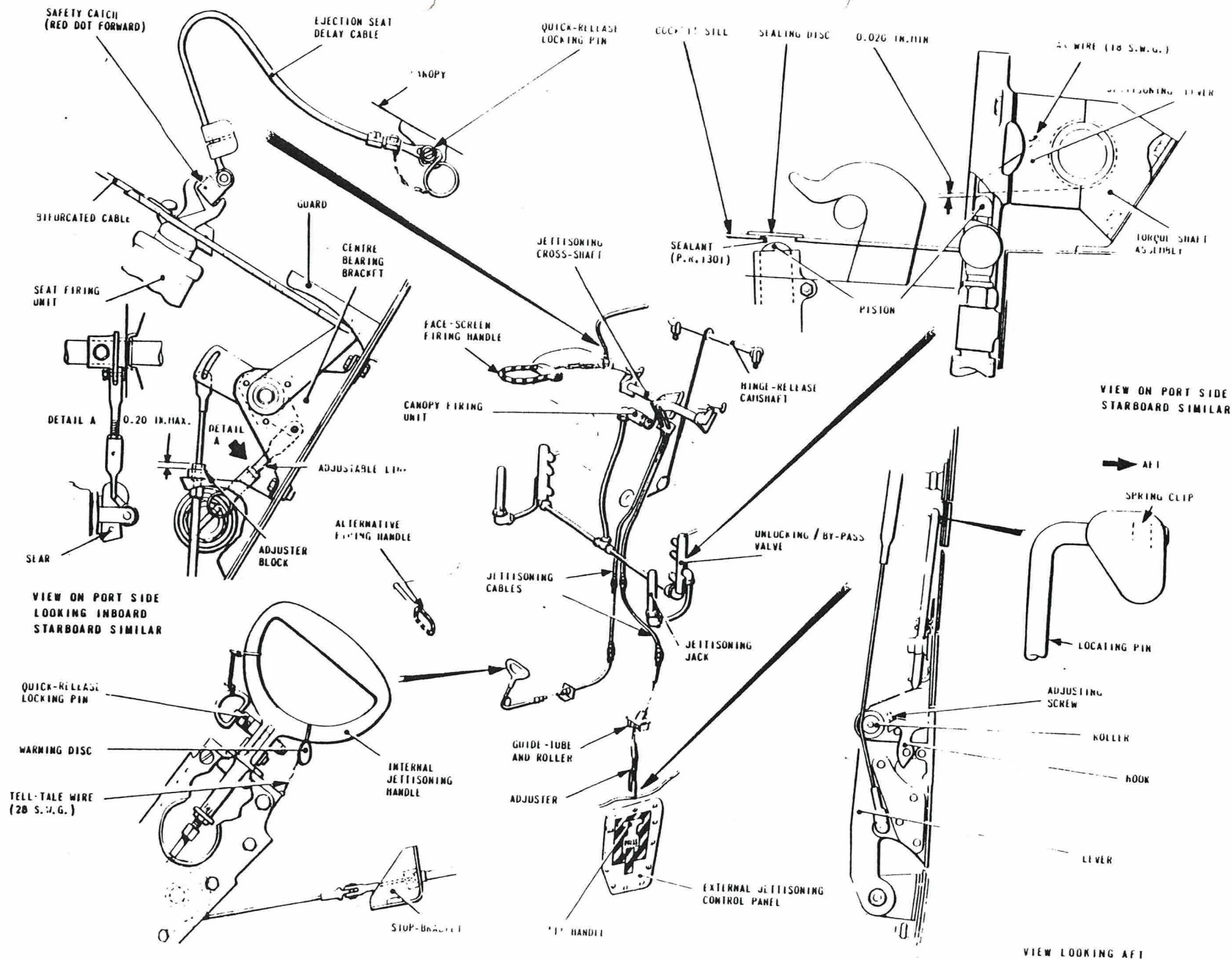
## Jettisoning Mechanism

### General Information

15. The canopy can be jettisoned independently from inside or outside the cockpit or in conjunction with seat ejection. Jettisoning is effected by a cable operated firing unit connected through associated valves to two jettisoning jacks. The sequence of operations prepares and jettisons the canopy.

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FIG. 8 JETTISONING MECHANISM



### Firing Unit Installation

16. The firing unit located on the rear bulkhead contains a percussion type cartridge and incorporates a removable firing pin assembly. The firing pin is held in the cocked position by a sear which is connected to the jettisoning cross-shaft by an adjustable link. The two canopy unlocking/bypass valves are attached to the forward face of each outer bearing bracket on the main torque shaft and bolted at the base to the rear bulkhead. The lower section of each valve houses a sliding piston and the upper section is slotted to accommodate the associated jettisoning lever. In the unoperated position, the piston is at the bottom with the piston crown almost contacting the underside of the jettisoning lever. The two jettisoning jacks, incorporating sliding pistons, are located under the cockpit sills just forward of the canopy locking hooks. Two holes in the sills, immediately above the piston crowns are sealed by thin metal discs cemented to the top surface.

### Ejection Seat Delay Cables

17. To ensure correct sequencing of canopy jettisoning and seat ejection, two safety devices, one on each seat installation, are connected to corresponding lugs on the canopy structure by two identical cable assemblies. The upper ends of the cables connect to the canopy by quick release locking pins, and the lower ends to spring loaded safety catches normally held between the jaws of restrictors incorporated on the associated ejection gun firing units. The restrictors prevent the units from functioning until the canopy is jettisoned and the safety catches withdrawn by the cables.

### Internal Controls

18. The internal controls consists of a single spade grip jettisoning handle mounted in the centre of the cockpit floor, and two firing handles incorporated on each ejection seat. Three cables, one from the jettisoning handle and one from each pair of seat handles are connected to corresponding levers on the jettisoning cross shaft. The cross shaft, supported in three bearing brackets on the rear bulkhead, is directly connected to the firing unit sear by an adjustable link. Operation of any one of the handles rotates the cross shaft and withdraws the sear from the firing unit to initiate the jettisoning sequence. To prevent the jettisoning handle being damaged when the ejection seats are removed during servicing, the handle is permitted to lie horizontally after removing a quick release locking pin from the spindle. In the normal unoperated position, a piece of thin indicating wire carrying a red warning disc is secured to the handle and the mounting bracket. From the handle the jettisoning cable is connected at the aft end to the inboard one of two identical levers on the cross shaft; the other lever connects the external jettisoning cable. The controls incorporated on each ejection seat are identical. Each installation comprises two inter-connected handles, the face screen handle located at the top of the seat, and the seat pan firing handle on the seat front. Attached to the face screen is a cable which is bifurcated at the rear end; the main leg hooks on to the open ended lever on the jettisoning cross shaft, the other is connected to the sear on the seat ejection gun. Two channel section guards, located on the rear bulkhead directly above the open-ended levers, prevent the cables from being detached in the unoperated position; the levers clear the guards during the final few degrees of operation thus leaving the cables free for subsequent seat ejection.