

CHAPTER

76

MAINTENANCE MANUAL

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CHAPTER 76

ENGINE CONTROLS

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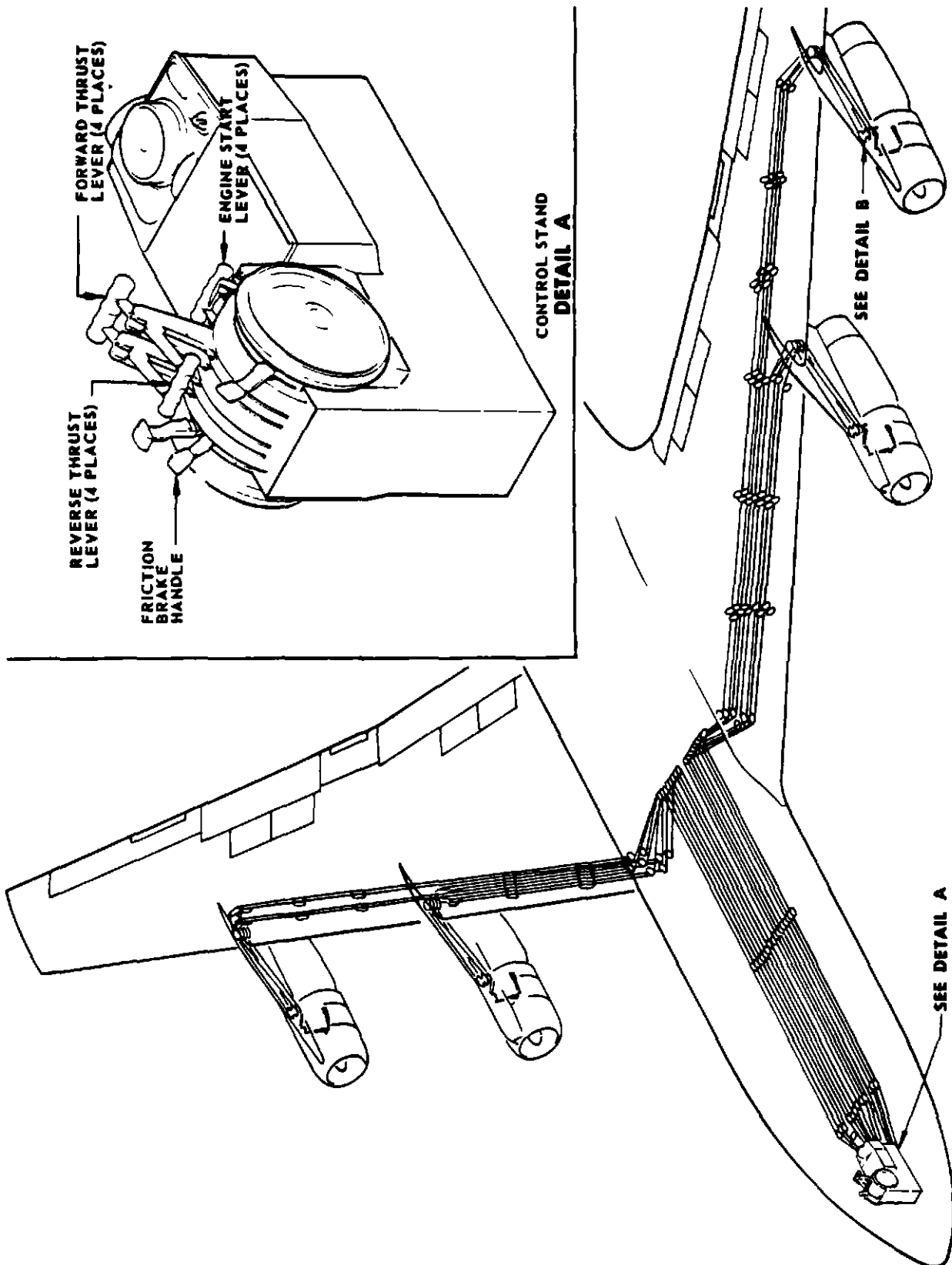
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THROTTLE SYSTEM - DESCRIPTION AND OPERATION1. General

- A. A manually-operated throttle system for each engine provides for separate control of engine starting and thrust. Starting of each engine is accomplished by use of a single lever to energize the ignition system and to initiate fuel flow to the engine. Another lever assembly controls both forward and reverse thrust by regulating fuel flow and actuating the thrust reverser. An interlock mechanism prevents simultaneous initiation of forward and reverse thrust for each engine.
- B. The throttle system consists of an engine start lever and a thrust lever assembly for each engine, connected by a series of throttle control cables and mechanical linkages to the fuel control units on the engines. (See figure 1.) A thrust lever friction brake applies a braking force to all thrust lever assemblies during forward thrust operation
- C. The engine start lever is connected by cables to an engine control drum-and-shaft assembly in the nacelle strut. This control assembly is connected, by a rod-and-bell crank installation on the right side of the engine to the fuel control unit.
- D. Advancing the engine start lever actuates an ignition switch to energize the ignition system. Further movement of the start lever opens a pilot shutoff valve in the fuel control unit.
- E. The thrust lever assembly is connected by cables to the drum-and-shaft assembly in the nacelle strut. The drum-and-shaft assembly is also connected to the fuel control unit by a rod-and-bell crank installation located on right side of engine.
- F. Actuation of the thrust lever assembly regulates fuel flow in the fuel control unit. For reverse thrust, the lever assembly movement actuates the thrust reverser before increasing fuel flow. It should be noted that the direction of travel of the thrust control cables and drums is the same for decreasing forward thrust as it is for increasing reverse thrust.
- G. A reverse thrust detent is installed on the throttle control cable for each engine. This detent provides an increase in reverse thrust lever load near maximum allowable reverse thrust.

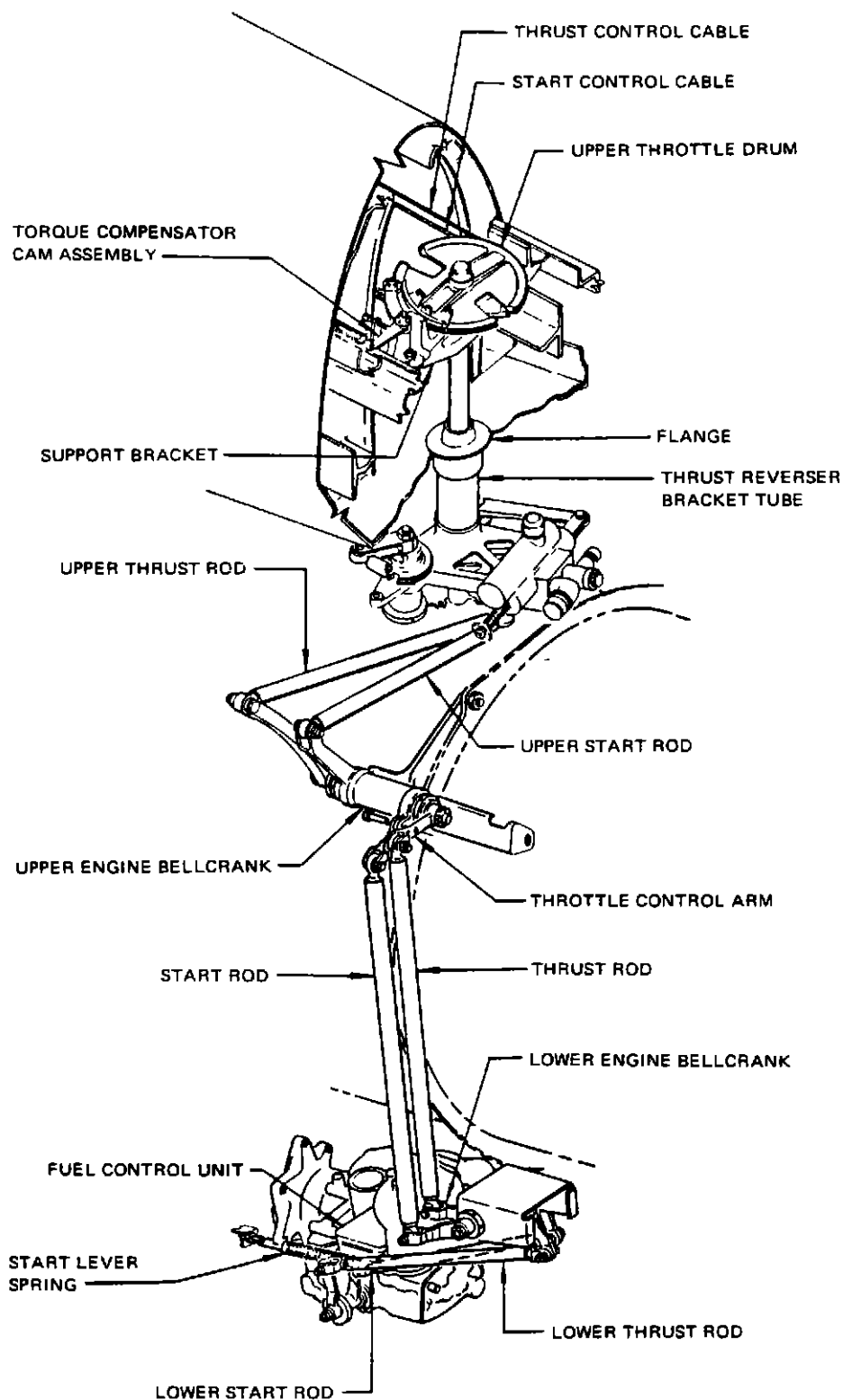
2. Thrust Lever Assembly

- A. Four thrust lever assemblies on the control stand quadrant control the forward thrust and reverse thrust of the engines. Each thrust lever



Throttle System
 Figure 1 (Sheet 1 of 2)

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DETAIL B

Throttle System
Figure 1 (Sheet 2)

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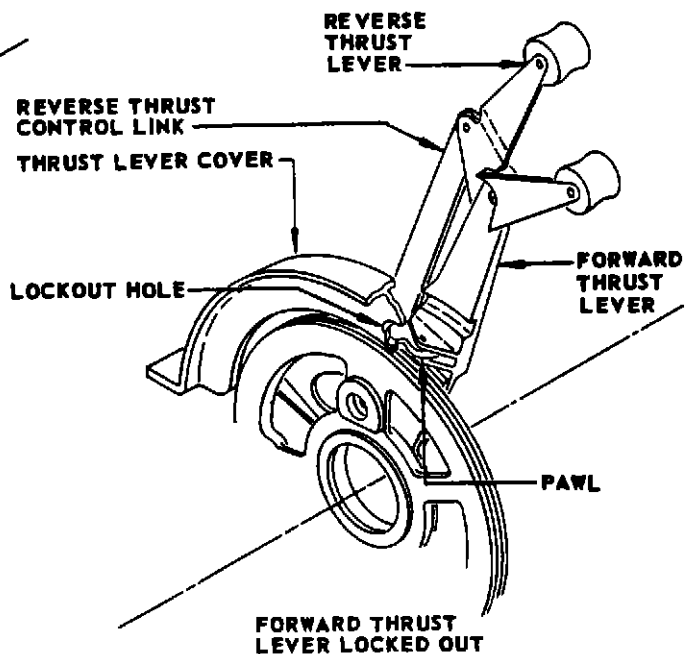
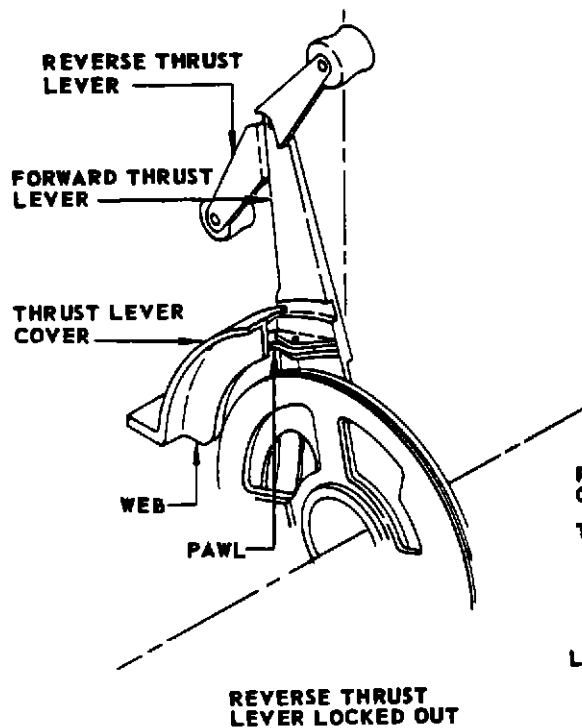
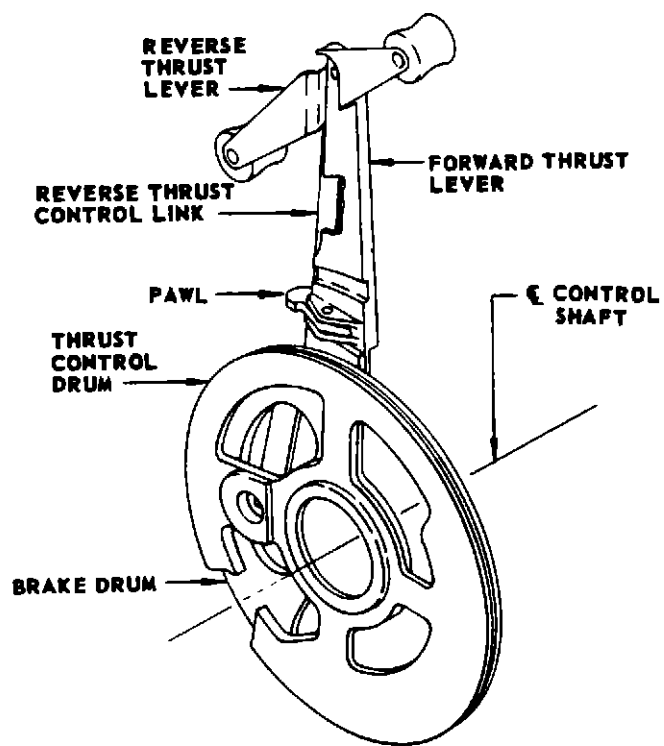
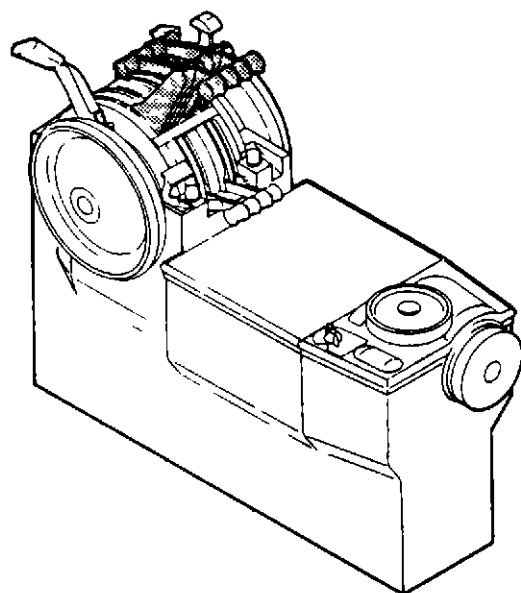
assembly consists of a forward thrust lever, a reverse thrust lever, a reverse thrust control link, a pawl, a brake drum, and a thrust control drum (See figure 2) The forward thrust lever, with the reverse thrust lever attached to it, is mounted on the brake drum. One end of the control link is riveted to the reverse thrust lever and the opposite end is attached to the thrust control drum

- B As either thrust lever is advanced from the idle position, the control link rotates the thrust control drum to actuate the fuel control unit to increase thrust. The forward thrust idle position is against an idle stop on the quadrant and full forward thrust is obtained before the lever is all the way forward. The reverse thrust lever, when in the idle position, is against an idle stop on the forward thrust lever.
- C. An interlock mechanism prevents simultaneous actuation of the forward and reverse thrust levers so as to assure positive forward or reverse thrust control. The ability of each lever to move depends on the position of the other lever. If the forward thrust lever is more than two degrees from the idle position, the reverse thrust lever cannot be moved more than 12 degrees from idle. However, if the reverse thrust lever is advanced more than 12 degrees from idle, the forward thrust lever cannot be moved. The interlock between the levers is a pawl, riveted to the forward thrust lever (See figure 2) The pawl is between the thrust lever and the control link. When the forward thrust lever is two degrees or less from the idle position, the pawl is aligned with a lockout hole in the web of the thrust lever cover. As the reverse thrust lever is moved from the idle position, the control link forces the pawl into the hole to lock the forward thrust lever in the idle position. As the reverse thrust lever is returned to the idle position the control link pushes the pawl from the hole to unlock the forward thrust lever. When the forward thrust lever is more than two degrees from the idle position, the pawl is not aligned with the lockout hole. The web then opposes the force of the control link on the pawl so that the reverse thrust lever cannot be moved more than 12 degrees from idle.
- D A torque compensator cam assembly is installed on the upper throttle drum in the nacelle strut. (See figure 1.) The cam is designed to increase the reverse thrust lever forces to counteract the negative torque of the fuel control unit shaft, reducing the probability of the thrust system creeping toward the full reverse thrust position.

3. Engine Start Lever

- A. Four engine start levers on the control stand quadrant are used to start engines. Each lever controls energizing the ignition system and initiating fuel flow to the respective engine. The start lever is provided with a spring-loaded detent catch which may be released by lifting the knob. A three position detent secures the start lever in the CUT-OFF, START or IDLE position. A stop between the start and idle positions prevents the start lever from drifting to the cut-off position and causing an inadvertent engine shutdown.

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- B. A start lever spring is installed on the lower start rod. This spring prevents engine cutoff due to the start lever not seating securely in the idle detent.

4. Throttle Control Cables

- A. Throttle control cables consist of engine start and thrust cables which connect the fuel control unit on each engine to the respective engine start lever and thrust lever assembly. The cables are routed under the floor from the control stand through the lower nose compartment and above the forward cargo compartment ceiling. (See figure 1.) From the cargo compartment, the cables are routed along the wing leading edge to the nacelle struts. In each strut, the cables are routed to the drum-and-shaft assembly which, in turn, is linked to the fuel control unit.

5. Thrust Lever Friction Brake

- A. A thrust lever friction brake on the control stand quadrant applies a variable braking force to all thrust levers during forward thrust operation (See figure 1.) The friction brake is used to manually select the proper amount of braking force to prevent throttle creep during flight. The friction brake consists of a brake handle mechanically linked to two leaf springs and four brake shoes.
- B. The brake handle, mounted to the right of the thrust levers, is connected by a brake link and an eye bolt to a brake crank. Bolted to the crank are the leaf springs and the brake shoes. As the brake handle is advanced, friction between the brake shoes and the brake drums is increased. A ratchet locks the brake handle in any position.

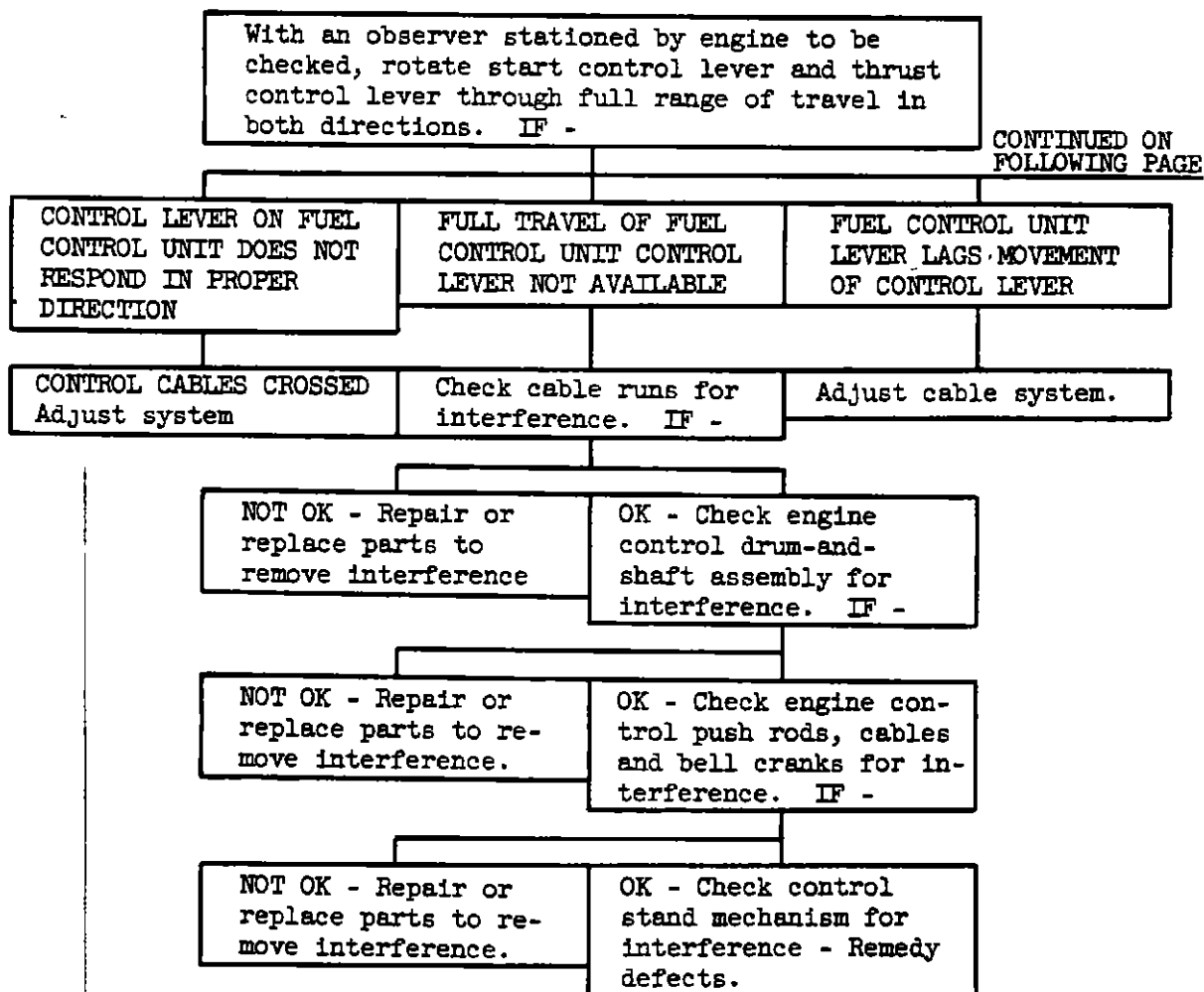
6. Engine Control Drum-and-Shaft Assembly

- A. An engine control drum-and-shaft assembly in the nacelle strut of each engine is a mechanical link in the throttle system which provides for independent control of the fuel control unit by the thrust and engine start levers.
- B. The drum-and-shaft assembly consists of concentric engine start and thrust control shafts, a thrust control drum, engine start drum, engine thrust control crank, and an engine start crank. (See figure 1.) The start drum and the start crank are mounted on each end of the engine start shaft. The thrust drum and thrust crank are mounted on each end of the thrust control shaft which is mounted inside the start shaft. The assembly is supported by a bracket on the strut aft of the forward engine mount. The start lever contacts the strut bracket to provide a mechanical stop for the engine start control system at "CUT-OFF". A lug on the strut bracket provides a stop for the thrust system at both 100% forward and reverse thrust.

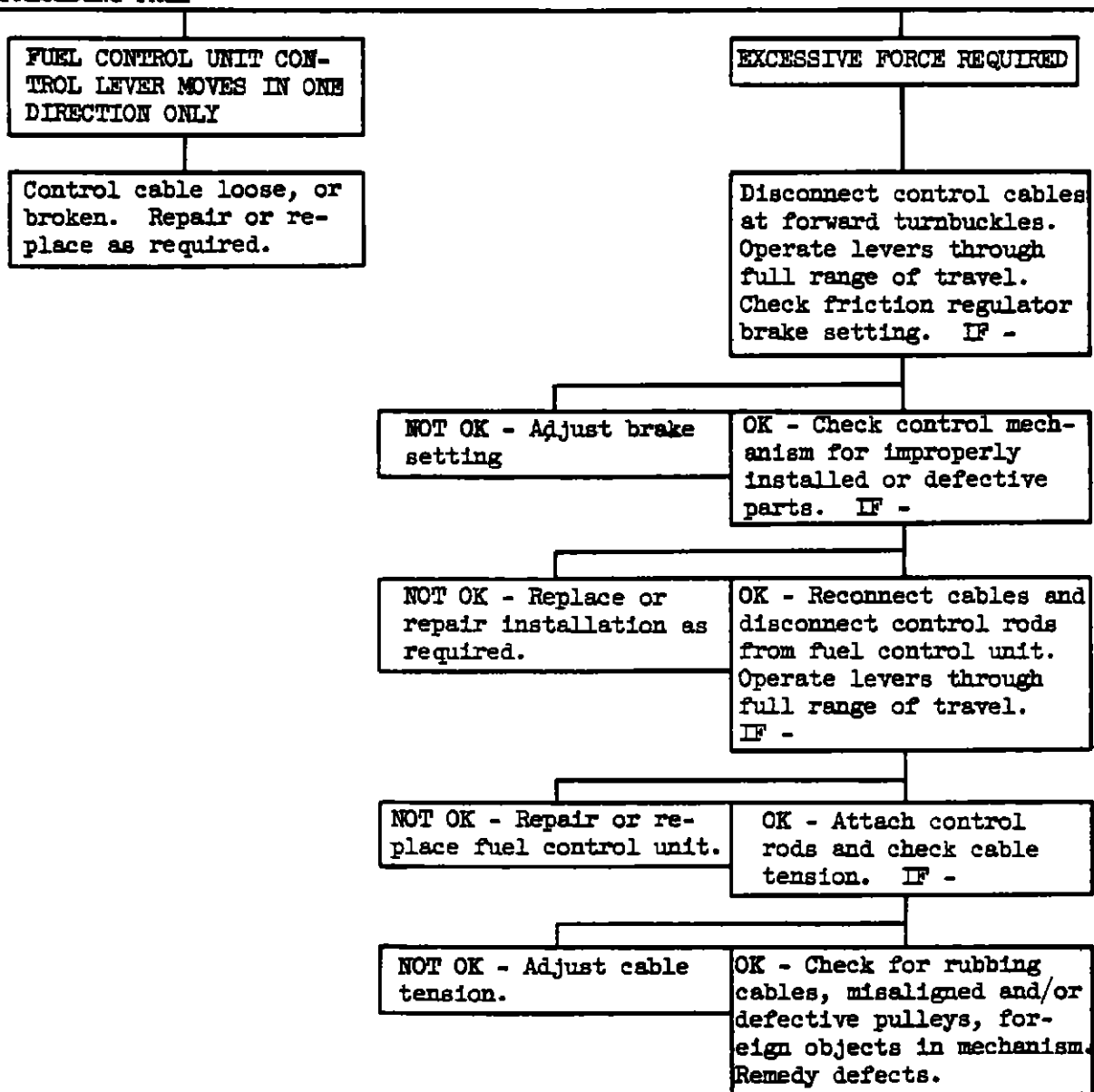
7. Operation

- A. Advancing the engine start lever to the START position causes a start control cable cam to actuate an ignition switch in the lower nose compartment. The lever movement also rotates the engine start control shaft which rotates the engine start crank. Motion of the engine start crank is transmitted through a bellcrank assembly to the fuel control unit.
- B. Placing the start lever in IDLE de-energizes the ignition system. When the lever is returned toward the CUTOFF position, the engine start crank in the drum-and-shaft assembly contacts the support bracket to stop the system motion at the strut. About 4 degrees of additional start lever motion is required to enter the CUTOFF detent. This stretches the control cable to provide sufficient load in the cable system to maintain positive engagement of the start lever in the CUTOFF detent.
- C. Advancing the forward thrust lever from the idle position, locks the reverse thrust lever in idle and rotates the thrust control shaft. As the shaft rotates, the motion is transmitted to a lever on the fuel control unit. This lever rotates to increase fuel flow to the burners. Forward motion of the forward thrust lever is terminated by a lug on the strut bracket. On the No. 3 engine, forward motion of the forward thrust lever causes a thrust control cable cam to actuate the flap and speed brake and stabilizer trim warning switch in the lower nose compartment.
- D. As the forward thrust lever is returned to the idle position, fuel flow is reduced and a thrust control cable cam actuates the landing gear warning switch. On some airplanes, when the thrust lever is 11 ($\pm .5$) degrees forward of the idle position, cams on No. 2 and No. 4 engine thrust cables at station 360-380 actuate a BELOW FLIGHT IDLE warning light on the captain's center panel during the landing configuration. The reverse thrust lever is unlocked.
- E. As the reverse thrust lever is advanced from the idle position, the forward thrust lever is locked out. The thrust control drum on the engine control drum and shaft assembly is rotated causing the thrust reverser main valve actuating cam to be rotated. This cam will continue to rotate with increased travel of the reverse thrust lever until it contacts the fan and aft thrust reverser locking cams. The locking cams are contacted at about one fourth of full reverse thrust lever travel. Further increase in reverse thrust is prevented at this point until both the fan and aft thrust reversers move aft to the closed position. Closing of the thrust reversers causes the thrust reverser control locking cams to be repositioned and frees the reverse thrust lever for travel to the full reverse thrust position. Under normal operation only a slight delay in lever operation will be experienced when the reverser thrust lever contact the locking cams. See Chapter 78, Thrust Reverser Control System.

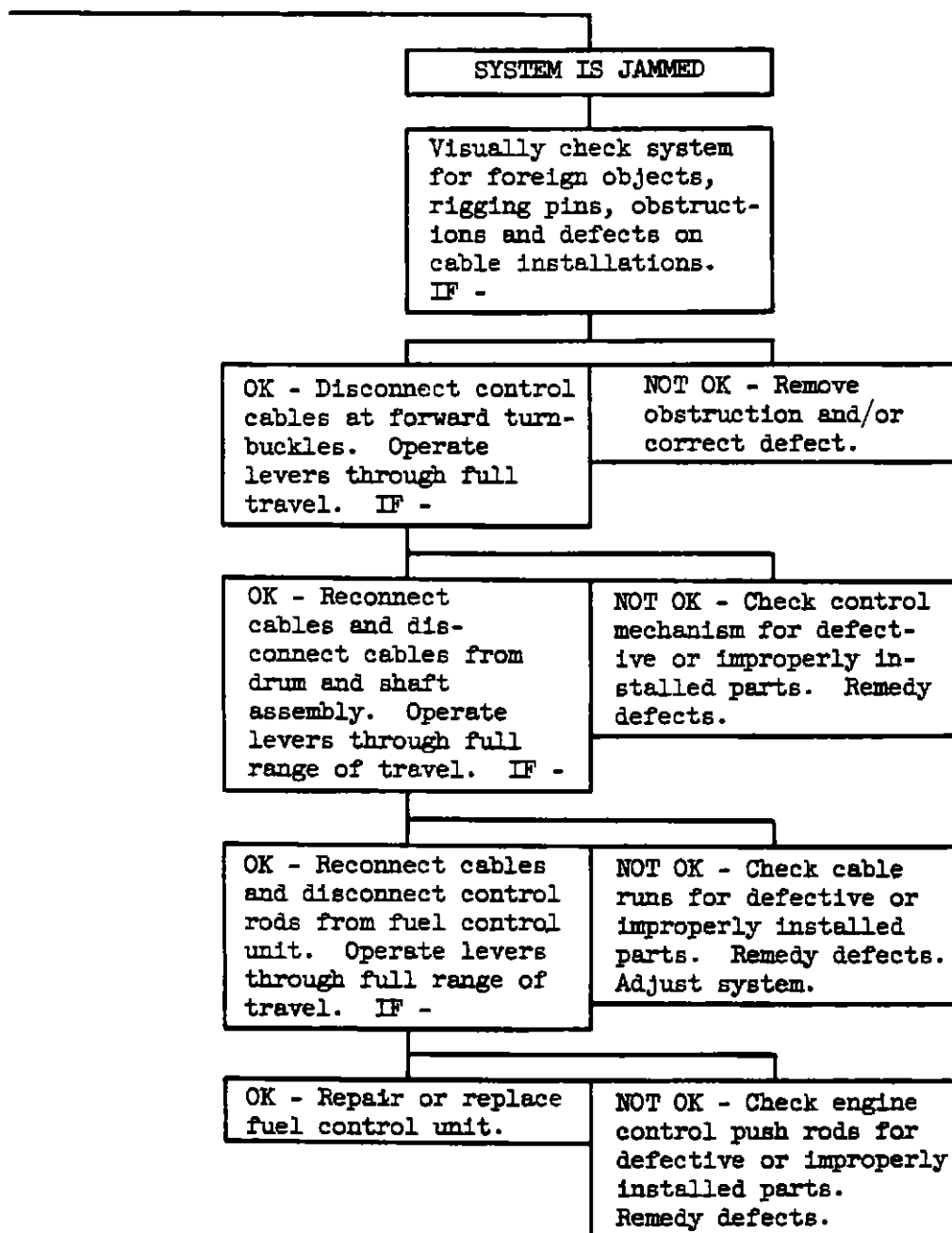
- F. As the reverse thrust lever approaches full reverse thrust position, a detent requiring approximately five pounds over-riding force is encountered. This detent indicates that engine is operating near maximum allowable reverse thrust.
- G. As the reverse thrust lever is returned to the idle position, the clamshell doors are rotated outboard and forward and the forward thrust lever is unlocked. If the clamshell doors do not open, forward motion of the forward thrust levers is blocked at approximately 8° from idle by the follow-up control stop.

THROTTLE SYSTEM - TROUBLE SHOOTING

CONTINUED FROM
PRECEDING PAGE



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THROTTLE SYSTEM - MAINTENANCE PRACTICES

- 1 Unit Servicing Throttle System (AF F-BHSV through F-BLCD; SAB 00-SJH through 00-SJK; WAI N372WA through N376WA; TWA N786TW through N792TW; NWA N351US through N369US; AA N755A through N7561A; IIA EI-AMW through EI-ANV; CAL N17321 through N17326)

A. Lubricate Throttle System Linkage (Relubrication of bearings containing MIL-G-25013C Extreme H₁ Temperature Grease.)

NOTE: Relubrication is not required for other airplanes which have dry stainless steel bearings

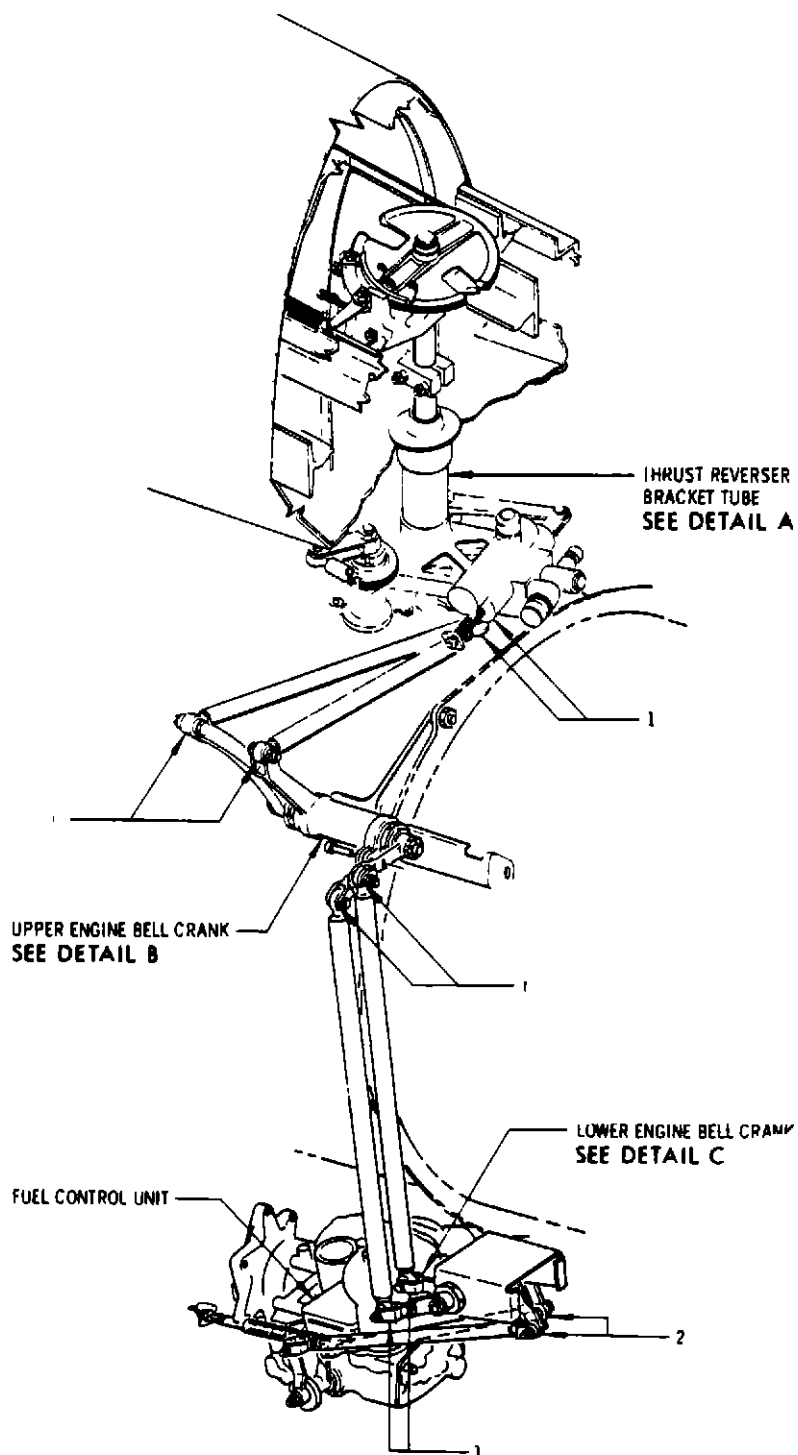
- (1) Seizure and binding of the strut and engine mounted throttle system bearings is generally caused by evaporation of the oil in the extreme h₁ temperature grease (blue-purple colored) with which the bearings are lubricated. Periodically replenishing the silicone fluid in the bearings will rejuvenate the grease and eliminate the necessity of replacing or repacking the bearings. (See figure 201)

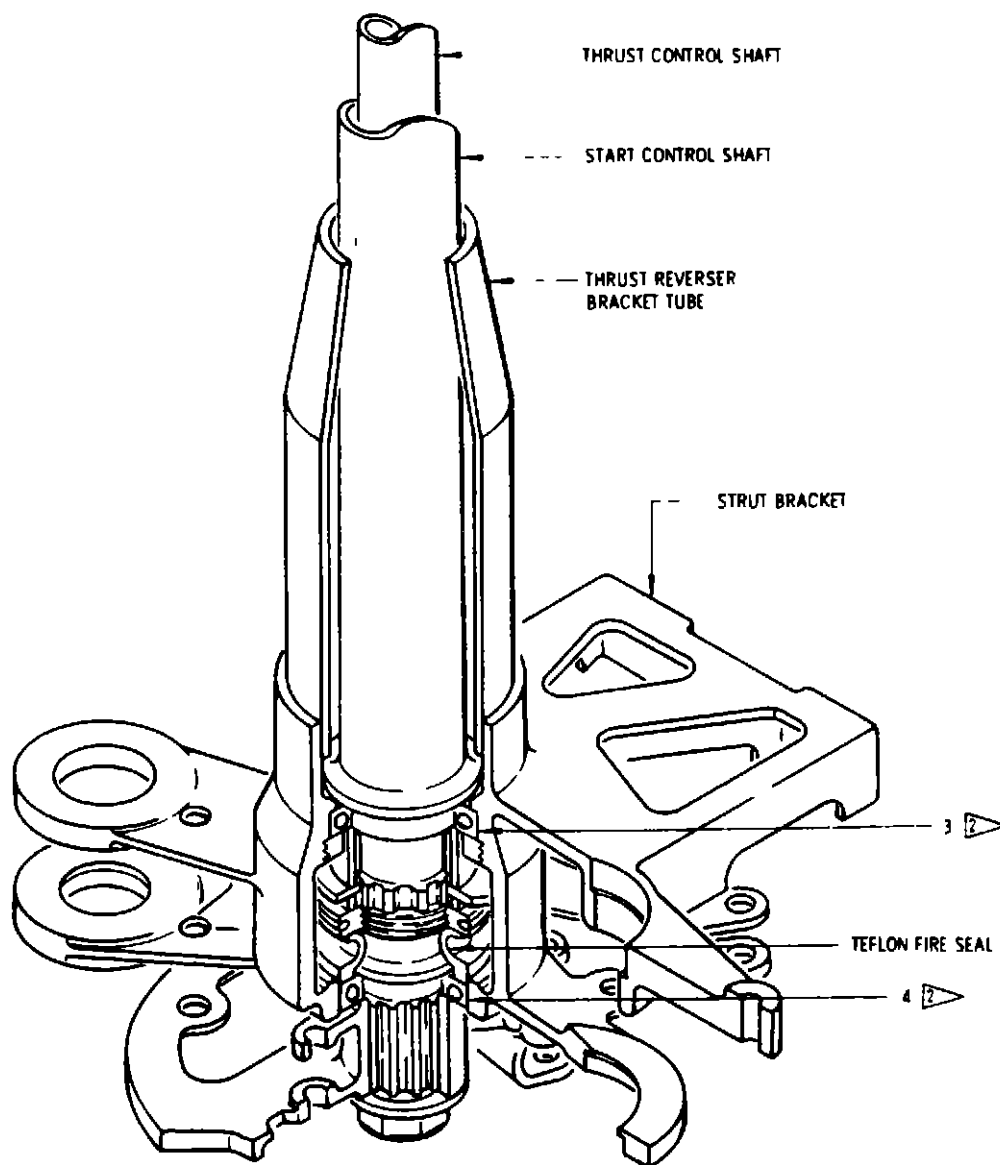
INDEX NO	ITEM LUBRICATED	INSTRUCTIONS
1	ROD END BEARINGS	Apply fluid ▷ to bearings. (8 places each engine.)
2	CRANK BEARINGS	Apply fluid ▷ to bearings. (2 places each engine.)
3 (LIMITED SEE DETAIL A)	START CONTROL SHAFT LOWER BEARING	Apply fluid ▷ through space between start control shaft and thrust reverser bracket tube. (1 place each strut.)
4 (LIMITED SEE DETAIL A)	THRUST CONTROL SHAFT LOWER BEARING	Lift teflon fire seal and apply fluid ▷ to bearing. (1 place each strut.)
5	UPPER ENGINE BELLCRANK	Apply fluid ▷ to bearings. (4 places each engine.)
6	LOWER ENGINE BELLCRANK	Apply fluid ▷ to bearings. (4 places each engine.)

▷ Silicone fluid, Dow Corning 550 or Dow Corning 510; -100, -500 or -1000 Centistoke. Source: Dow Corning Chemical Company; Midland, Michigan.

NOTE: The presence of the seals on the bearings may not allow the fluid to readily enter the bearing; therefore, thinning will aid getting the fluid into the bearing. If thinning is desired, it may be done in the following proportions with DuPont Freon TE or Freon TA solvent (Source: E I DuPont de Nemours, Inc ; Wilmington, Delaware).
 Two parts Dow Corning 550 or 510-100 Centistoke to one part of solvent.
 One part Dow Corning 510-500 Centistoke to one part of solvent.
 One part Dow Corning 510-1000 Centistoke to two parts of solvent.

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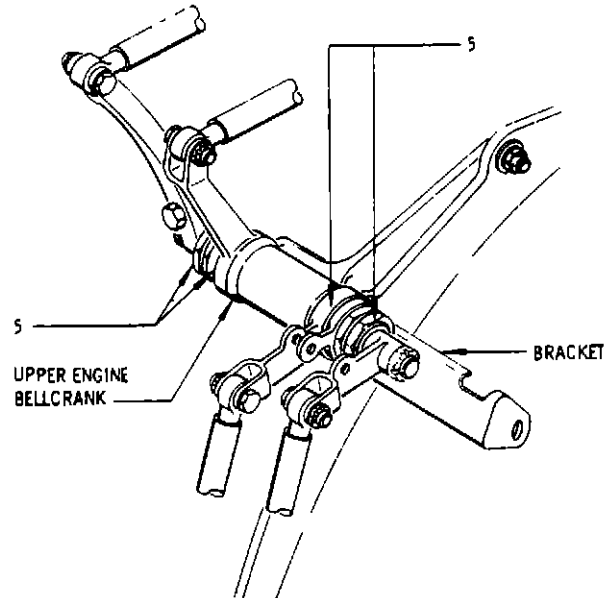


DETAIL A

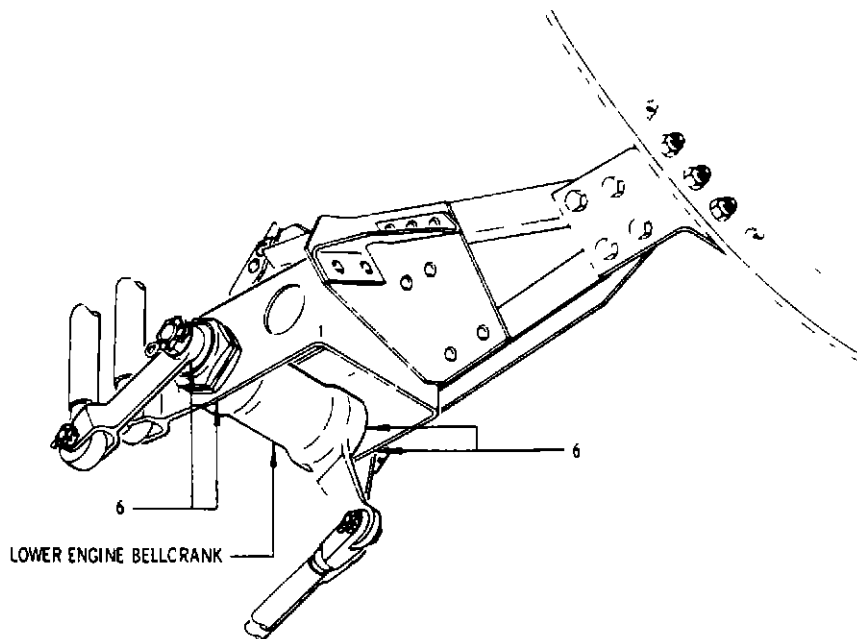
2 REQUIRED FOR WAI N373WA, N374WA AND N375WA SAB OO-SJH ONLY
RELUBRICATION IS NOT REQUIRED IF DRY STAINLESS STEEL BEAR-
INGS ARE INSTALLED.

NOTE BEARINGS THAT REQUIRE RELUBRICATION WILL HAVE A
RESIDUE OF BLUE-PURPLE COLORED GREASE ON THE
SEALS

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DETAIL B
TYPICAL UPPER ENGINE CONTROL BELL CRANK



DETAIL C
TYPICAL LOWER ENGINE CONTROL BELL CRANK

2 Adjustment/Test Throttle System

A. General

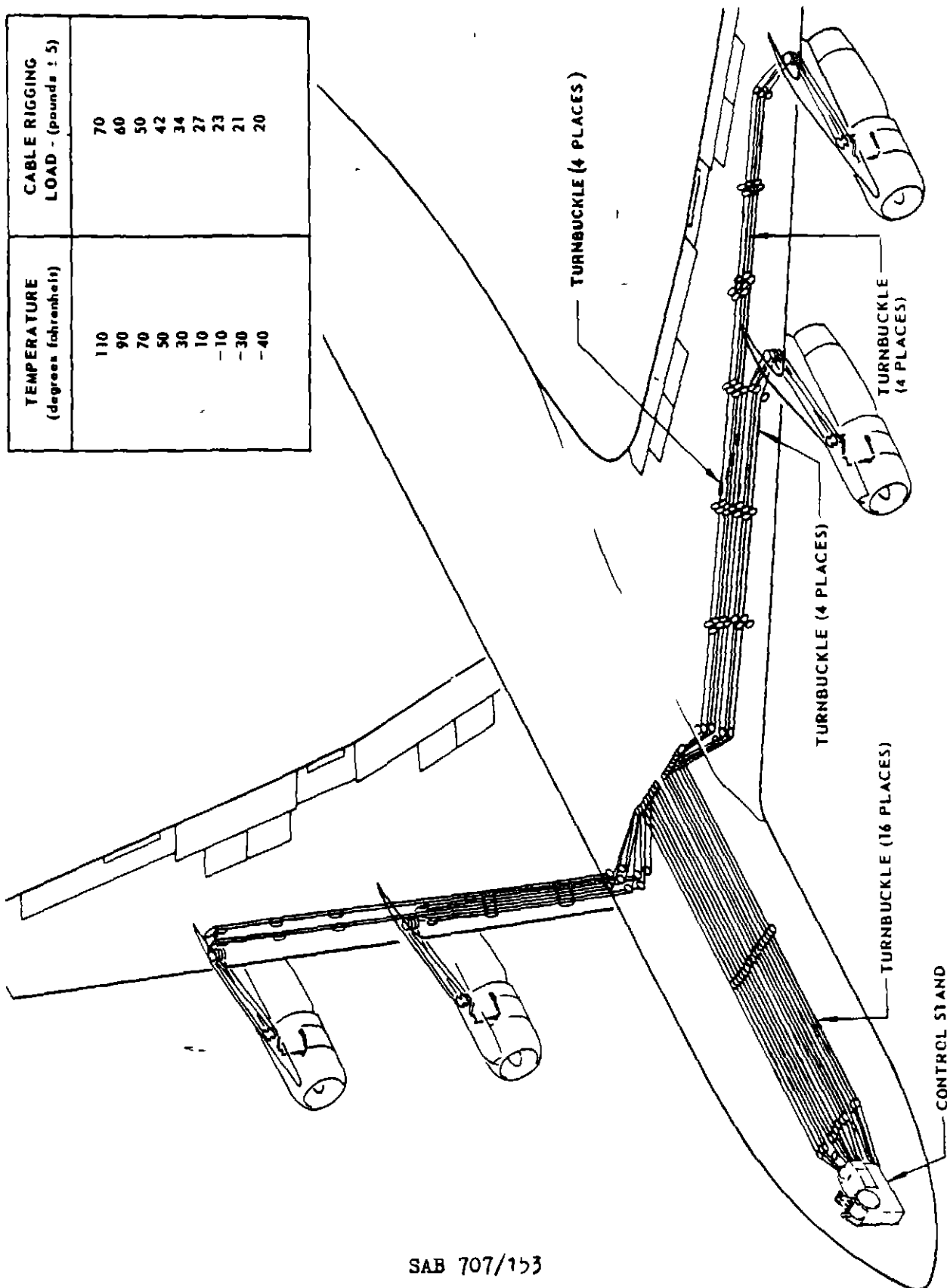
- (1) When performing adjustment/test, the throttle system for each engine is divided into two parts: the thrust system and the engine start control system. Each part is adjusted separately. Rigging pins are inserted at various points to isolate sections of each system to facilitate rigging. Cables in each section must be rigged to an equal load so that proper adjustment will be maintained after rigging pin removal.
- (2) The thrust system is adjusted to synchronize forward thrust lever and reverse thrust lever movements with engine thrust variation. The system is rigged from the control stand to the engine control drum-and-shaft assembly. Finally, the thrust system is rigged from the drum-and-shaft assembly to the fuel control unit on the engine. (See figure 201A.)
- (3) The engine start control system is adjusted to synchronize engine start lever movement with ignition and fuel flow initiation. The system is rigged from the control stand to the engine control drum-and-shaft assembly. (See figure 201A.) Next, the system is rigged from the drum-and-shaft assembly to the fuel control unit on the engine.
- (4) When new cables are installed the initial yield must be taken up before the control cables are rigged to normal operating tension. Rig new cables to 100 pounds and cycle the system 25 times without lockwiring cable turnbuckles. After cycling reduce cable tension to the appropriate tension for ambient temperature per table on figure 201A, and lockwire turnbuckles.

CAUTION: DO NOT ATTEMPT TO OPERATE CONTROLS WITH RIGGING PINS OR LEADING EDGE FLAP LOCK ASSEMBLY INSTALLED.

B. Equipment and Materials

- (1) Bubble Protractor - F52485-500 or equivalent

TEMPERATURE (degrees fahrenheit)	CABLE RIGGING LOAD - (pounds : 5)
110	70
90	60
70	50
50	42
30	34
10	27
-10	23
-30	21
-40	20



SAB 707/153

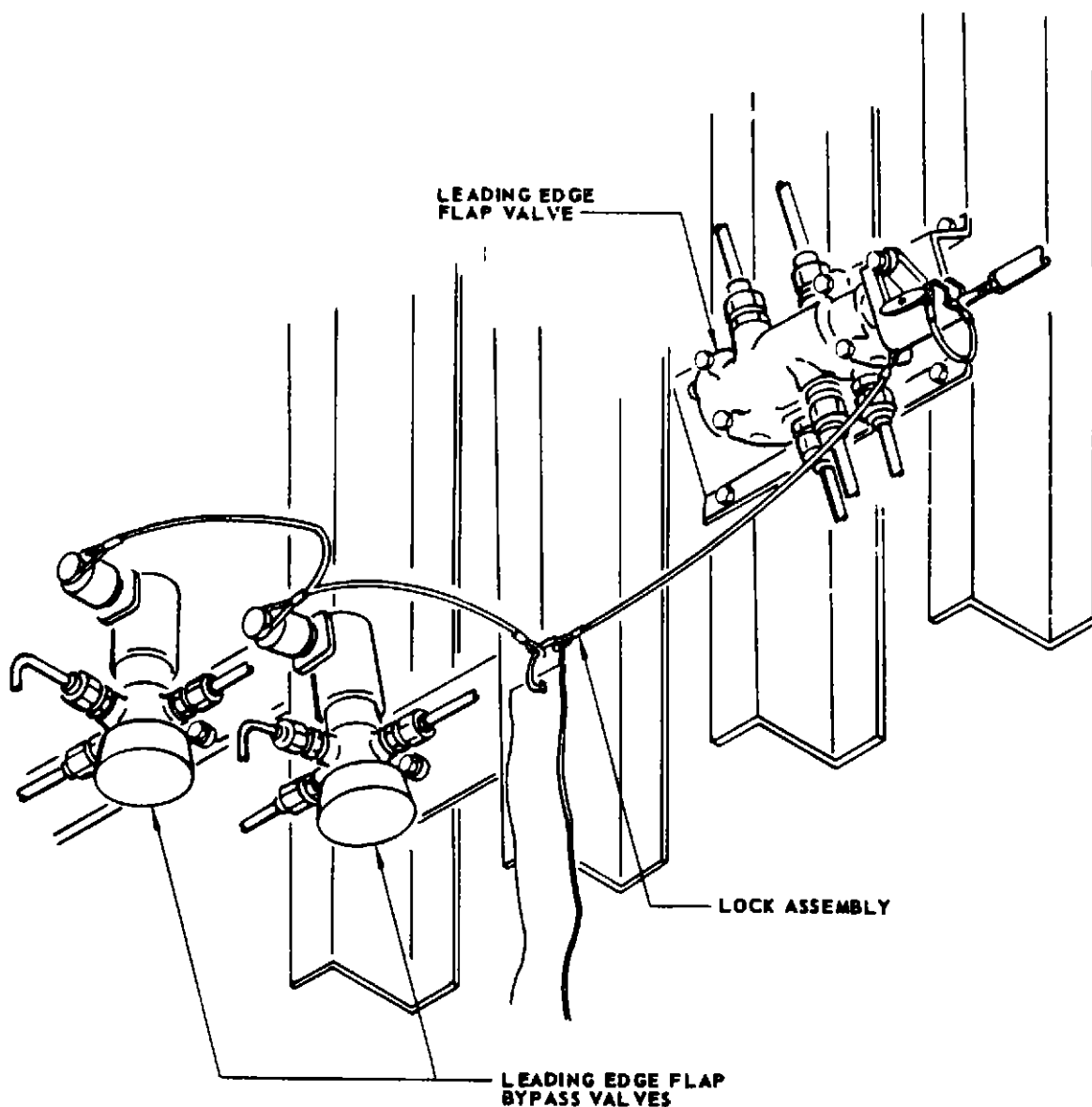
Throttle System Adjustment
Figure 201A

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- (2) Reverse Thrust Lever Protractor Assembly, - F70044 or equivalent
- (3) Lock Assembly, Leading Edge Flap - F70144 or equivalent
- (4) Throttle Rigging Lock Assembly - F70084-24 or equivalent
- (5) Rigging Pins - MS20392-4 or AN5 Bolts
- (6) Tensiometer - 0 to 100 pound capacity
- (7) Spring Scale - 0 to 50 pound capacity
- (8) Air pressure source that can be regulated from 0 to 50 psi gage pressure
- (9) Spacer - 0.41 inches

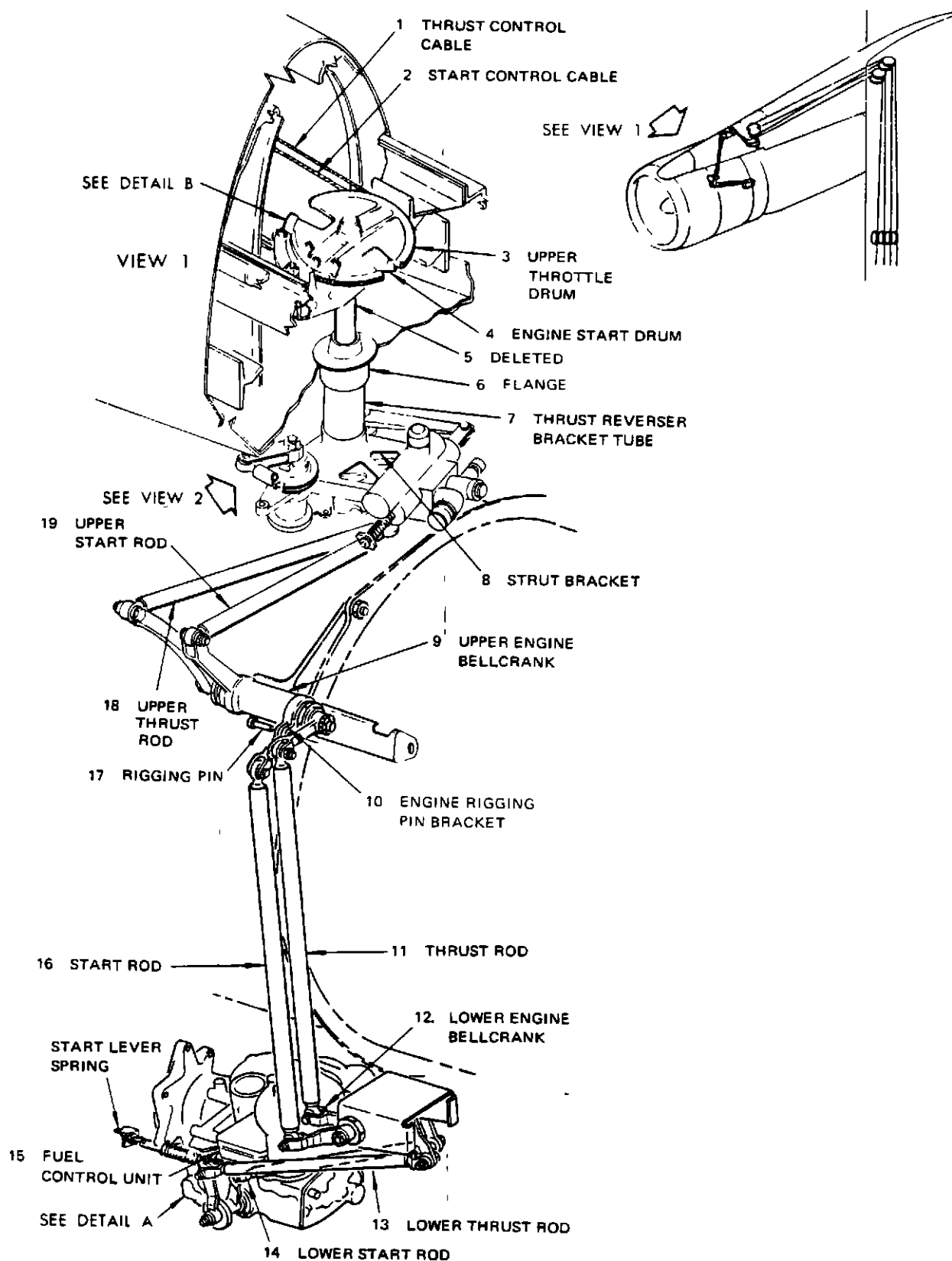
C. Adjust Throttle System

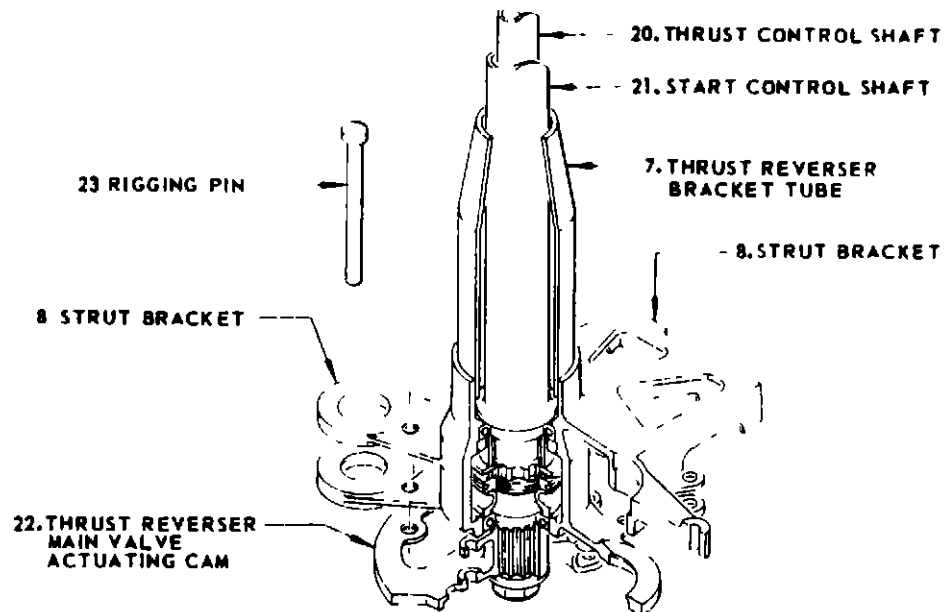
(1) Adjust Thrust System

- (a) Remove engine right cowl panel.
- (b) Insert rigging pin (23, figure 203) through bracket and thrust reverser main valve actuating cam (22) on engine control drum and shaft assembly.
- (c) Position and lock thrust lever in idle no load position.
 - 1) Clamp thrust lever against idle stop on control stand.
 - 2) Position reverse thrust lever to OFF position.
- (d) Lower wing leading edge flaps for turnbuckle access.
 - 1) Pressurize utility hydraulic system.
 - 2) Position flap control lever to first extension detent.
 - 3) Install leading edge flap lock assemblies.

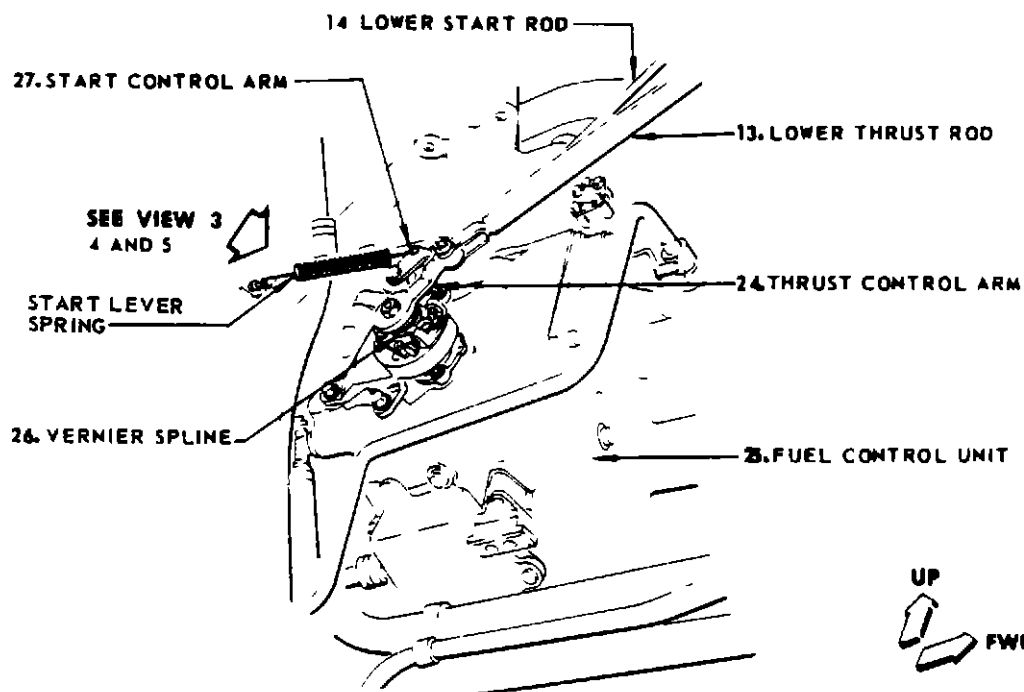
WARNING ASSURE THAT LEADING EDGE FLAP LOCK ASSEMBLY IS PROPERLY INSTALLED TO PREVENT INJURY TO PERSONNEL OR DAMAGE TO AIRPLANE.

NOTE: Leading edge flap bypass valves and leading edge flap valve are located against the forward bulkhead in the left wheel well. (See figure 202.)





VIEW 2



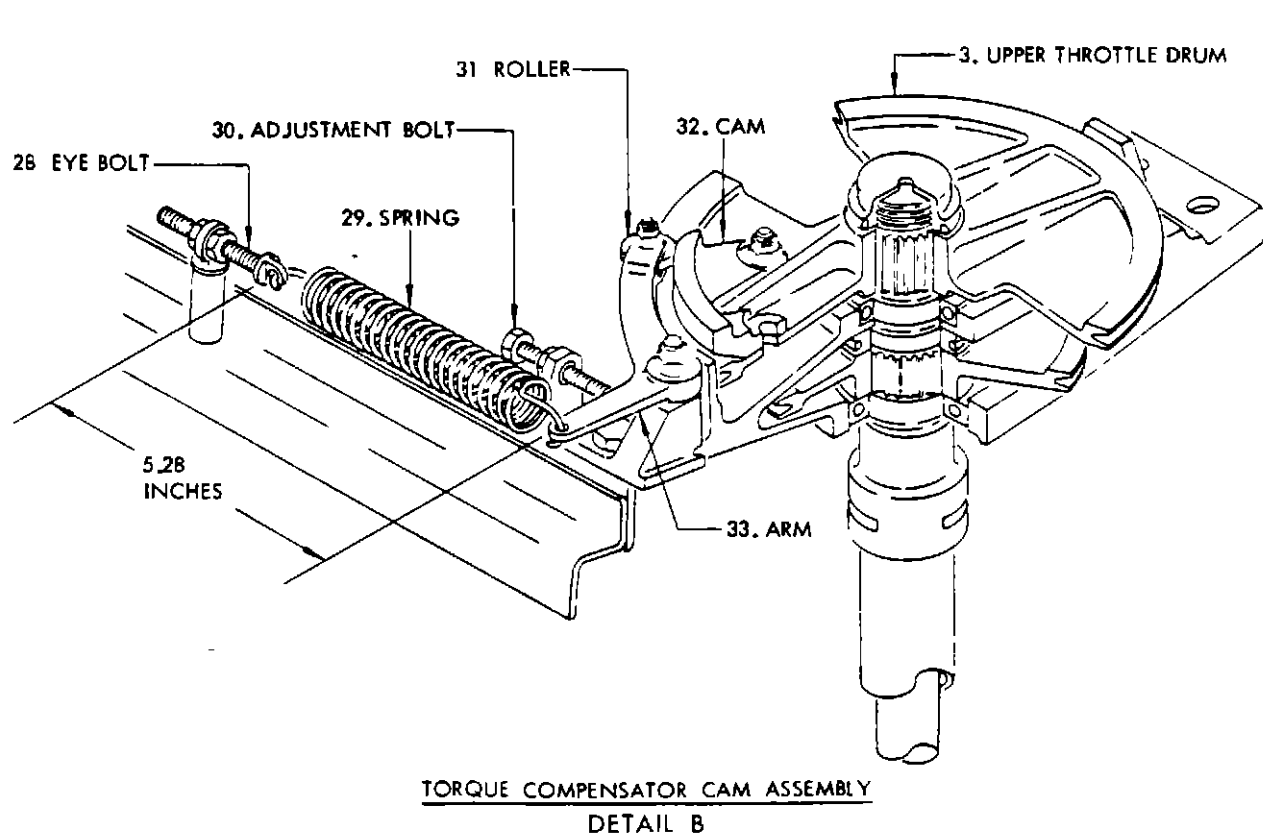
DETAIL A

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- (e) Adjust turnbuckles in wing leading edge to rig cables to load specified in figure 201A. Use tensiometer to measure rigging load and balance tension so rigging pin (23, figure 203) fits freely.

NOTE: If turnbuckle travel is not adequate for complete adjustment of cable tension, further adjustment is possible by use of turnbuckle in lower nose compartment and forward cargo compartment. Access in cargo compartment is provided by removal of ceiling. See Chapter 25, Forward Cargo Compartment.

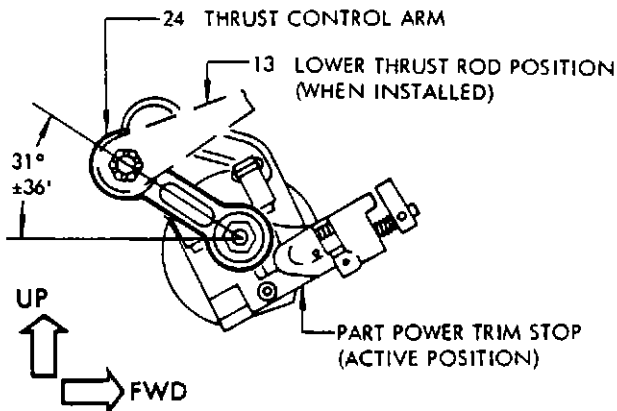
- (f) Remove leading edge flap downlocks.
(g) Raise wing flaps.
(h) Depressurize utility hydraulic system.



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1 ADJUSTABLE MAXIMUM POWER STOPS

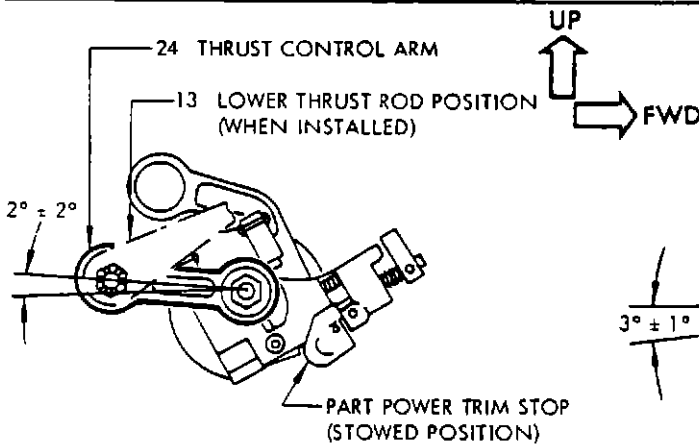
2 FIXED MAXIMUM POWER STOPS



2 NO PART POWER RIGGED POSITION

1 PART POWER RIGGED POSITION

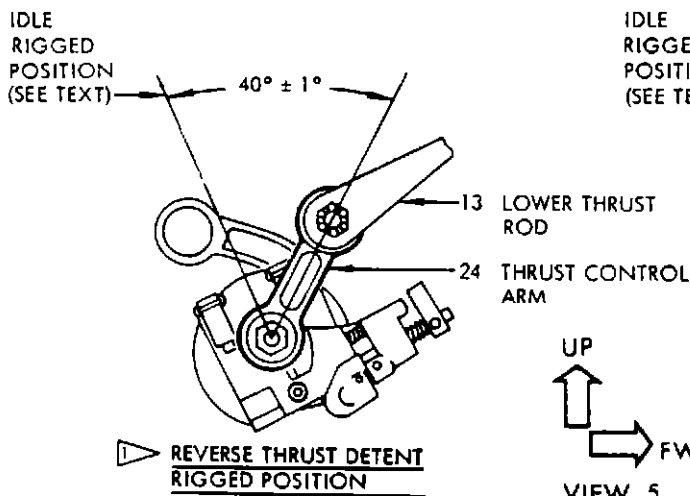
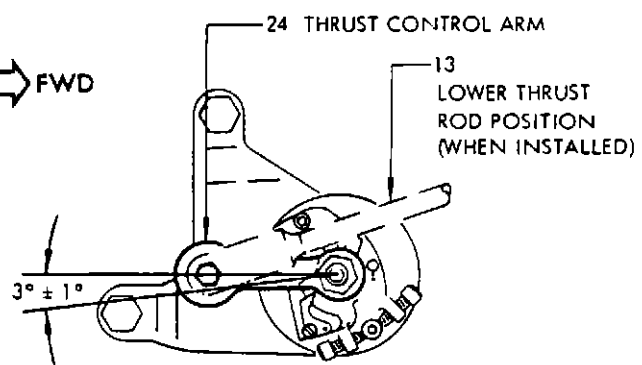
VIEW 3



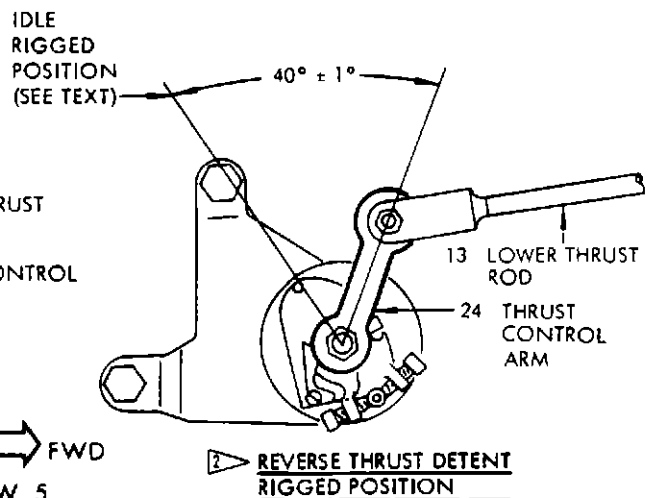
1 FULL POWER RIGGED POSITION

VIEW 4

2 FULL POWER RIGGED POSITION



UP
FWD
VIEW 5



Engine Thrust Control System Adjustment
Figure 203 (Sheet 4)



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- (i) Release adjustable control rod (18) from actuating cam (22)
- (j) Insert rigging pin (17) through rigging pin bracket (10) and throttle control arm on engine control drum and shaft assembly.
- (k) Adjust upper thrust rod (18) so that rod may be attached with rigging pin installed and attach upper rod (18)
- (l) Release lower thrust rod (13) from thrust control arm (24)
- (m) On fuel control units with adjustable maximum power stops, rotate the thrust control arm (24) clockwise away from part power trim stop. (See figure 203.)

CAUTION IT IS RECOMMENDED THAT ANY READJUSTMENT OF THRUST ARMS FOUND NECESSARY TO MEET THE REQUIREMENTS OF STEPS (N), (O), OR (P) BE PERFORMED BY THE FUEL CONTROL UNIT MANUFACTURERS' SERVICE REPRESENTATIVE

- (n) Engage part power trim stop in active position and rotate thrust control arm counterclockwise against stop. Check that the angle measured clockwise from a line parallel to the horizontal centerline of the engine to the centerline of the thrust control arm is $31^{\circ} (\pm 36')$ (See View 3.)
- (o) Remove the part power trim stop and rotate the thrust control arm counterclockwise against the full power stop. Check that the angle measured clockwise from a line parallel to the horizontal centerline of the engine to the centerline of the thrust control arm is $2^{\circ} (\pm 2^{\circ})$ (See View 4.)
- (p) On fuel control units with fixed maximum power stops, rotate the thrust control arm counterclockwise against the full power stop. (See figure 203.) Check that the angle measured counterclockwise from a line parallel to the horizontal centerline of the engine to the centerline of the thrust control arm is $3^{\circ} (\pm 1^{\circ})$ (See View 4.)



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- (q) Rotate thrust control arm (24) clockwise and activate the part power trim stop on all engines.
- (r) Remove rigging pins (23 and 17). Slowly advance all forward thrust levers $35-1/2^\circ$ ($\pm 1/2^\circ$) from the control stand idle stop and clamp the levers in this position.
- (s) Rotate the thrust control arm counterclockwise against the part power trim stop and adjust the lower thrust rod (13) so that it will attach freely to the thrust control arm and attach.

NOTE: In the event the lower thrust rod (13) cannot be adjusted within the thread safety limits of the rod end, the length of the upper thrust rod (18) may be adjusted a maximum of $1/2$ turn.

- (t) Remove restraining clamps from forward thrust levers on control stand and move part power trim stops to the inactive position and secure.

NOTE: If a definite throttle lever misalignment occurs when clamps are removed, a further adjustment of thrust rods (13) and (18) will be required.

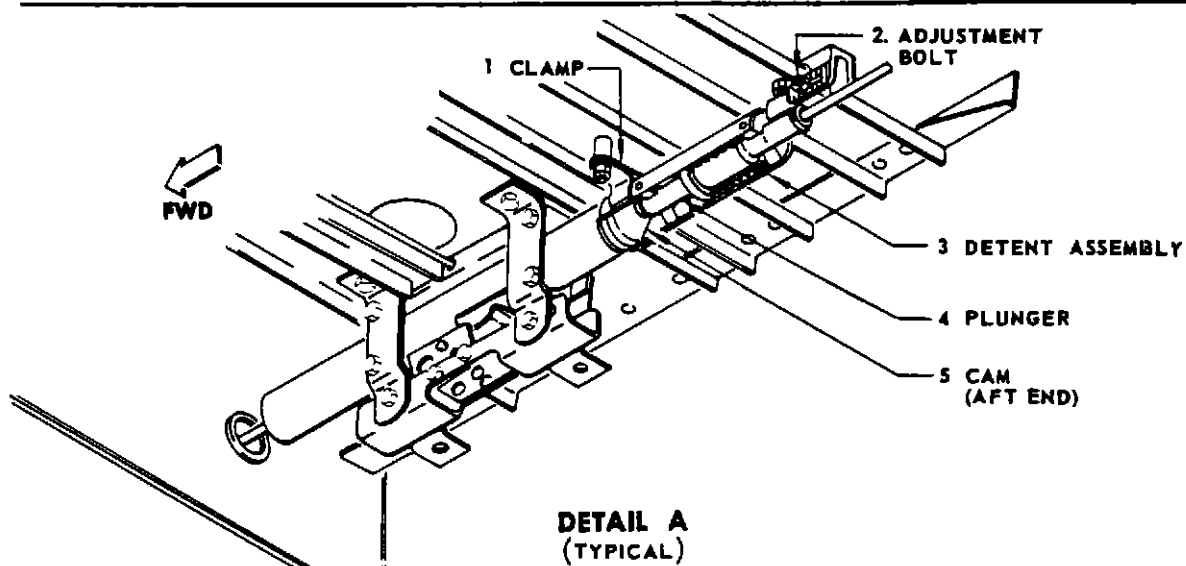
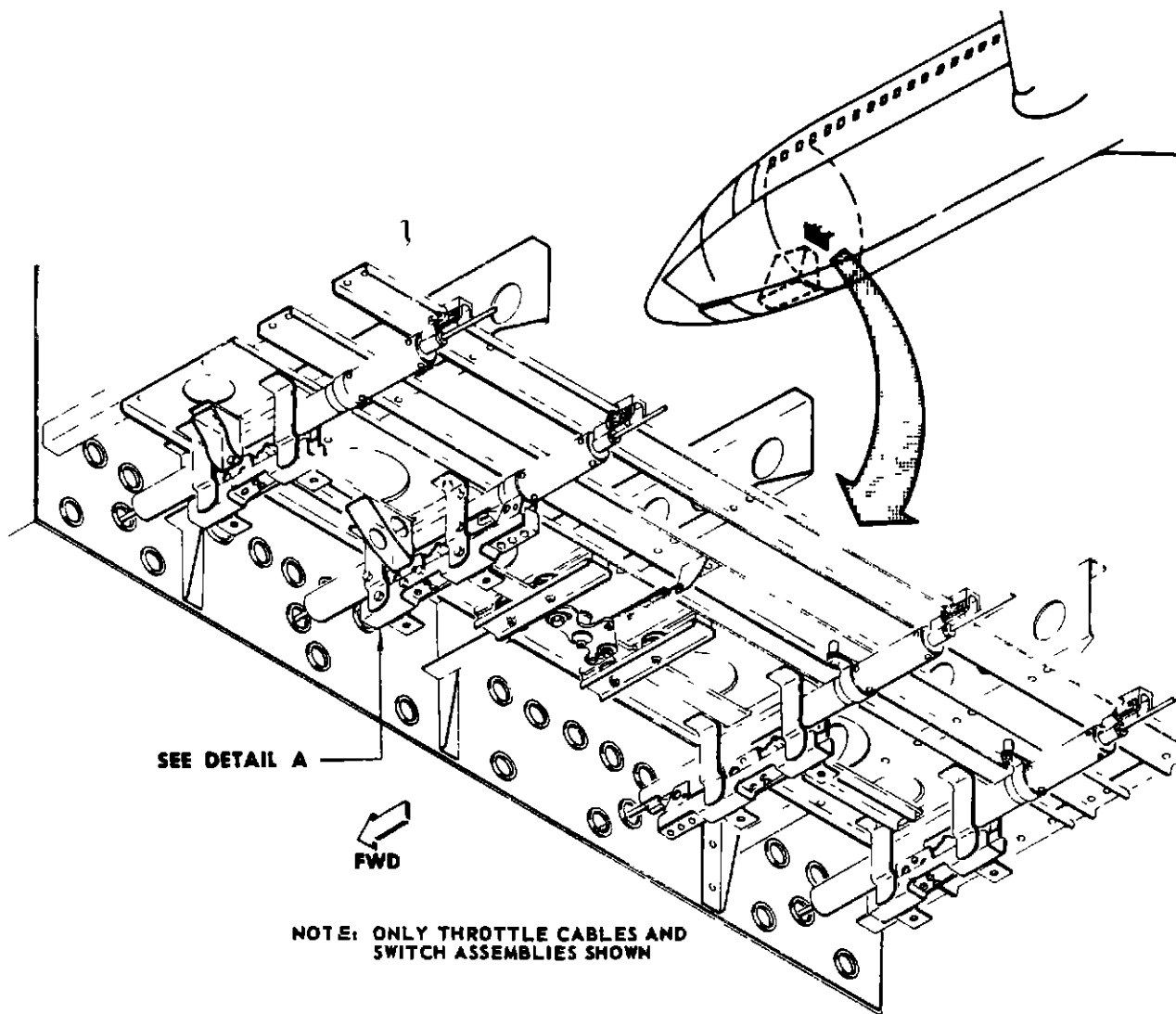
- (u) Slowly advance each thrust lever until a stop is contacted. Slowly release each lever from this position.

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Reverse Thrust Detent Adjustment
Figure 203A

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- (v) Measure the clearance between the forward edge of each thrust lever and the forward end of the lever slot. This dimension shall not exceed 1.10 inches. If the dimension exceeds 1.10 inches, recheck rigging.
- (w) On controls with adjustable maximum power stops, check to ensure that the thrust control arm is in the full open position, i.e. against the adjustable stop.
- (x) Adjust torque compensator assembly.
 - 1) Install rigging pin (23) through start bracket (8) and thrust reverser main valve actuating cam (22).
 - 2) Adjust eyebolt (28) so spring (29) has a 5.28 (± 0.06) inch length. Roller (31) will be in contact with cam (32). Tighten checknuts.
 - 3) Set adjustment bolt (30) so roller (31) is 0.010 ($+0.00/-0.008$) inches from cam (32). Tighten checknuts.
 - 4) Remove rigging pin (23) from thrust reverser main valve actuating cam.
- (y) Adjust reverse thrust detent assembly.
 - 1) Position thrust levers in (idle-no load) rigged position.
 - 2) Check rigging pin (23) will fit freely through strut bracket (8) and thrust reverser main valve actuating cam (22).
 - 3) Zero bubble protractor on thrust control arm of fuel control unit.
 - 4) Move reverse thrust lever toward 100% reverse thrust until thrust control arm has moved 40 (± 1) degrees from idle rigged position of step 3. (See figure 203, view 5.)

NOTE Insure all rigging pins are removed from system prior to moving reverse thrust lever.

- 5) Loosen clamp (1, figure 203A) and bolt (2) on reverse thrust detent assembly located above the electronic access door.

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- 6) Adjust plunger (4) so that it just contacts aft end of cam (5)
- 7) Tighten clamp (1) and bolt (2)
- (z) Check adjustment of landing gear warning thrust lever switch. Refer to 31-26-0, Adjustment/Test (Landing Gear Warning Thrust Lever Switch).
- (aa) For engine No. 3, check adjustment of flap, speed brake, and stabilizer trim warning switch. Refer to 31-26-0, Adjustment/Test (Thrust Lever Actuated Takeoff Warning Switch).
- (ab) On airplanes incorporating the BELOW FLIGHT IDLE warning switches, check adjustment as follows
 - 1) Move No. 2 and 4 thrust levers 11 ± 5 degrees forward of idle (no-load) position
 - 2) Gain access to switches actuated by cables TB2 and TB4 at station 360-380 through electronic access door
 - 3) Loosen bolts in switch adjustment slots.
 - 4) Adjust switches to actuate by making contact with cam.

NOTE. Flap control must be in a detent position greater than 30 degrees for BELOW FLIGHT IDLE warning light illumination.
 - 5) Tighten adjustment bolts.
- (2) Adjust Engine Start Control System
 - (a) Position engine start lever.
 - 1) Place 0.41 inch NO LOAD CUTOFF spacer F70248-1, or equivalent, against CUTOFF detent stop on control stand (Fig 207).
 - 2) Position engine start levers against NO LOAD CUTOFF spacer so that start lever detent lugs contact spacer. Clamp levers against spacer.
 - (b) Remove engine cowl panels
 - (c) Lower wing leading edge flaps for turnbuckle access.
 - 1) Pressurize utility hydraulic system
 - 2) Position flap control lever to DOWN.

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- 3) Disconnect electrical connections from leading edge flap bypass valves and disconnect pushrod from leading edge flap valve. Install leading edge flap lock assembly.

WARNING: ASSURE THAT LEADING EDGE FLAP LOCK ASSEMBLY IS PROPERLY INSTALLED TO PREVENT INJURY TO PERSONNEL OR DAMAGE TO AIRPLANE.

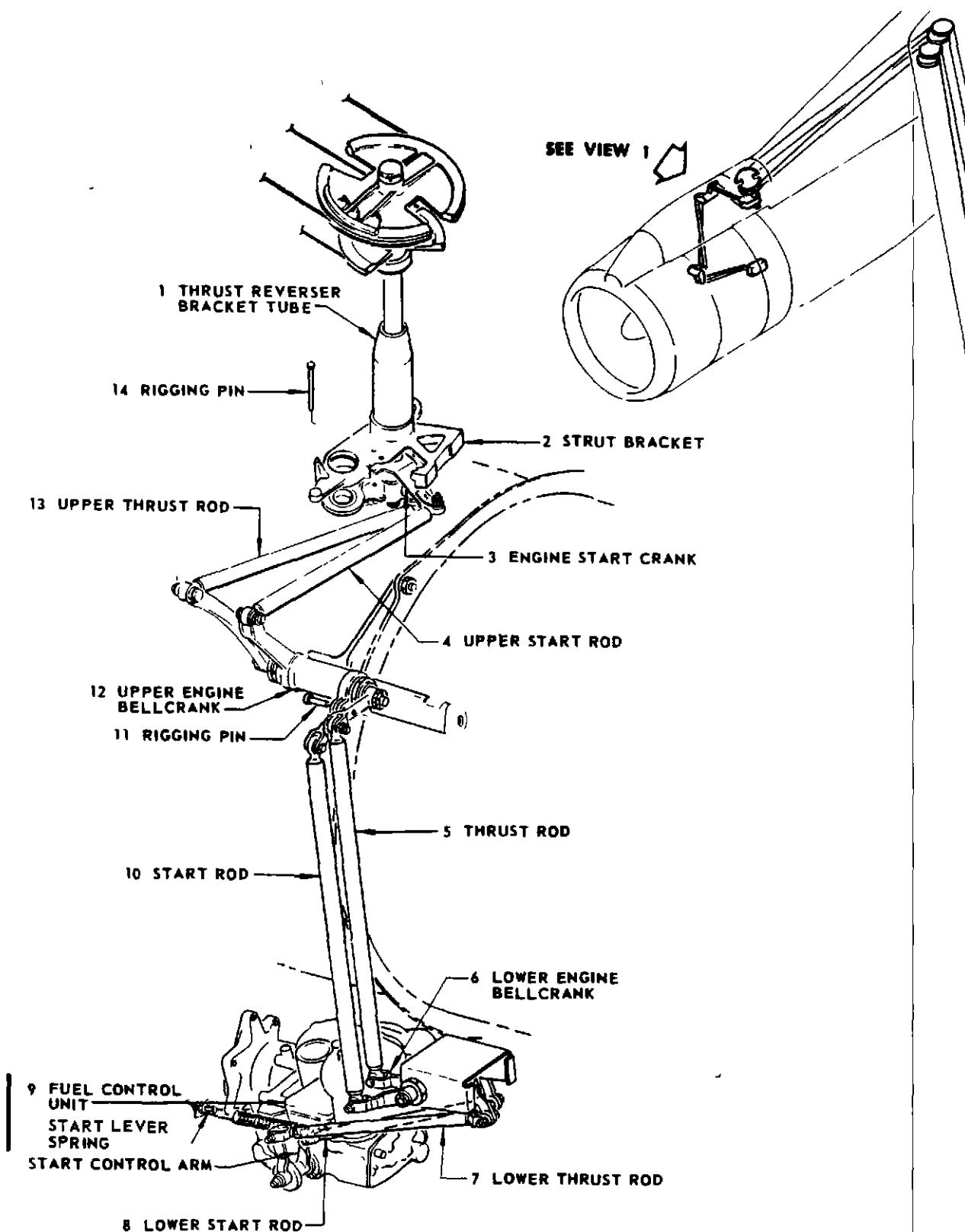
NOTE: Leading edge flap bypass valves and leading edge flap valve are located against the forward bulkhead in the left wheel well. (See figure 202.)

- (d) Adjust turnbuckles in wing leading edge until rigging pin (14, figure 204) can be inserted freely through engine start crank (3) and strut bracket (2) when cables are rigged to tension specified in figure 201A. Measure cable load with tensiometer.

NOTE: If turnbuckle travel is not adequate for complete adjustment of cable tension, further adjustment is possible by use of turnbuckles in lower nose compartment and forward cargo compartment. Access in cargo compartment is provided by removal of ceiling. (See Chapter 25, Forward Cargo Compartment.)

- (e) Adjust length of upper start rod (4) so that rigging pin (11) can be freely inserted through upper engine bellcrank (12) and rigging pin bracket and install rigging pin.
- (f) Release lower start rod from start control arm.
- (g) Position start control arm at 37-degree index mark on fuel control unit.
- (h) Adjust length of (80 degrees from horizontal) lower start rod (8) so that rod may be attached with rigging pin inserted in crank.
- (i) Connect lower start rod (8) to start control arm.

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Engine Start System Adjustment
 Figure 204

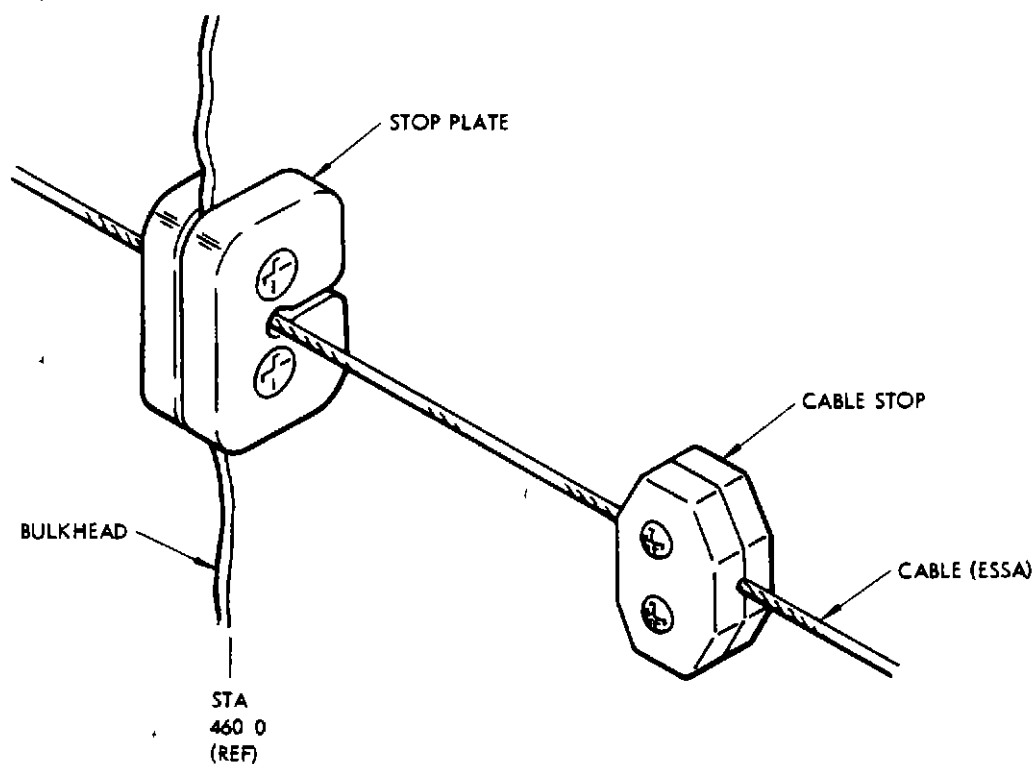
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- (j) Remove rigging pins.
- (k) Install cowl panels.
- (l) Remove clamps from engine start lever.
- (m) Remove spacer from behind lever.
- (n) Remove leading edge flap lock assembly. Connect electrical connectors to leading edge flap bypass valves and connect pushrod to leading edge flap valve.
- (o) Check that a 13 (+3/-2) pound force at the start lever knob is required to spring the lever into and against the aft edge of the idle detent. (See figure 204A for effectivity.) If not:
 - 1) Remove forward cargo compartment ceiling. See Forward Cargo Compartment, Chapter 25.
 - 2) Ensure the phenolic stop plate is installed so the hole is centered about the engine start cable.
 - 3) Adjust cable stop to provide desired start lever load.
- (p) Check adjustment of ignition switches. See Ignition Switches, Chapter 74.
- (q) Replace access panels.

D. Test Throttle System

- (1) Remove engine cowl panels.
- (2) Test engine start system.
 - (a) Insert rigging pin through start crank and strut bracket.
 - (b) Check that start lever has 4-1/4 (± 2) degrees overtravel to CUTOFF.
 - (c) Check that indicator on fuel control unit is at 37 (± 1) degrees scribe mark.
 - (d) Remove rigging pins.
 - (e) Advance start lever to START position.
 - (f) Check that start lever on fuel control unit has traveled at least 44 degrees from position at CUTOFF.

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AF	F BLCK and on
SABENA	OO SJL and on
BOAC	G-AVPB and on
All	VT-DXT and on
NWA	N380US and on
CAL	N47332 and on
AA	N8410 and on



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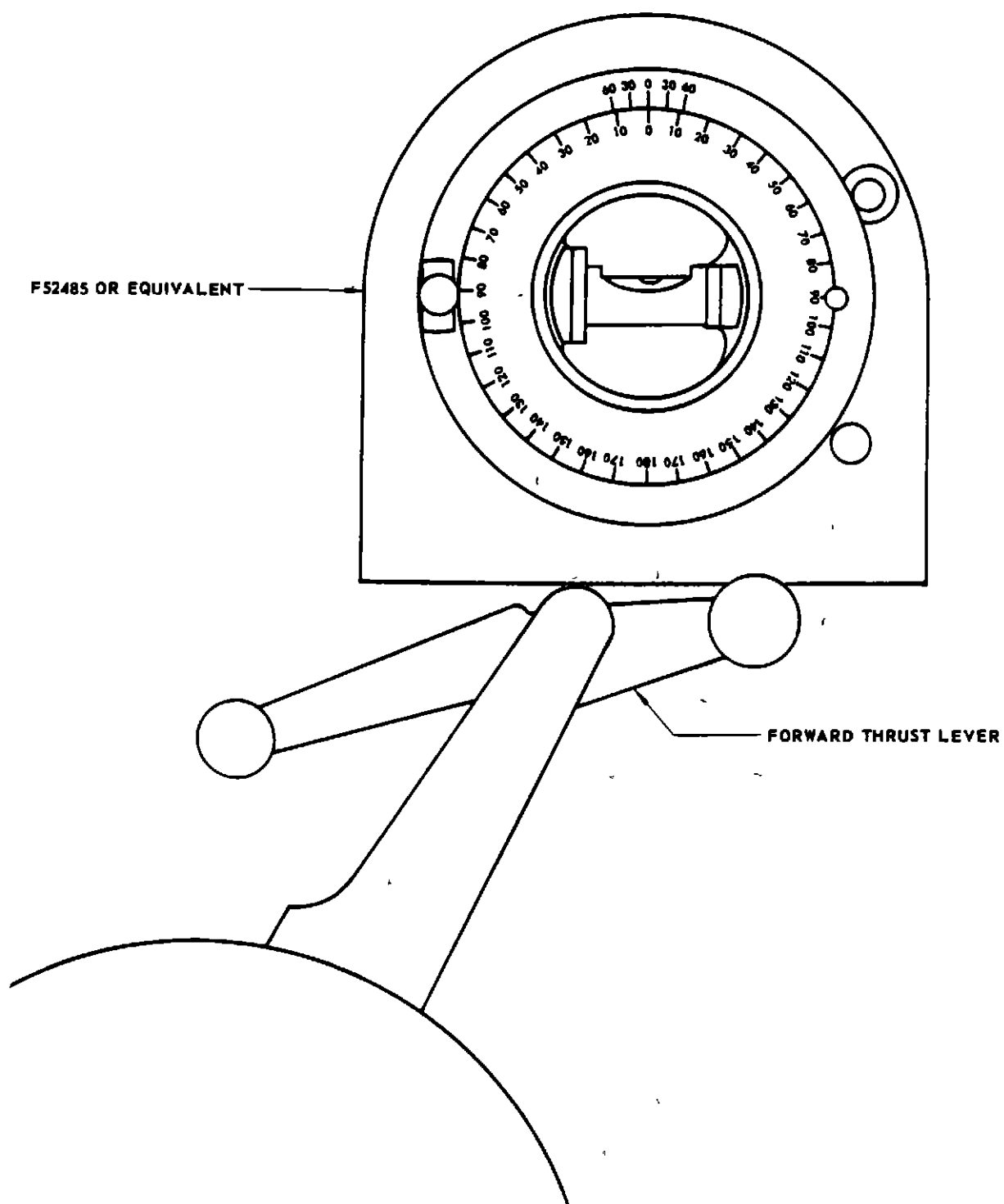
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- (g) Advance start lever to "IDLE" position.
 - (h) Check that load on lever as measured at knob center line does not exceed 7.5 pounds through full range of travel toward "START" and lift to "IDLE" position.
 - (i) Check that start lever on fuel control unit has traveled at least 53 degrees from "CUT-OFF" position.
- (3) Test Thrust System
- (a) Apply 25 psig pressure at the P_{t4} ground service connection.
CAUTION: CHECK THAT BOTH ENGINE AND FAN COWL PANELS ARE COMPLETELY REMOVED BEFORE CONNECTING AIR SUPPLY.
 - (b) Set friction regulator brake handle at full aft position.
 - (c) Using spring scale at knob center line, advance forward thrust lever through entire travel.
 - (d) Check that load on lever does not exceed 3.5 pounds.
 - (e) Return thrust lever to idle position.
 - (f) Set brake handle at fully forward position (full brake).
 - (g) Advance thrust lever through entire range of travel.
 - (h) Check that load on lever is 2 to 4 pounds greater than load observed in step (d).
 - (i) Check that friction regulator brake handle retains setting during lever travel.
 - (j) Return friction regulator brake handle to full aft position.
 - (k) Place forward thrust lever against the control stand idle stop.
 - (l) Check rigging pin (23, figure 203) fits freely through bracket and thrust reverser main valve actuating cam (22) on engine control drum and shaft assembly. Use MS20392-4 or AN5 bolt for rigging pin.
 - (m) Remove part power trim tool from stowed position and install in active position.



Thrust Lever Position Measurement
Figure 205

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- (n) Advance forward thrust lever until lever on fuel control unit contacts stop.
- (o) Check that forward thrust lever has traveled $36^{\circ} (\pm 3^{\circ})$ from idle position. Use bubble protractor to measure position. (See figure 205.)
- (p) Slowly release each lever and allow to spring back. Check that each lever is aligned within $1/4$ inch of adjacent levers.
- (q) Return thrust lever to idle position.
- (r) Return part power trim tool to stowed position.
- (s) Advance forward thrust lever until the 100% forward thrust stop at the thrust reverser main valve actuating cam in the strut or at the engine fuel control unit is contacted.
- (t) Gradually release lever allowing it to spring back.
- (u) Check that final forward thrust lever position is at least 57 degrees from idle position.
- (v) Check that thrust control arm on fuel control unit is at least 71.2 degrees from idle position. Advance forward thrust lever until the control stand full forward thrust stop is contacted.
- (w) Check that forward thrust lever has traveled at least $66-1/2$ degrees from idle position.
- (x) Move forward thrust lever to idle position.
- (y) Position reverse thrust lever not less than 20° from off position.
- (z) Apply 20 pound load in forward direction to forward thrust lever.
- (aa) Check that locking device resists load.
- (ab) Return forward thrust lever to idle position.
- (ac) Move reverse thrust lever to full aft position.
- (ad) Turn air supply off.



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- (af) Move reverse thrust lever to "OFF" position.
 - (ag) Advance forward thrust lever against stop position and apply 50 pound load to lever in forward direction. Follow up lock shall withstand load.
 - (ah) Move forward thrust lever to idle position.
 - (ai) With air pressure remaining off, manually push aft sleeve only to cruise (forward) position.
 - (aj) Actuate the forward thrust lever forward against the first stop, approximately 12° from idle position. The follow up lock shall withstand a 15 pound load in the forward direction.
 - (ak) Apply a 25 pound load to the lever in the forward direction. The lever shall rotate a minimum of 45° from the idle position before the second stop is contacted.
- (4) Test reverse thrust system.
- (a) Restore 25 psig to P₄ and note clamshell doors return to forward thrust position and "Reverser Operating Light" goes off.
 - (b) Position forward thrust lever 5° ($\pm 2^\circ$) from idle position.
 - (c) Pull reverse thrust lever aft until motion is locked by pawl.
 - (d) Check that lever is not more than 15 degrees from idle position. Measure angle with reverse thrust lever protractor assembly.
 - (e) Using spring scale apply 10 pound load in aft direction to each reverse thrust lever. Pawl shall resist load.
 - (f) Return forward thrust lever to idle position.
 - (g) Move reverse thrust lever to "OFF" position then using spring scale move lever aft through full range of travel.
 - (h) Check that load required to pull lever from "OFF" position is 1.5 (+1.5/-1.0) pounds.
 - (i) Check that load does not exceed 6.0 pounds at any point during first 65° of travel, 5.0 pounds from 65° to 100° and 11.0 pounds from 100° until contact with 100° reverse thrust stop (126°).



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- (j) Position the reverse thrust lever so the 100% reverse thrust stop at the thrust reverser main valve actuating cam in the strut or at the engine fuel control unit contacts.
- (k) Check that thrust control lever on fuel control unit is at least 52° clockwise from idle position or that the full power stop on the fuel control unit is contacted.
- (l) Gradually release lever and allow it to spring back.
- (m) Check that final lever position is 100° ($\pm 4^\circ$) from OFF position.
- (n) Check that aft end of throttle cam contacts plunger in reverse thrust detent when thrust control arm on fuel control unit has traveled 40° ($\pm 1^\circ$) from idle position.
- (o) Return reverse thrust levers to OFF position.
- (p) Disconnect air supply.
- (q) With forward thrust lever in idle position actuate the reverse thrust lever aft against a stop.
- (r) Apply a 50 pound load to reverse thrust lever in aft direction.
- (s) Follow-up lock should withstand load.
- (5) Test Friction Brake Regulator
 - (a) Rotate friction brake regulator lever through full travel.
 - (b) Check that lever moves freely through full travel.
 - (c) Check that force required to disengage lever handle from ratchet is 5 to 10 pounds.
 - (d) Check that friction brake regulator lever retains setting during full travel of forward thrust levers.
- (6) Replace cowl panels.

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ENGINE CONTROL SYSTEM - INSPECTION/CHECK

1. General

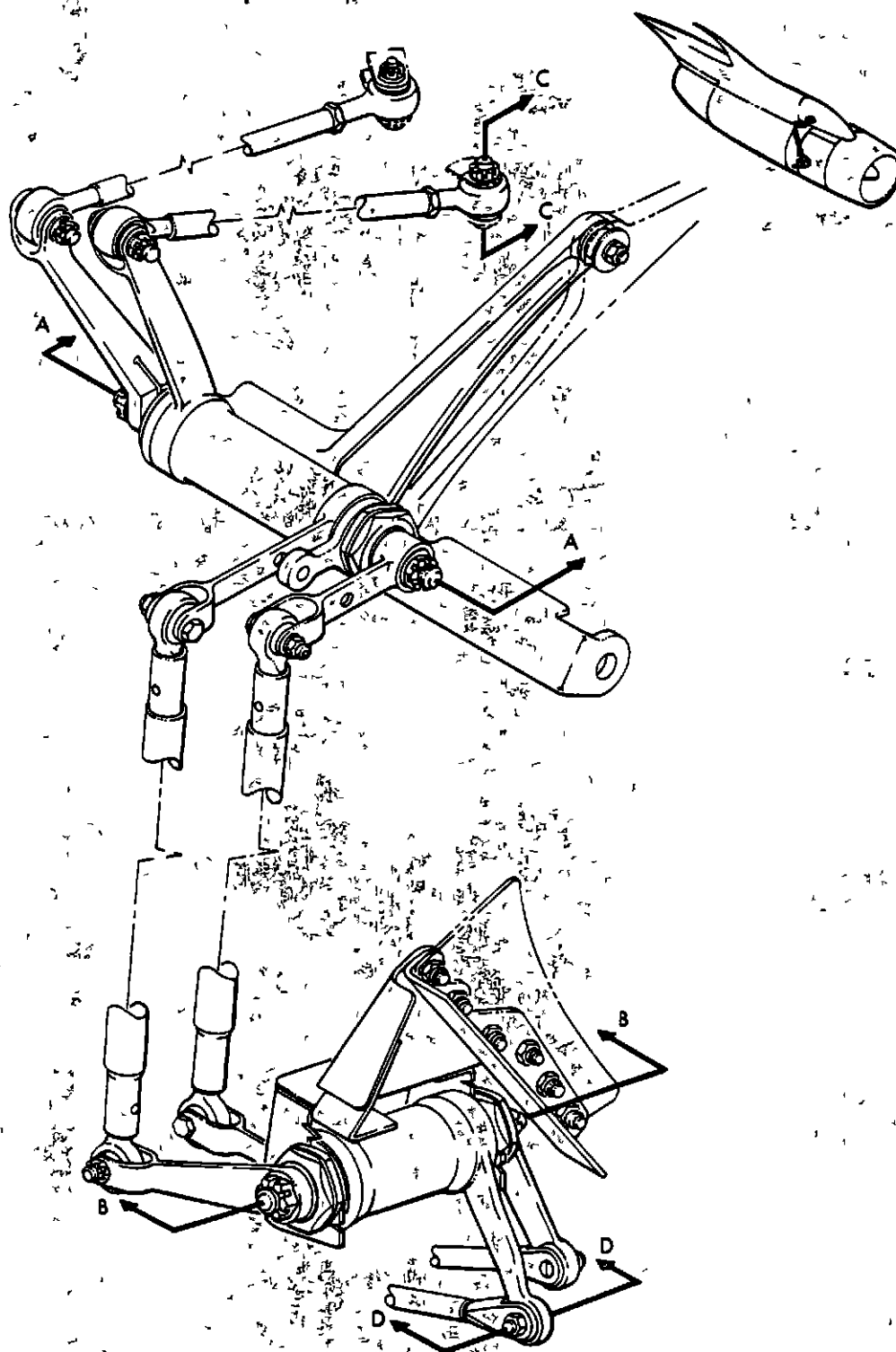
- A. This data consists of illustrations and wear limits charts. There will be no procedure given in this section for gaining access to or removing and replacing the component after inspection for wear. Refer to Component Removal/Installation for this information.

2. Throttle Cable Wear Limits

- A. Examine throttle control cables for wear. (Refer to Chapter 27, Control Cables.)
- (1) Engine thrust cables are allowed 65% wear of outer wires before replacement.
 - (2) Engine start cables are allowed 65% wear of outer wires before replacement.

3. Engine Control Bellcrank Linkage Wear Limits (See figure 601.)

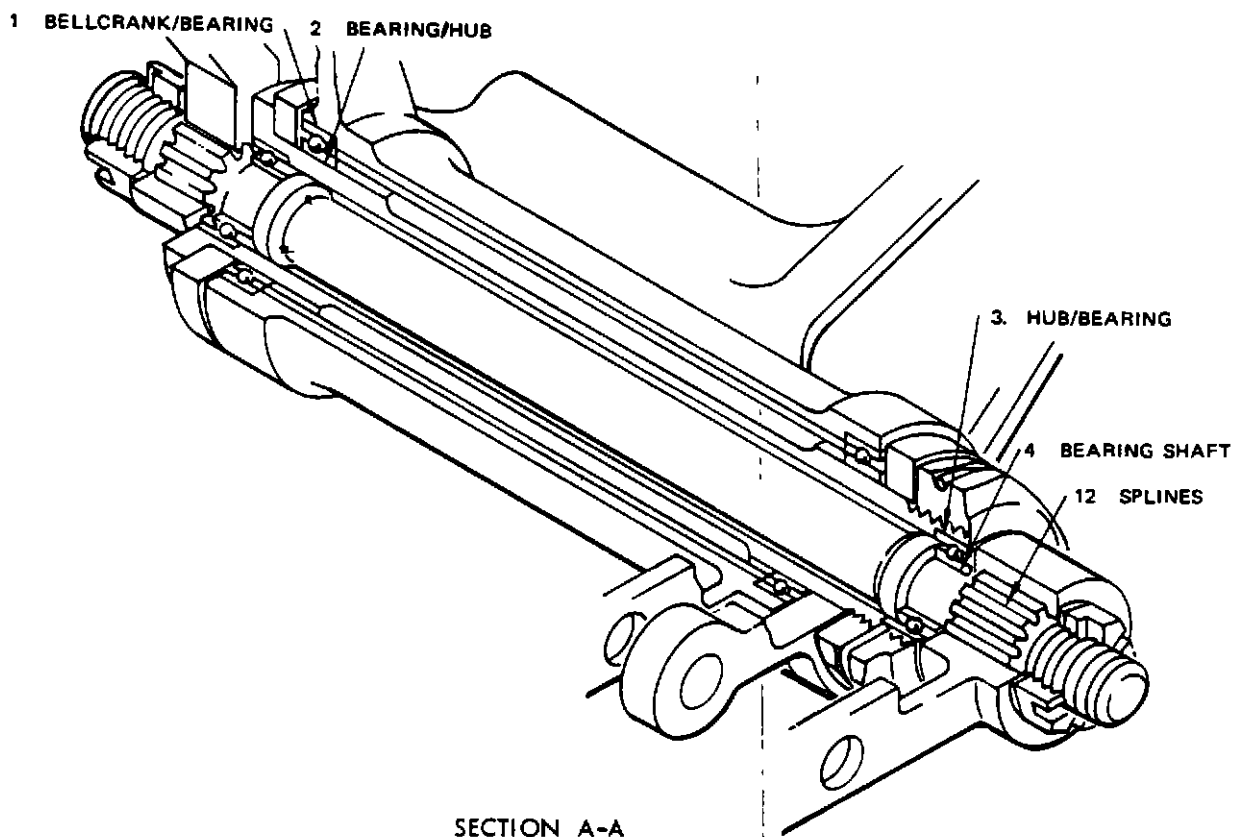
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Engine Control Bellcrank Linkage Wear Limits
Figure 601 (Sheet 1)

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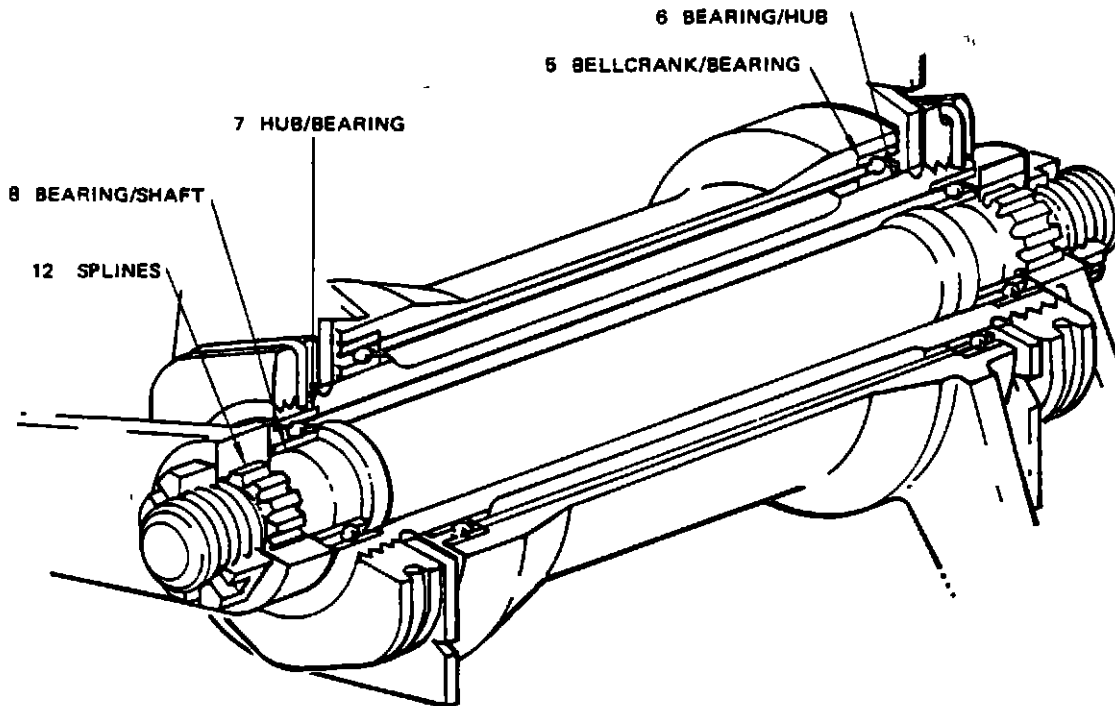
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			DIAMETER		MAX WEAR DIM	MAX DIAM CLEAR-ANCE			
			MIN	MAX					
1.	BELLCRANK	ID	1.7500	1.7510	1.7660	.015		X	▷
	BEARING	OD	1.7490	1.7500	1.7340		▷ X		
2.	BEARING	ID	1.3118	1.3132	1.3282	.015	▷ X		
	HUB	OD	1.3105	1.3115	1.2955			X	▷
3.	HUB	ID	1.0625	1.0635	1.0785	.015		X	▷
	BEARING	OD	1.0615	1.0625	1.0465		▷ X		
4.	BEARING	ID	.6243	.6257	.6407	.015	▷ X		
	SHAFT	OD	.6230	.6240	.6080			X	▷

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Engine Control Bellcrank Linkage Wear Limits
Figure 601 (Sheet 2)

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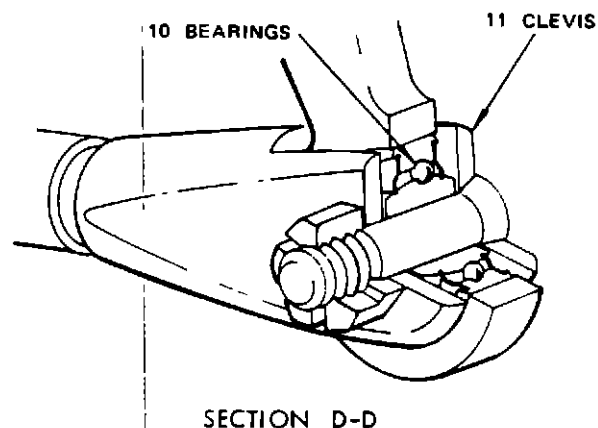
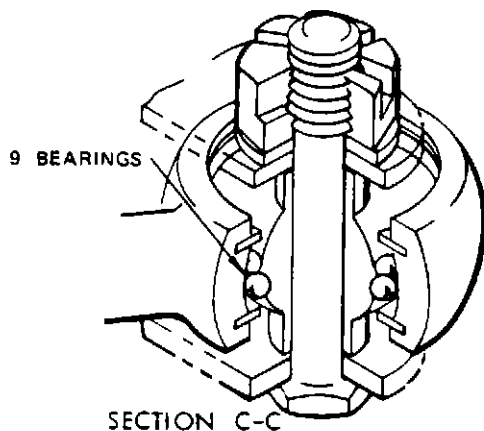


SECTION B-B

INDEX NO	PART NAME	DIM	DESIGN LIMITS		WEAR LIMITS		REPLACE WORN PART	REPAIR WORN PART	REPAIR INSTR
			DIAMETER		MAX WEAR DIM	MAX DIAM CLEAR-ANCE			
			MIN	MAX					
5.	BELLCRANK	ID	1.7500	1.7510	1.7660	.015		X	
	BEARING	OD	1.7490	1.7500	1.7340		 X		
6.	BEARING	ID	1.3118	1.3132	1.3282	.015	 X		
	HUB	OD	1.3105	1.3115	1.2955			X	
7.	HUB	ID	1.0625	1.0635	1.0785	.015		X	
	BEARING	OD	1.0615	1.0625	1.0465		 X		
8.	BEARING	ID	.6243	.6257	.6407	.015	 X		
	SHAFT	OD	.6230	.6240	.6080			X	

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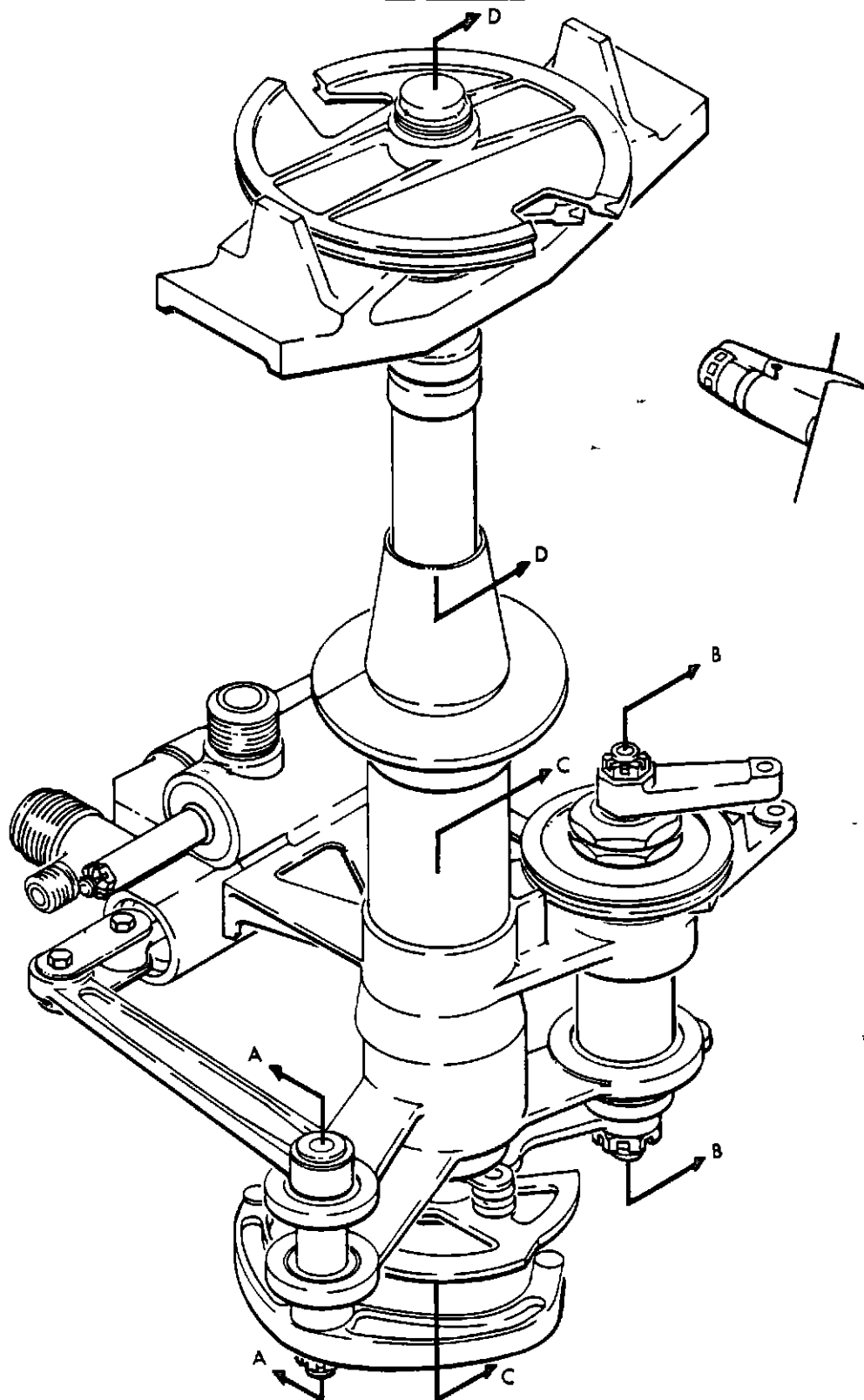
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INDEX NO	PART NAME	DIM	DESIGN LIMITS		WEAR LIMITS		REPLACE WORN PART	REPAIR WORN PART	REPAIR INSTR
			DIAMETER		MAX WEAR DIM	MAX DIAM CLEARANCE			
			MIN	MAX					
9.	BEARING	ID							
		OD							
10.	BEARING	ID							
		OD							
11.	CLEVIS	ID							
		OD							
12.	SPLINE	ID							
		OD							

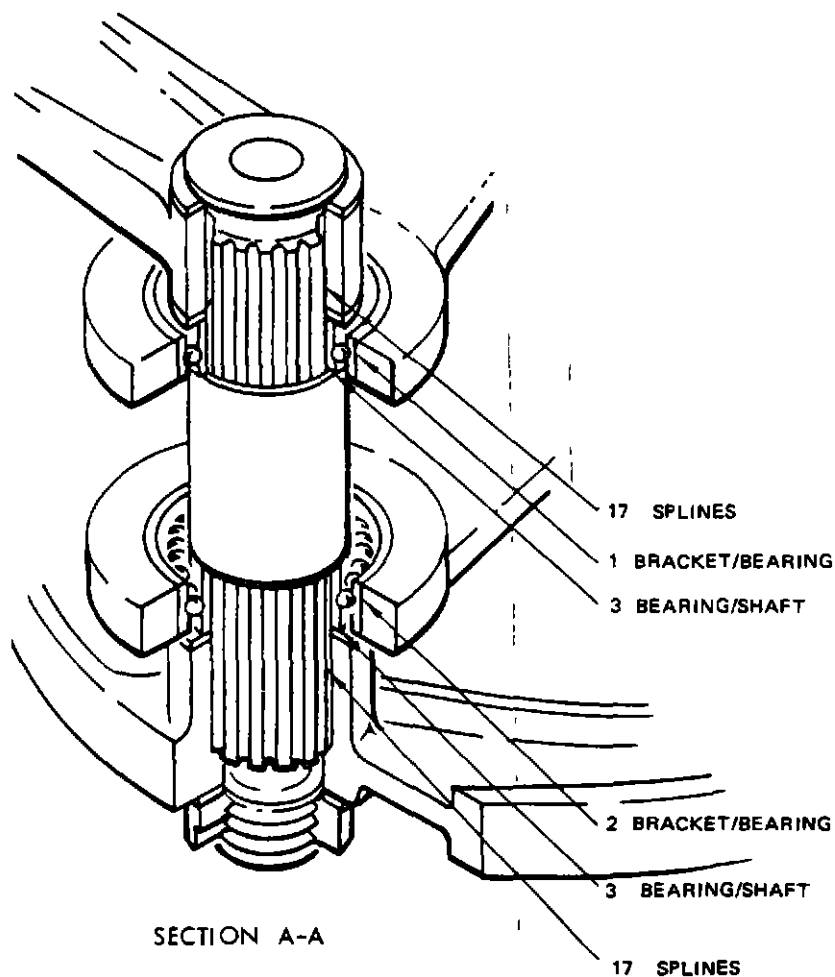
- 1 Clean up bearing contact surface by machining maximum base metal. Removal is limited to .02 inch beyond minimum design ID or maximum design OD. Return to design dimensions with chrome plate not to exceed .02 inch thickness.
- 2 Also replace if bearing runs rough or axial play exceeds .01 inch
- 3 Replace when combination radial clearance and bearing hole exceeds .01 inch
- 4 Replace if running rough
- 5 Replace if .254/.250 inch clevis holes show .02 inch maximum wear or elongation
- 6 Spline wear is limited to a maximum of .01 inch backlash between mating parts

4. Engine Control Drum and Shaft Assembly Wear Limits (See figure 602.)



Engine Control Drum and Shaft Assembly Wear Limits
 Figure 602 (Sheet 1)

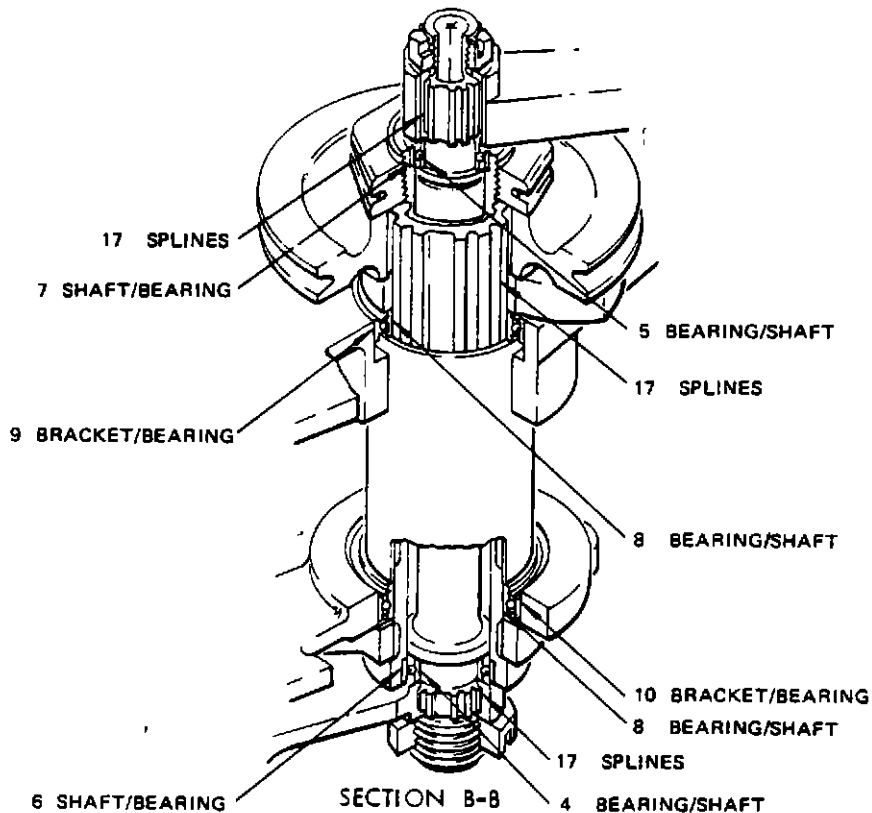
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SECTION A-A

INDEX NO	PART NAME	DIM	DESIGN LIMITS		WEAR LIMITS		REPLACE WORN PART	REPAIR WORN PART	REPAIR INSTR
			DIAMETER		MAX WEAR DIM	MAX DIAM CLEAR-ANCE			
			MIN	MAX					
1.	BRACKET	ID	1.1880	1.1890	1.2040	.015		X	
	BEARING	OD	1.1865	1.1875	1.1715		 X 		
2.	BRACKET	ID	1.1875	1.1885	1.2035	.015		X	
	BEARING	OD	1.1865	1.1875	1.1715		 X		
3.	BEARING	ID	.7493	.7507	.7657	.015	 X		
	SHAFT	OD	.7480	.7490	.7330			X	

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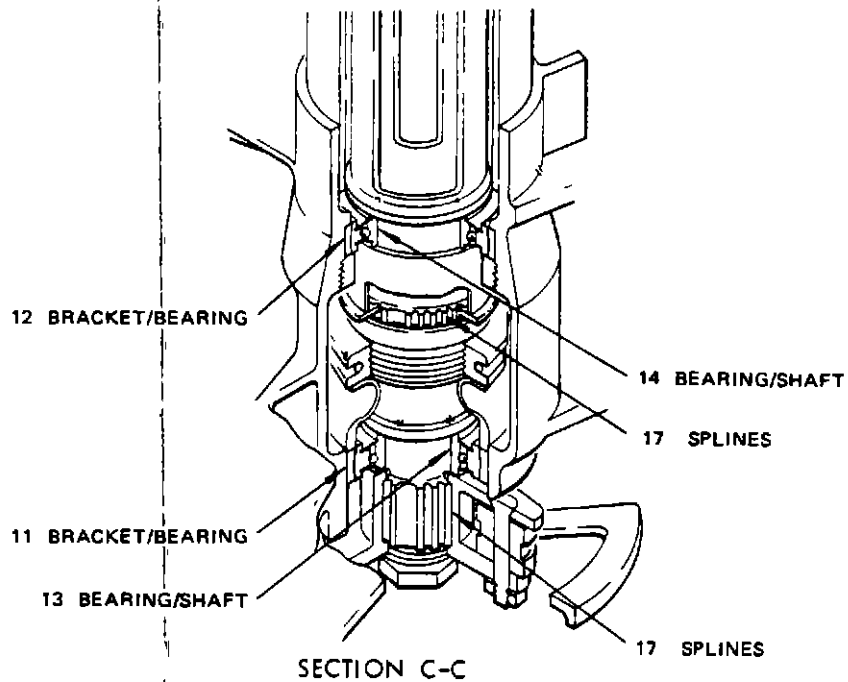


INDEX NO	PART NAME	DIM	DESIGN LIMITS		WEAR LIMITS		REPLACE WORN PART	REPAIR WORN PART	REPAIR INSTR
			DIAMETER		MAX WEAR DIM	MAX DIAM CLEAR-ANCE			
			MIN	MAX					
4.	BEARING	ID	.8743	.8757	.8907	.015			
	SHAFT	OD	.8730	.8740	.8580			X	
5.	BEARING	ID	.6243	.6257	.6407	.015			
	SHAFT	OD	.6230	.6240	.6080			X	
6.	SHAFT	ID	1.3125	1.3135	1.3285	.015		X	
	BEARING	OD	1.3115	1.3125	1.2965			X	
7.	SHAFT	ID	1.0625	1.0635	1.0785	.015		X	
	BEARING	OD	1.0615	1.0625	1.0465			X	
8.	BEARING	ID	1.5618	1.5632	1.5782	.015			
	SHAFT	OD	1.5605	1.5615	1.5455			X	

Engine Control Drum and Shaft Assembly Wear Limits
Figure 602 (Sheet 3)

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INDEX NO	PART NAME	DIM	DESIGN LIMITS		WEAR LIMITS		REPLACE WORN PART	REPAIR WORN PART	REPAIR INSTR
			DIAMETER		MAX WEAR DIM	MAX DIAM CLEAR-ANCE			
			MIN	MAX					
9.	BRACKET	ID	2.0005	2.0015	2.0165	.015		X	
	BEARING	OD	1.9990	2.0000	1.9840		 X		
10.	BRACKET	ID	2.0000	2.0010	2.0160	.015		X	
	BEARING	OD	1.9990	2.0000	1.9840		 X		
11.	BRACKET	ID	1.9380	1.9390	1.9590	.020		X	
	BEARING	OD	1.9365	1.9375	1.9215		 X		
12.	BRACKET	ID	2.3755	2.3765	2.3915	.015		X	
	BEARING	OD	2.3740	2.3750	2.3590		 X		
13.	BEARING	ID	.9990	1.0000	1.0150	.015	 X		
	SHAFT	OD	.9970	.9990	.9820			X	
14.	BEARING	ID	1.4370	1.4380	1.4530	.015	 X		
	SHAFT	OD	1.4350	1.4370	1.4200			X	

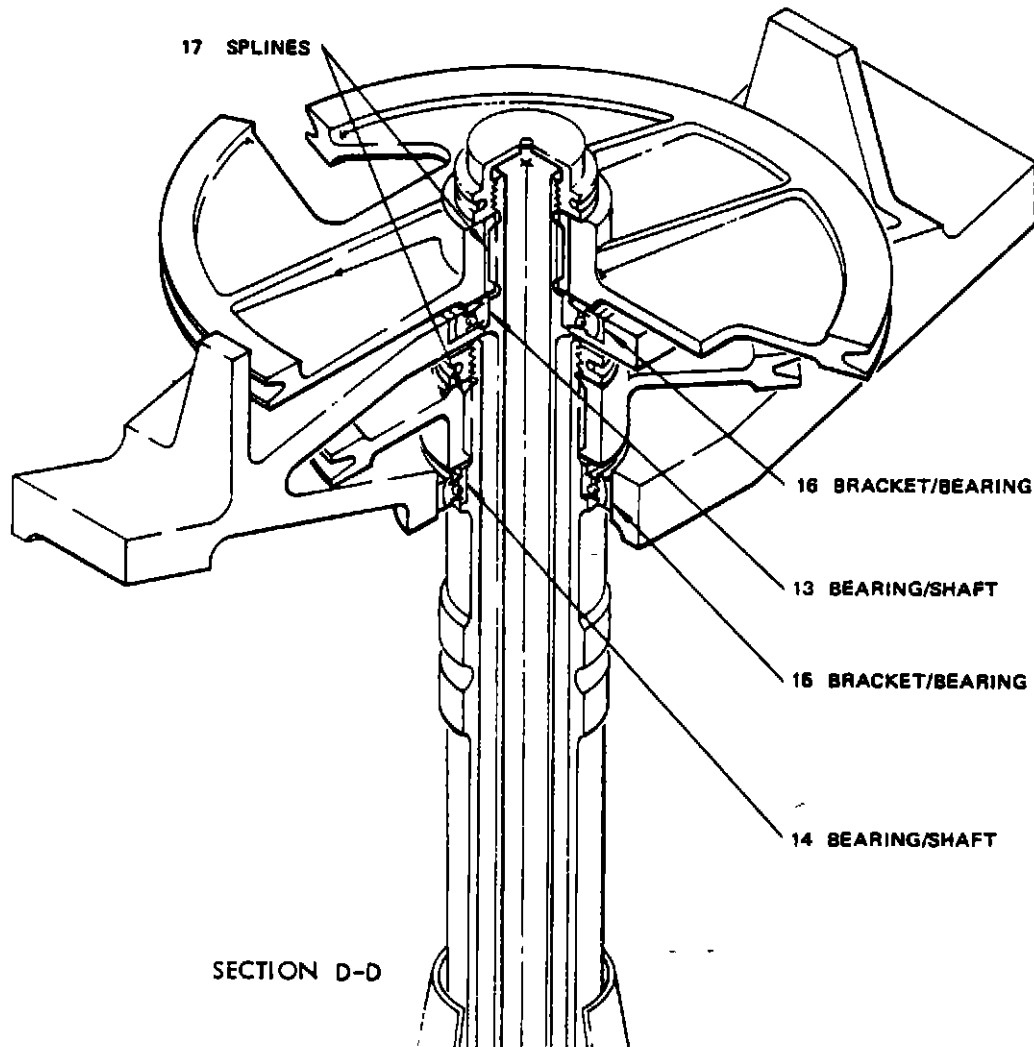
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Engine Control Drum and Shaft Assembly Wear Limits
Figure 602 (Sheet 4)

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INDEX NO	PART NAME	DIM	DESIGN LIMITS		WEAR LIMITS		REPLACE WORN PART	REPAIR WORN PART	REPAIR INSTR
			DIAMETER		MAX WEAR DIM	MAX DIAM CLEAR-ANCE			
			MIN	MAX					
15.	BRACKET	ID	2.3750	2.3760	2.3960	.020		X	
	BEARING	OD	2.3740	2.3750	2.3590		 X		
16.	BRACKET	ID	1.9375	1.9380	1.9530	.015		X	
	BEARING	OD	1.9365	1.9375	1.9215		 X		
17.	SPLINE	ID							
		OD							

Engine Control Drum and Shaft Assembly Wear Limits
Figure 602 (Sheet 5)



MAINTENANCE MANUAL

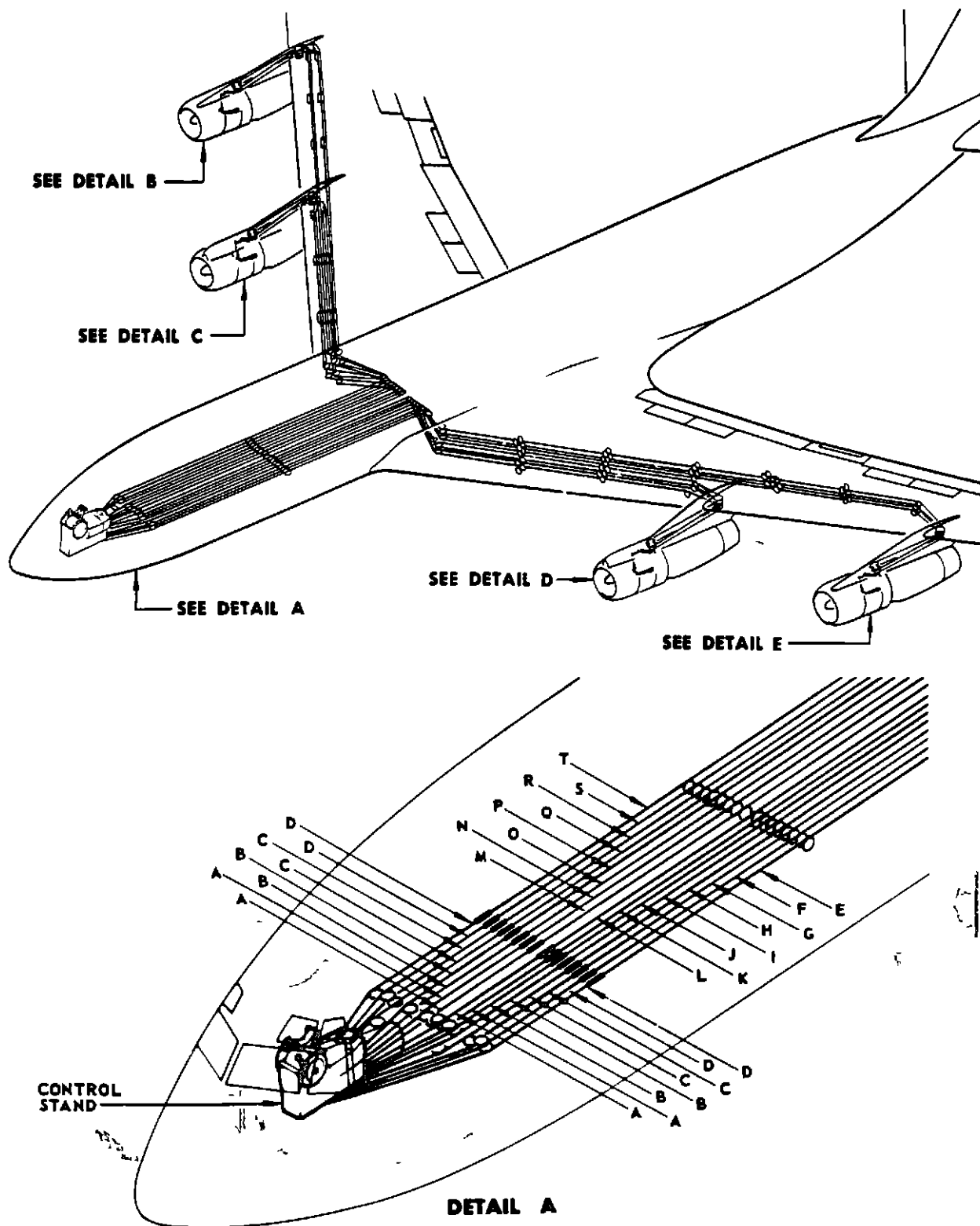
- 1 Obtain steel (17-4PH CRES) and fabricate bushing. Bore 1.31 inch maximum diameter oversize hole with a bushing interference fit of .0005 to .0021 inch. Ream bushing to 1.1880/1.1890 inch diameter.
- 2 Also replace if bearing runs rough or axial play exceeds .01 inch
- 3 Obtain steel (17-4PH CRES) and fabricate bushing. Bore 1.25 inch maximum diameter oversize hole with a bushing interference fit of .0005 to .0021 inch. Ream bushing to 1.1875/1.1885 inch diameter.
- 4 Clean up bearing contact surface by machining maximum base metal. Removal is limited to .02 inch beyond minimum design ID or maximum design OD. Return to design dimensions with hard chrome plate not to exceed .02 inch thickness.
- 5 Obtain steel (17-4PH CRES) and fabricate bushing. Bore 2.12 inch maximum diameter oversize hole with a bushing interference fit of .0008 to .0027 inch. Ream bushing to 2.0005/2.0015 inch diameter.
- 6 Obtain steel (17-4PH CRES) and fabricate bushing. Bore 2.06 inch maximum diameter oversize hole with a bushing interference fit of .0008 to .0027 inch. Ream bushing to 2.0000/2.0010 inch diameter.
- 7 Obtain steel (17-4PH CRES) and fabricate bushing. Bore 2.06 inch maximum diameter oversize hole with a bushing interference fit of .0008 to .0027 inch. Ream bushing to 1.9380/1.9390 inch diameter.
- 8 Also replace if bearing runs rough or axial clearance exceeds .02 inch or if self-aligning spherical surfaces rotate freely (diametrical clearance greater than .0005 inch).
- 9 Obtain steel (17-4PH CRES) and fabricate bushing. Bore 2.44 inch maximum diameter oversize hole with a bushing interference fit of .0010 to .0029 inch. Ream bushing to 2.3755/2.3765 inch diameter.
- 10 Obtain steel (17-4PH CRES Cad Plated) and fabricate bushing. Bore 2.50 inch maximum diameter oversize hole with a bushing interference fit of .0015 to .0035 inch. Ream bushing to 2.3750/2.3760 inch diameter.
- 11 Obtain steel (17-4PH CRES Cad Plated) and fabricate bushing. Bore 2.00 inch maximum diameter oversize hole with a bushing interference fit of .0013 to .0031 inch. Ream bushing to 1.9375/1.9380 inch diameter.
- 12 Spline wear is limited to a maximum of .01 inch backlash between mating parts.
- 13 On some airplanes bond outer bearing race to housing. See Chapter 13, Standard Practices.

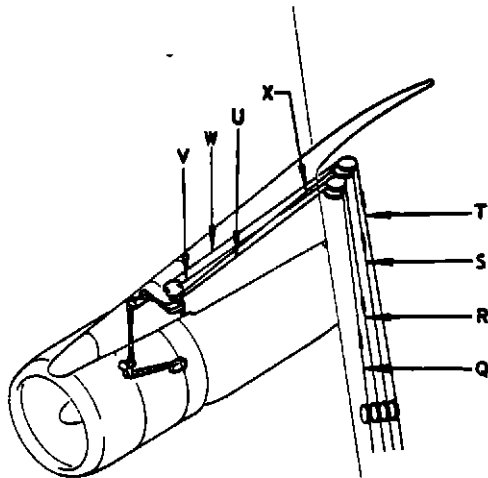
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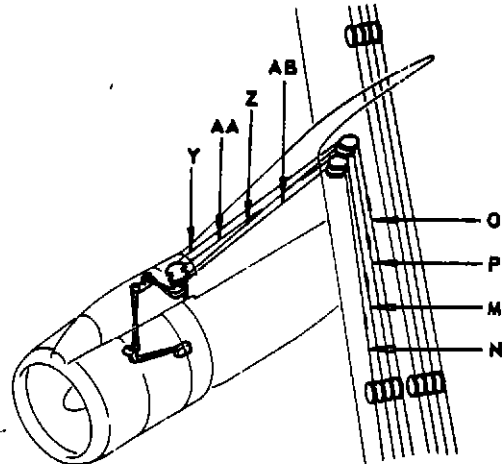
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THROTTLE CONTROL CABLES - MAINTENANCE PRACTICES

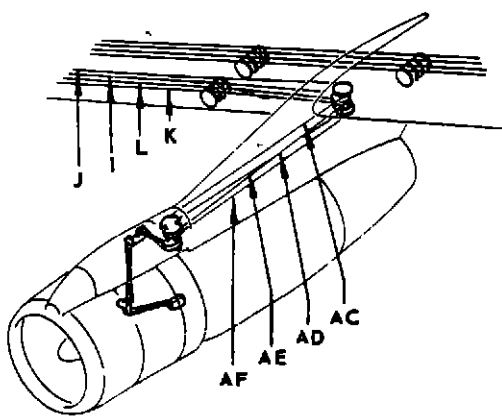




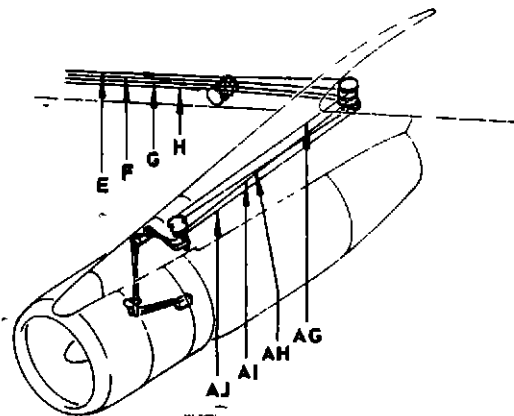
DETAIL B



DETAIL C



DETAIL D



DETAIL E

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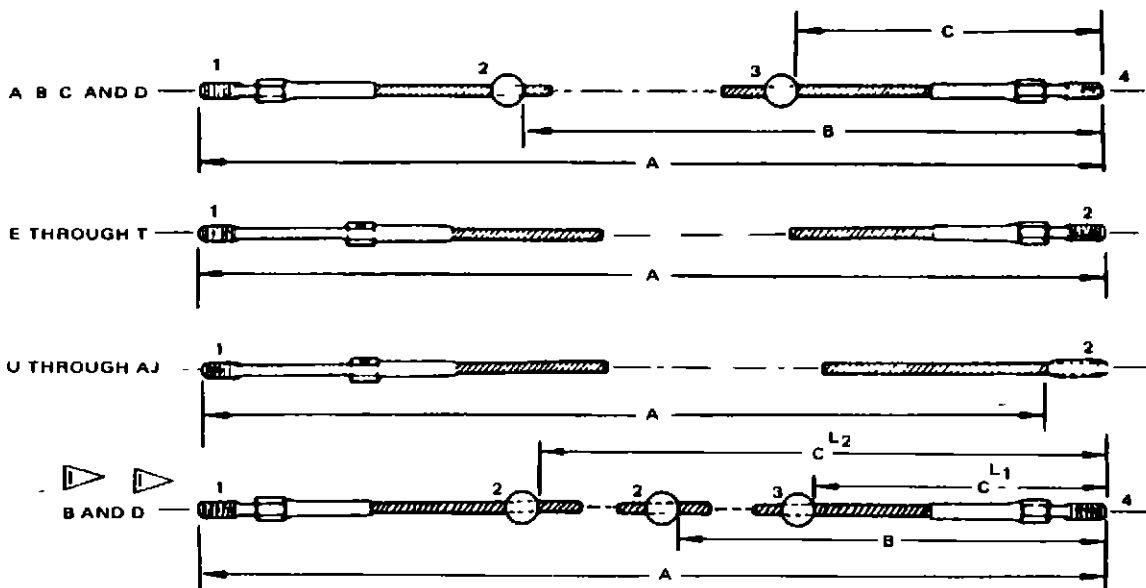
CABLE REF	DRAWING NO	NO REQ	LENGTH			CABLE SIZE	FITTINGS			
			A	B	C		1	2	3	4
A B B B	66-3155-20	2	501 2	260 5	96 0	3/32 7 x 7	AN669S3LH	BAC-T14B 3	BAC T14B 3	AN669S3LH
	66-3155-18	2	497 5	257 8	82 6	3/32 7 x 7	AN669S3LH	BAC T14B 3	BAC T14B 3	AN669S3LH
	66-3155-18	1	497 5	257 6	82 6 L ₁	3/32 7 x 7	AN669S3LH	BAC T14B 3	BAC T14B 3	AN669S3LH
	66-3155-42	1	497 5	257 6	82 6 L ₁ 441 9 L ₂	3/32 7 x 7	AN669S3LH	BAC T14B 3	BAC T14B 3	AN669S3LH
C D D D	66-3155-19	2	341 3	180 6	13 2	3/32 7 x 7	AN669S3LH	BAC T14B 3	BAC T14B 3	AN669S3LH
	66-3155-17	2	401 9	200 8	23 9	3/32 7 x 7	AN669S3RH	BAC T14B 3	BAC T14B 3	AN669S3LH
	66-3155-17	1	401 9	200 8	23 9 L ₁	3/32 7 x 7	AN669S3RH	BAC T14B 3	BAC T14B 3	AN669S3LH
	66-3155-43	1	401 9	200 8	23 9 L ₁ 387 6 L ₂	3/32 7 x 7	AN669S3RH	BAC T14B 3	BAC T14B 3	AN669S3LH
E F G H	NAS 303 47 7250	1	725 0			3/32 7 x 7	MS21260L3RH	MS21260S3LH		
	NAS 303 45 2400	1	240 0			3/32 7 x 7	MS21260L3LH	MS21260L3RH		
	NAS 303 46 7040	1	704 0			3/32 7 x 7	MS21260L3RH	MS21260S3RH		
	NAS 303 45 2400	1	240 0			3/32 7 x 7	MS21260L3LH	MS21260L3RH		
I J K L	NAS 303 46 7580	1	758 0			3/32 7 x 7	MS21260L3RH	MS21260S3RH		
	NAS 303 45 2800	1	280 0			3/32 7 x 7	MS21260L3LH	MS21260L3RH		
	NAS 303 46 7640	1	764 0			3/32 7 x 7	MS21260L3RH	MS21260S3RH		
	NAS 303 45 2800	1	280 0			3/32 7 x 7	MS21260L3LH	MS21260L3RH		
M N O P	NAS 303 46 6690	1	669 0			3/32 7 x 7	MS21260L3RH	MS21260S3RH		
	NAS 303 46 6215	1	621 63			3/32 7 x 7	MS21260L3RH	MS21260S3RH		
	NAS 303 46 7000	1	700 00			3/32 7 x 7	MS21260L3RH	MS21260S3RH		
	NAS 303 46 7014	1	701 50			3/32 7 x 7	MS21260L3RH	MS21260S3RH		
Q R S T	NAS 303 56 7014	1	701 5			3/32 7 x 7	MS21260L3LH	MS21260S3RH		
	NAS 303 56 7000	1	700 0			3/32 7 x 7	MS21260L3LH	MS21260S3RH		
	NAS 303 56 6215	1	621 63			3/32 7 x 7	MS21260L3LH	MS21260S3RH		
	NAS 303 56 6690	1	669 0			3/32 7 x 7	MS21260L3LH	MS21260S3RH		
U V W X	NAS 303 56 7640	1	764 0			3/32 7 x 7	MS21260L3LH	MS21260S3RH		
	NAS 303 45 2800	1	280 0			3/32 7 x 7	MS21260L3LH	MS21260L3RH		
	NAS 303 56 7580	1	758 0			3/32 7 x 7	MS21260L3LH	MS21260S3RH		
	NAS 303 45 2800	1	280 0			3/32 7 x 7	MS21260L3LH	MS21260L3RH		
Y Z AA AB	NAS 303 56 7040	1	704 0			3/32 7 x 7	MS21260L3LH	MS21260S3RH		
	NAS 303 45 2400	1	240 0			3/32 7 x 7	MS21260L3LH	MS21260S3RH		
	NAS 303 57 7250	1	725 0			3/32 7 x 7	MS21260L3LH	MS21260S3LH		
	NAS 303 45 2400	1	240 0			3/32 7 x 7	MS21260L3LH	MS21260L3RH		

△ All VT-DXT and on
SN OO-S/L and on

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Throttle Control Cables
Figure 201 (Sheet 3)

CABLE REF	DRAWING NO	NO REQ	LENGTH			CABLE SIZE	FITTINGS			
			A	B	C		1	2	3	4
U	BAC C13G 320-1288	1	128 8			3/32 7 x 7	AN669L3RH	BAC T14A 3		
V	BAC C13G 320-1605	1	160 5			3/32 7 x 7	AN669L3RH	BAC T14A 3		
W	BAC C13G 320-2100	1	210 0			3/32 7 x 7	AN669L3RH	BAC T14A 3		
X	BAC C13G 320-2200	1	220 0			3/32 7 x 7	AN669L3RH	BAC T14A 3		
Y	BAC C13G 320-2530	1	253 0			3/32 7 x 7	AN669L3RH	BAC T14A 3		
Z	BAC C13G 320-1725	1	172 5			3/32 7 x 7	AN669L3RH	BAC T14A 3		
AA	BACC13G320-1558	1	155 8			3/32 7 x 7	AN669L3RH	BACT14A3		
AB	BACC13G320-1235	1	123 5			3/32 7 x 7	AN669L3RH	BACT14A3		
AC	BACC13G319 2434	1	243 4			3/32 7 x 7	AN669L3LH	BACT14A3		
AD	BACC13G319 1815	1	181 5			3/32 7 x 7	AN669L3LH	BACT14A3		
AE	BACC13G319 1460	1	146 0			3/32 7 x 7	AN669L3LH	BACT14A3		
AF	BACC13G319 1343	1	134 3			3/32 7 x 7	AN669L3LH	BACT14A3		
AG	BACC13G319 1998	1	199 8			3/32 7 x 7	AN669L3LH	BACT14A3		
AH	BACC13G319 1510	1	151 0			3/32 7 x 7	AN669L3LH	BACT14A3		
AI	BACC13G319 2300	1	230 0			3/32 7 x 7	AN669L3LH	BACT14A3		
AJ	BACC13G319 1390	1	139 0			3/32 7 x 7	AN669L3LH	BACT14A3		



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THRUST LEVER FRICTION BRAKE - MAINTENANCE PRACTICES

1. Removal/Installation Thrust Lever Friction Brake Crank

A. Equipment and Materials

- (1) Tensionometer - 0 to 100 pounds capacity
- (2) Dowel - 1-1/2 inches diameter, 10 inches long
- (3) Rigging pins are MS-20392-4 or AN5 bolts

B. Remove Thrust Lever Friction Brake Crank

- (1) Depressurize hydraulic systems.
 - (a) Connect electrical power.
 - (b) Manually position the utility system bypass valve to "BYPASS."
 - (c) Connect the utility and auxiliary hydraulic systems by operating the interconnect switch on the copilot's instrument panel.
- (2) Open main gear wheel well doors and right engine cowl panel.
- (3) Remove nacelle strut access panels No. 3716 (for turbocompressor equipped engines) and access panels No. 1739 (for other engines) See Chapter 12, "Access Doors and Panels."
- (4) Insert rigging pin through strut bracket and thrust reverser main valve actuating cam on engine control drum and shaft assembly.
- (5) Insert rigging pin in center speed brake control drum and drum support in right wheel well. (See figure 209.)
- (6) Install rigging pin through flap control valve support bracket and follow-up cable drum in each main gear wheel well (See figure 211.)
- (7) Insert rigging pin through engine start arm and bracket. (See figure 210.)

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- (8) Relieve tension on stabilizer trim chain assembly by adjusting support linkages to raise forward mechanism. (See figure 205.)
- (9) Relieve tension on wing flap control cables by loosening turnbuckles in lower nose compartment.
- (10) Relieve tension on speed brake control cables by loosening turnbuckles in lower nose compartment.
- (11) Relieve tension on thrust cables for engines No. 1 and No. 2. Disconnect thrust cables for engines No. 3 and No. 4.
- (12) Relieve tension on all engine start cables.
- (13) Remove left tie rod nut (15, figure 204.)
- (14) Pull stabilizer trim control wheel tie rod (6) from stabilizer trim control wheel shaft (1).
- (15) Remove right stabilizer trim control wheel (5) from stabilizer trim control wheel shaft.
- (16) Remove upper right access cover (4).
- (17) Remove forward right electronic unit (13) from aft electronic panel.
- (18) Remove lower right access panel (7) to gain access to the mounting nuts on upper right side panel (9).
- (19) Remove switch guard (8) to gain access to bolt (14) for removal of upper right side panel.
- (20) Loosen stabilizer trim indicator crank bolt from nutplate (11) on upper right side panel.

NOTE: Do not remove bolt from stabilizer trim indicator crank.
- (21) Remove bolt (14) from within aft electronic panel and upper right side panel. Nut will be free to fall when bolt (14) is removed.
- (22) Remove right control shaft nut (3).
- (23) Remove bottom screws in upper right side panel (9) and remove splice channel (10). Two nuts will be free to fall when bottom screws are removed.



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- (24) Remove key (2) from slot in upper right side panel (9) and right control shaft (12), as upper right side panel is moved to right.
- (25) Remove upper right side panel (9).
- (26) Replace right control shaft nut (7, figure 203) on right control shaft (1) to allow removal of spacer, stabilizer trim indicator, friction brake handle, and flap handle as a unit.
- (27) Detach eye bolt (4) from friction brake crank (2) by removing bolt (3).
- (28) Detach stabilizer trim indicator link (10) from stabilizer trim indicator crank (8) by removing flat head pin (9).
- (29) Remove right control shaft (1) with nut, spacer, trim indicator, friction brake handle, and flap handle as a unit.
- (30) Rotate left stabilizer trim wheel until the connector link (6) in the stabilizer trim chain is in an accessible position for removal.
- (31) Detach connector link and remove chain from sprocket. Secure chain in bottom of control stand.
- (32) Remove start lever detents (11, figure 202) from cover assemblies (2).
- (33) Remove forward and aft cover tie straps (1 and 13).
- (34) Remove forward and aft cover angles (3 and 8).
- (35) Disconnect mach trim warning light cover (11, figure 203).
- (36) Lift cover assemblies (2, figure 202) from control stand.
- (37) Deleted.
- (38) Remove left stabilizer trim control wheel (12) from stabilizer trim control wheel shaft (5).
- (39) Remove stabilizer trim control wheel shaft (5) and sprocket (6) from right side of control stand.
- (40) Remove left control shaft nut (10) from left control shaft.

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- (41) Using dowel (10, figure 201), push left control shaft clear of control stand

NOTE Key (9, figure 202) will be free from left control shaft and upper left side panel when left control shaft is driven from control stand.

- (42) Pull dowel to left until No. 3 and 4 thrust lever assemblies can be lifted out of quadrant.

NOTE Tag position of all spacers as they are removed. Position and thickness of spacers may vary in different control stands.

- (43) Pull start levers aft to obtain room for removal of friction brake crank from control stand.

- (44) Remove cable guard (8, figure 201) by removing bolt.

- (45) Remove plug button (11) from upper left side panel.

- (46) Remove bolt (6) and lift friction brake crank (4) from control stand.

NOTE Bearings (3) and spacer (5) will be free in brake crank when bolt (6) is removed.

C Install Thrust Lever Friction Brake Crank

- (1) Install spacer (5, figure 201) and bearings (3) in friction brake crank (4)

- (2) Place friction brake crank (4) in control stand and secure by installing brake crank bolt (6)

- (3) Install plug button (11) in upper left side panel

- (4) Install cable guard (8) in control stand.

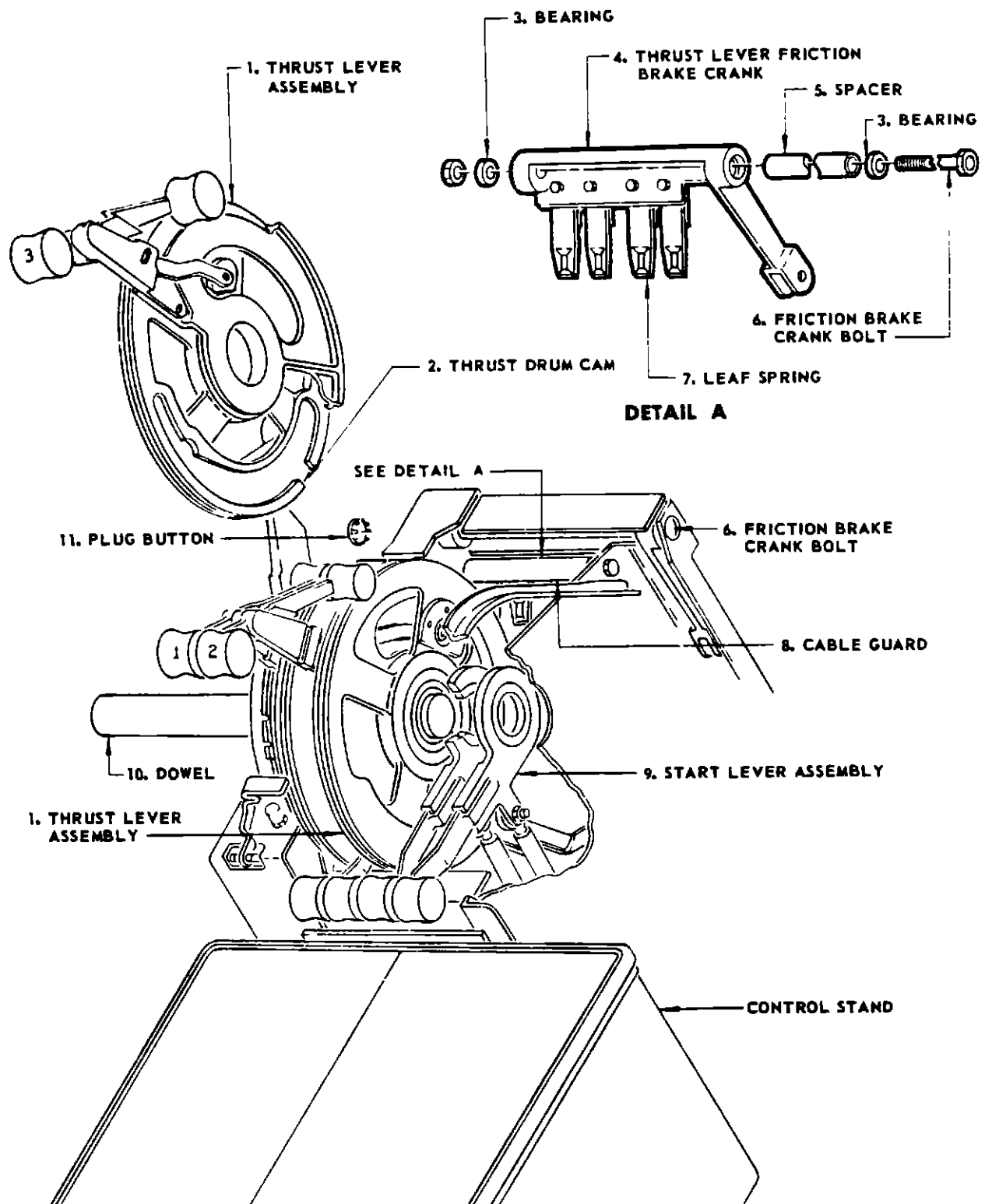
- (5) Install Nos. 3 and 4 thrust lever and Nos. 3 and 4 start lever in control stand.

(a) Position levers from right to left in following order No. 4 start, No. 4 thrust, No. 3 start and No. 3 thrust.

(b) Position spacers in the order they were removed.

(c) Advance left control shaft from right to left as levers and spacers are positioned.

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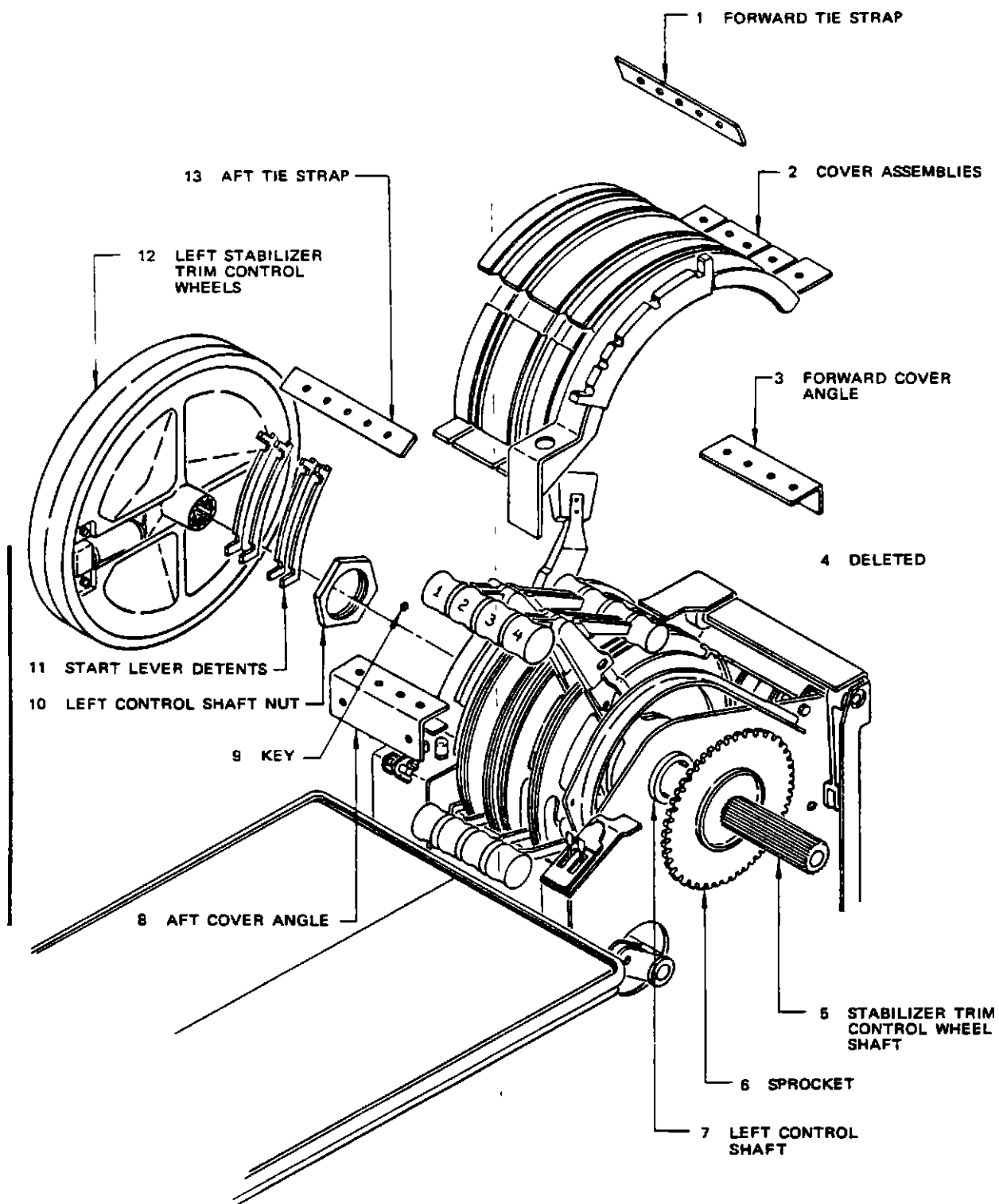
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- (6) Complete installation of left control shaft.
 - (a) Push left control shaft against dowel (10).
 - (b) Force dowel to left until clear of control stand.

CAUTION EXERCISE CARE TO PREVENT SPACERS FROM FALLING WHEN
DOWEL IS FORCED FROM CONTROL STAND.

- (7) Insert key (9, figure 202) in left control shaft and upper left side panel.
- (8) Install left control shaft nut (10). Torque nut from 200 to 300 pound-inches.
- (9) Bend leaf springs (7, figure 201) so each contacts the brake drums with equal load.
- (10) Install stabilizer trim control wheel shaft (5, figure 202) and sprocket (6) in left control shaft (7).
- (11) Place stabilizer trim chain on sprocket and install connector link (6, figure 203).
- (12) Deleted.
- (13) Install cover assemblies (2) on control stand.
- (14) Install mach trim warning light cover (11, figure 203) on cover assembly (2, figure 202).
- (15) Install forward and aft cover angles (3) and (8) on control stand.
- (16) Install forward and aft cover tie straps (1) and (13).
- (17) Install start lever detents (11).
- (18) Install left stabilizer trim control wheel (12) on stabilizer trim control wheel shaft (5).
- (19) Install right control shaft (1) with nut, spacer, stabilizer trim indicator, friction brake handle, and flap handle installed.
- (20) Connect eye bolt (4, figure 203) on friction brake link to friction brake crank (2) by installing bolt (3). Adjust eye bolt so, with friction brake handle in OFF position, brake shoes just contact brake drums.

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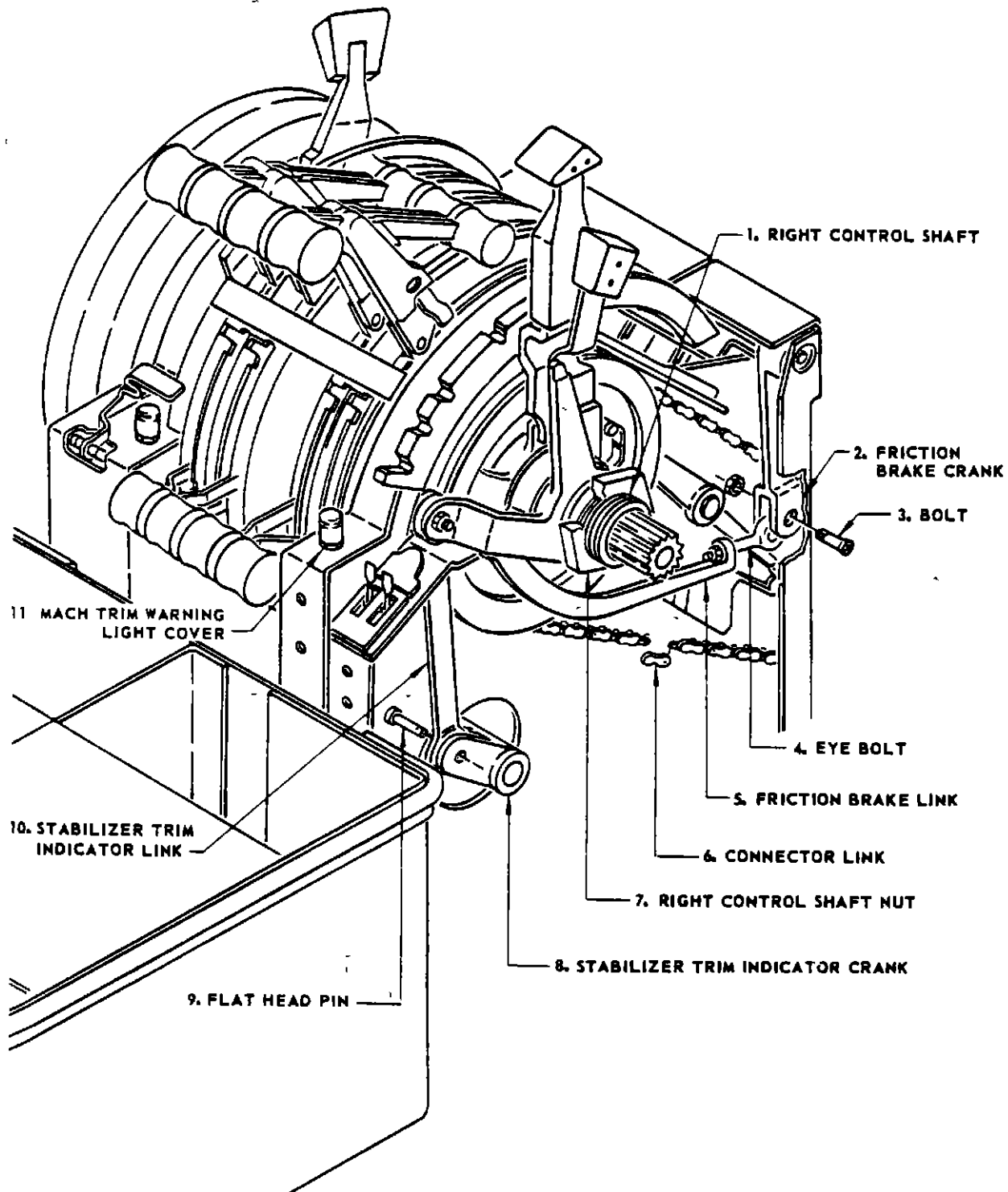


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Installation of Control Stand Center Components
 Figure 202

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Installation of Stabilizer Trim Indicator Components
Figure 203

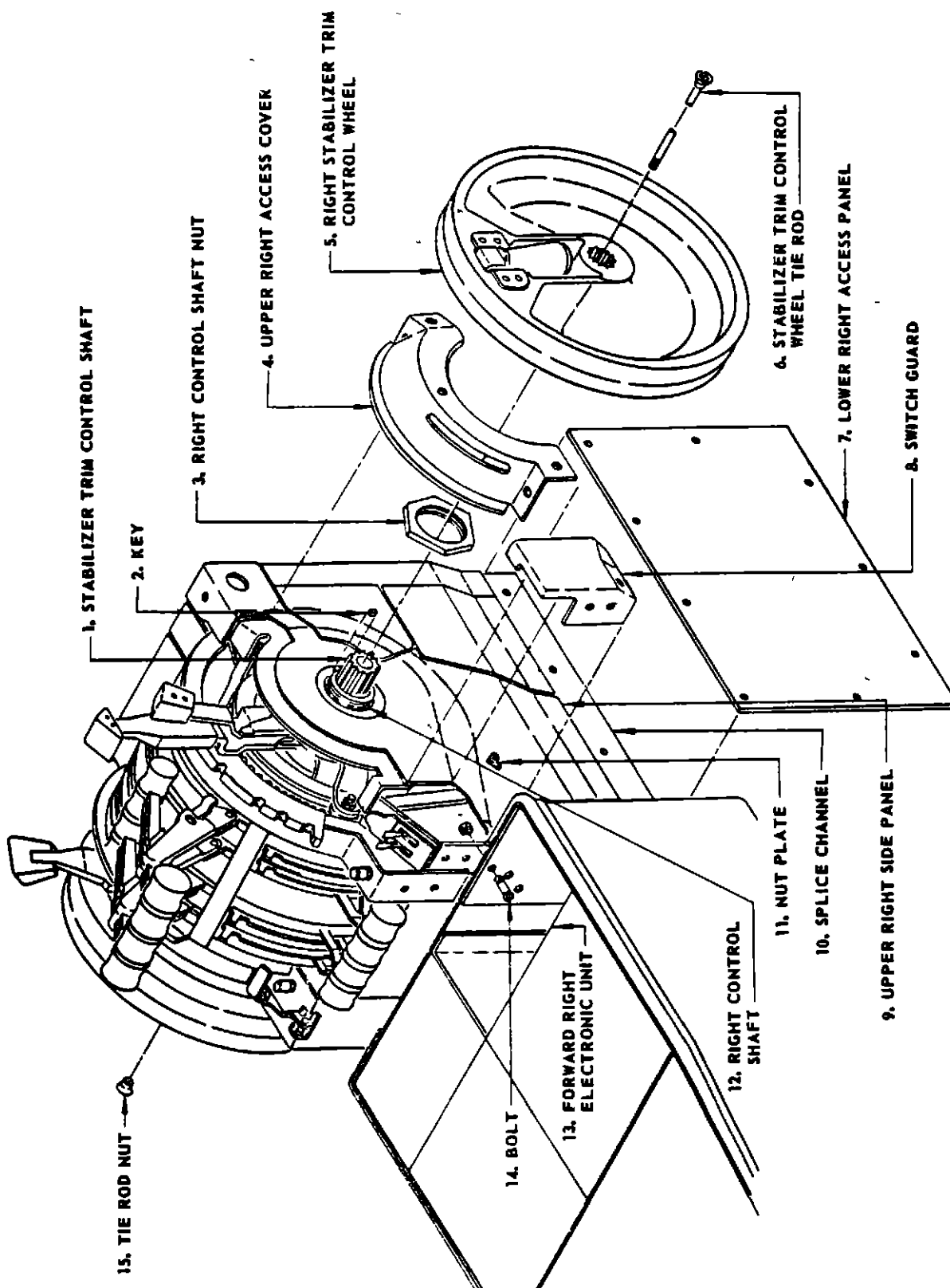
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- (21) Connect stabilizer trim indicator link (10) to stabilizer trim indicator crank (8) by installing flat head pin (9).
- (22) Remove right control shaft nut (7) from right control shaft (1).
- (23) Attach upper right side panel (9, figure 204). Secure panel with screws on each side only.
- (24) Position splice channel (10) at bottom edge of upper right panel (9) and install bottom screws through upper right side panel and splice channel.
- (25) Install key (2) in upper right side panel (9) and right control shaft (12).
- (26) Install right control shaft nut (3). Torque nut from 200 to 300 pound-inches.
- (27) Install bolt (14) through aft electronic panel and upper right side panel.
- (28) Install switch guard (8).
- (29) Replace forward right electronic unit (13) in aft electronic panel.
- (30) Install right access cover (4) on control stand.
- (31) Install lower right access panel (7) on control stand.
- (32) Install right stabilizer trim control wheel (5) on stabilizer trim control wheel shaft (1).

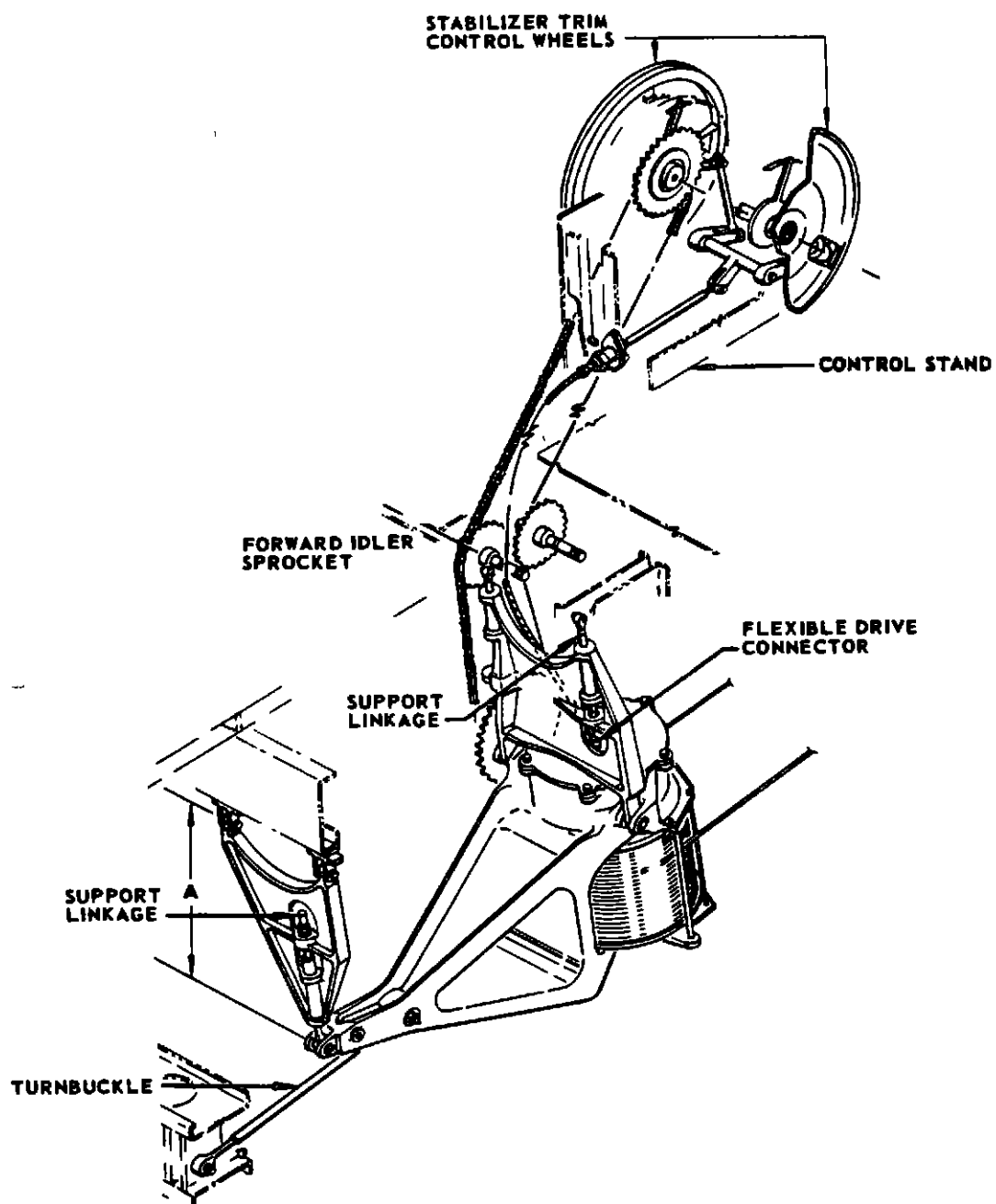
NOTE: Handles on stabilizer trim control wheels should be 90 ($\pm$ 5) degrees apart when installed on control stand.
- (33) Install stabilizer trim control wheel tie rod (6).
- (34) Install left stabilizer trim control wheel tie rod nut (15).
- (35) In lower nose compartment, tension trim chain assembly by adjusting support linkages to lower forward mechanism. (See figure 205.)
- (36) Check that stabilizer trim indicator position agrees with position of stabilizer. If out of adjustment see 27-10-0, "Adjustment/Test Stabilizer Trim System."

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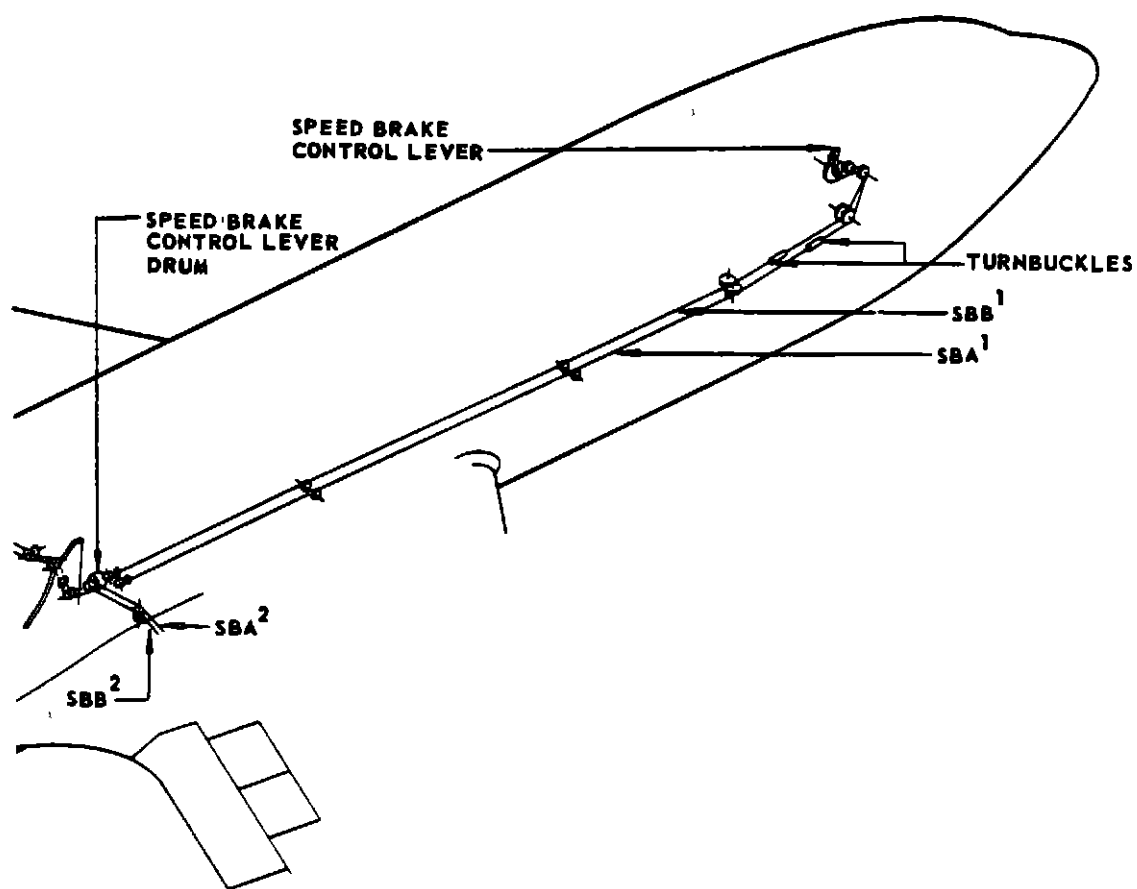
Installation of Control Stand Access Panels
Figure 204

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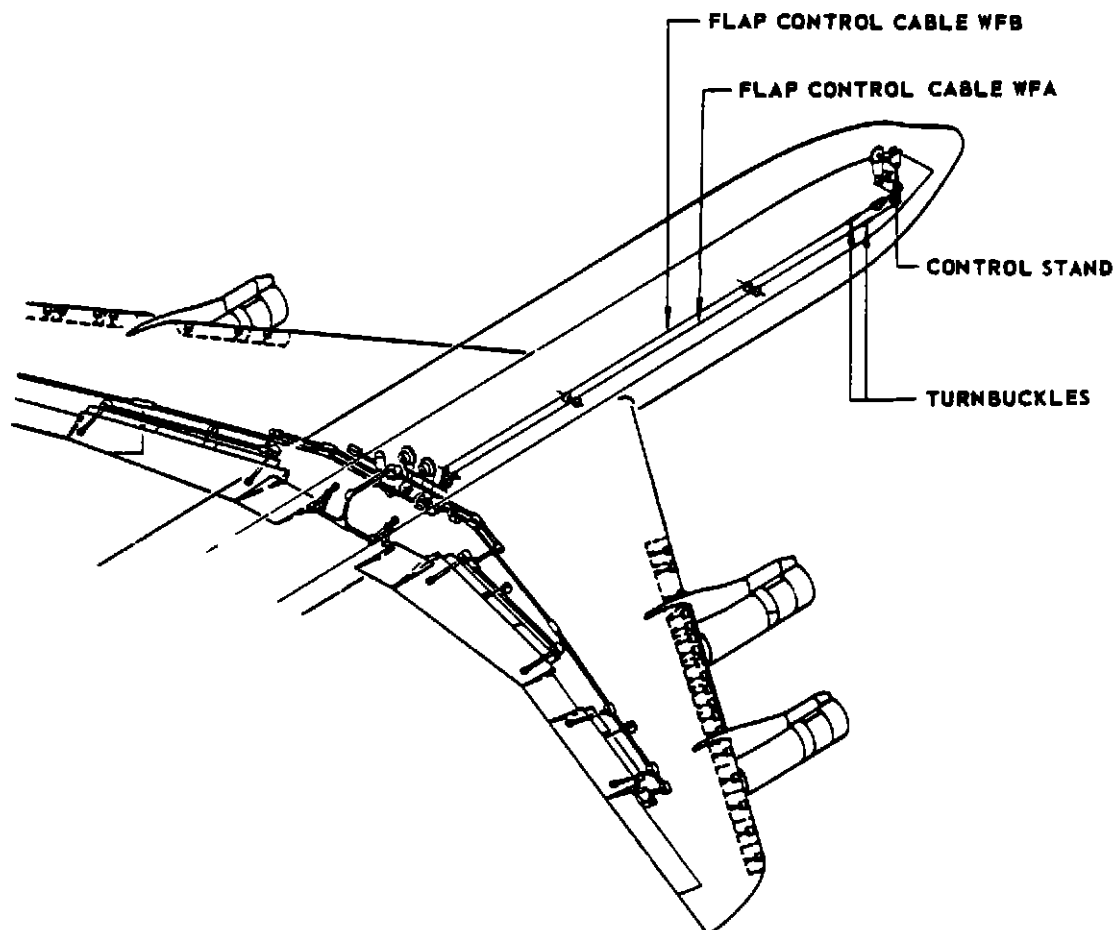


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- (37) Tension speed brake control cables by adjusting turnbuckles in lower nose compartment. (See figure 206.)
- (38) Tension wing flap control cables by adjusting turnbuckles in lower nose compartment. (See figure 207.)
- (39) Connect thrust control cables for engines No. 3 and No. 4. Tension all thrust control cables by adjusting turnbuckles. (See figure 208.)
- (40) Tension all engine start cables by adjusting turnbuckles.
- (41) Remove rigging pin from center speed brake control drum and drum support in right wheel well. (See figure 209.)
- (42) Remove rigging pin from each thrust reverser main valve actuating cam and strut bracket and each engine start crank and bracket. (See figure 210.)
- (43) Remove rigging pins from each control valve support bracket and follow-up cable drum. (See figure 211.)
- (44) Replace nacelle strut access panels.
- (45) Close right engine cowl panel.

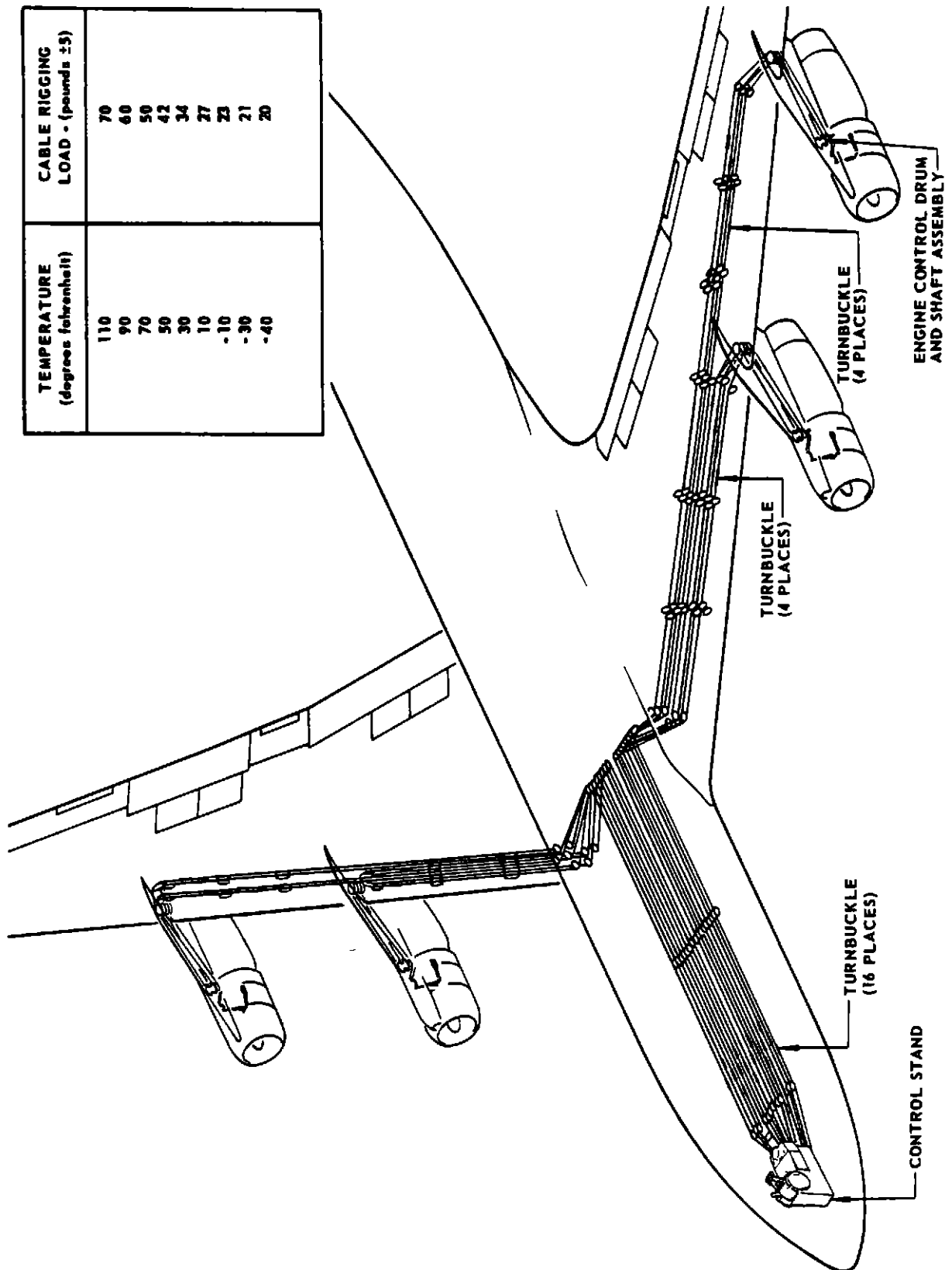


TEMP	RIGGING LOAD LB (± 10 LB)
110	119
90	111
70	100
50	92
30	84
10	75
-10	67
-30	59
-40	53

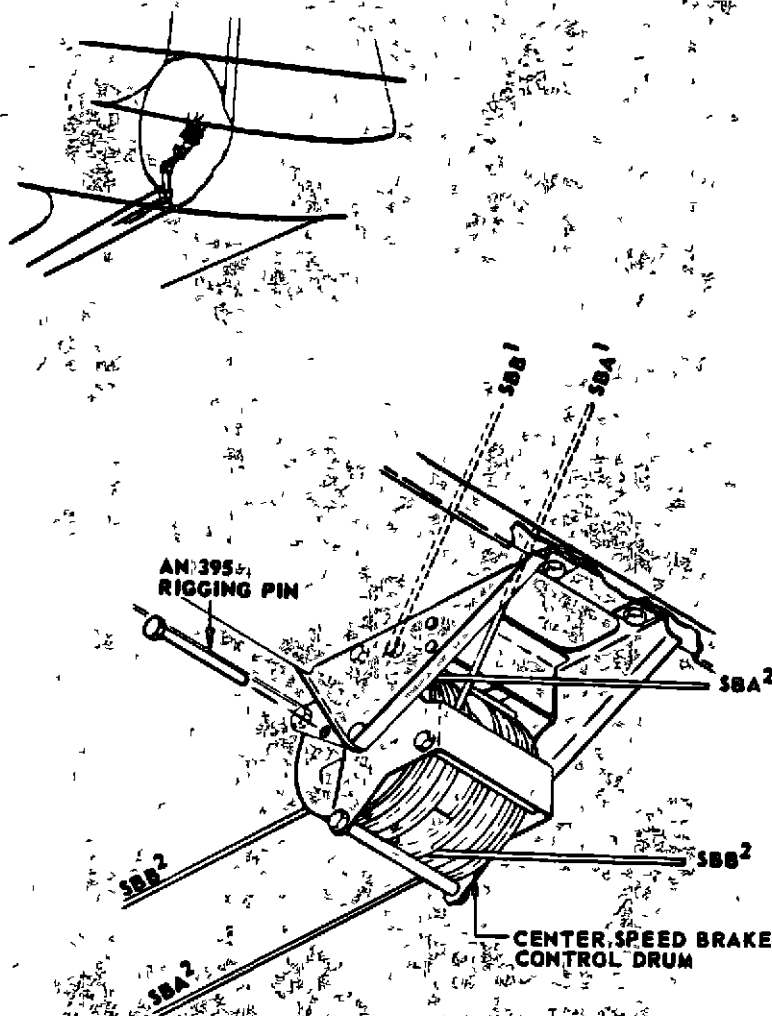


TEMP °F	RIGGING LOAD ± 10 LBS WFA, WFB
100	73
90	61
70	50
50	40
30	32
+ 10	25
- 10	19
- 30	15
- 40	14

TEMPERATURE (degrees fahrenheit)	CABLE RIGGING LOAD - (pounds ± 5)
110	70
90	60
70	50
50	42
30	34
10	27
-10	23
-30	21
-40	20

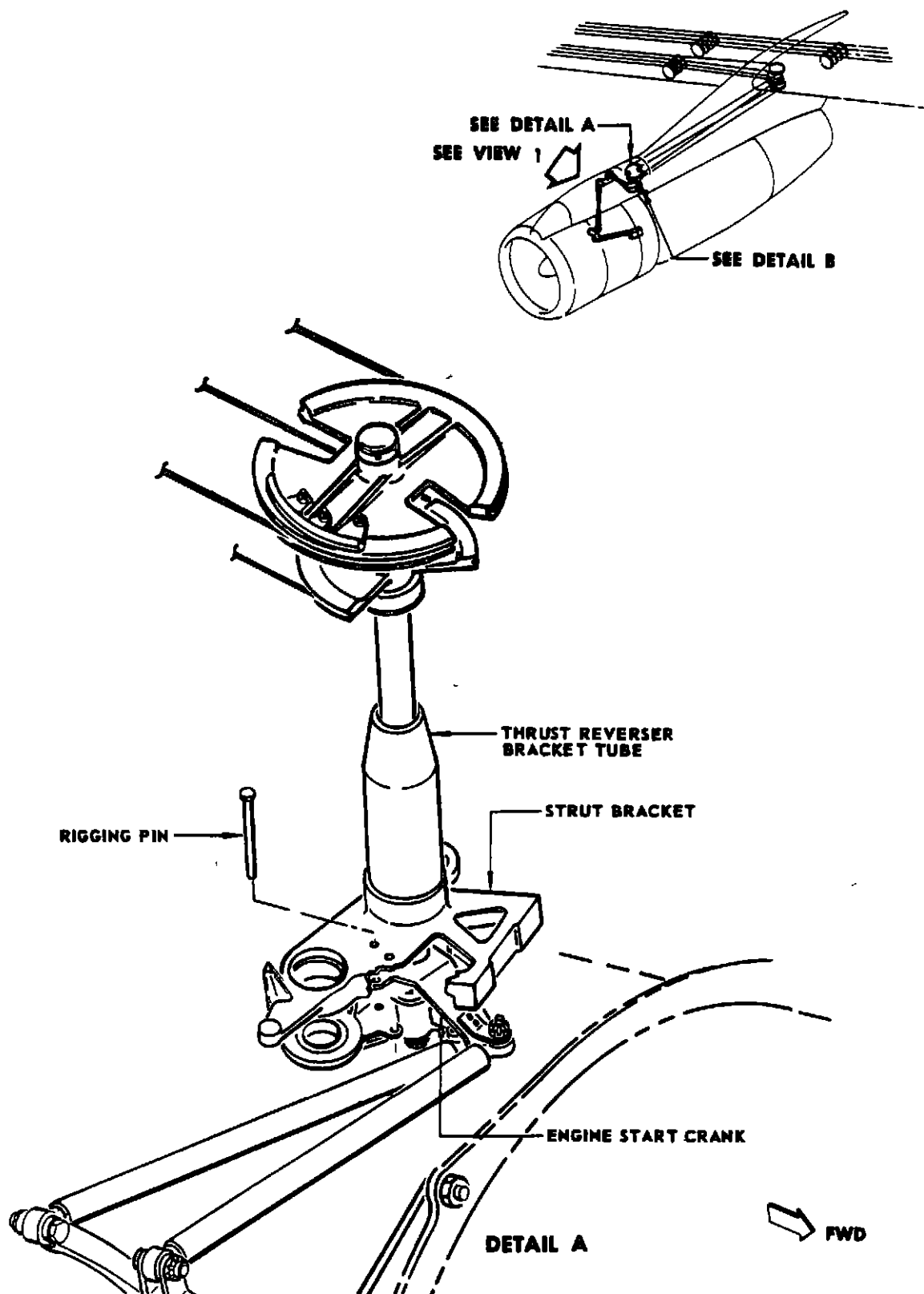


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Center Speed Brake Control Drum Rigging Pin Installation
Figure 209

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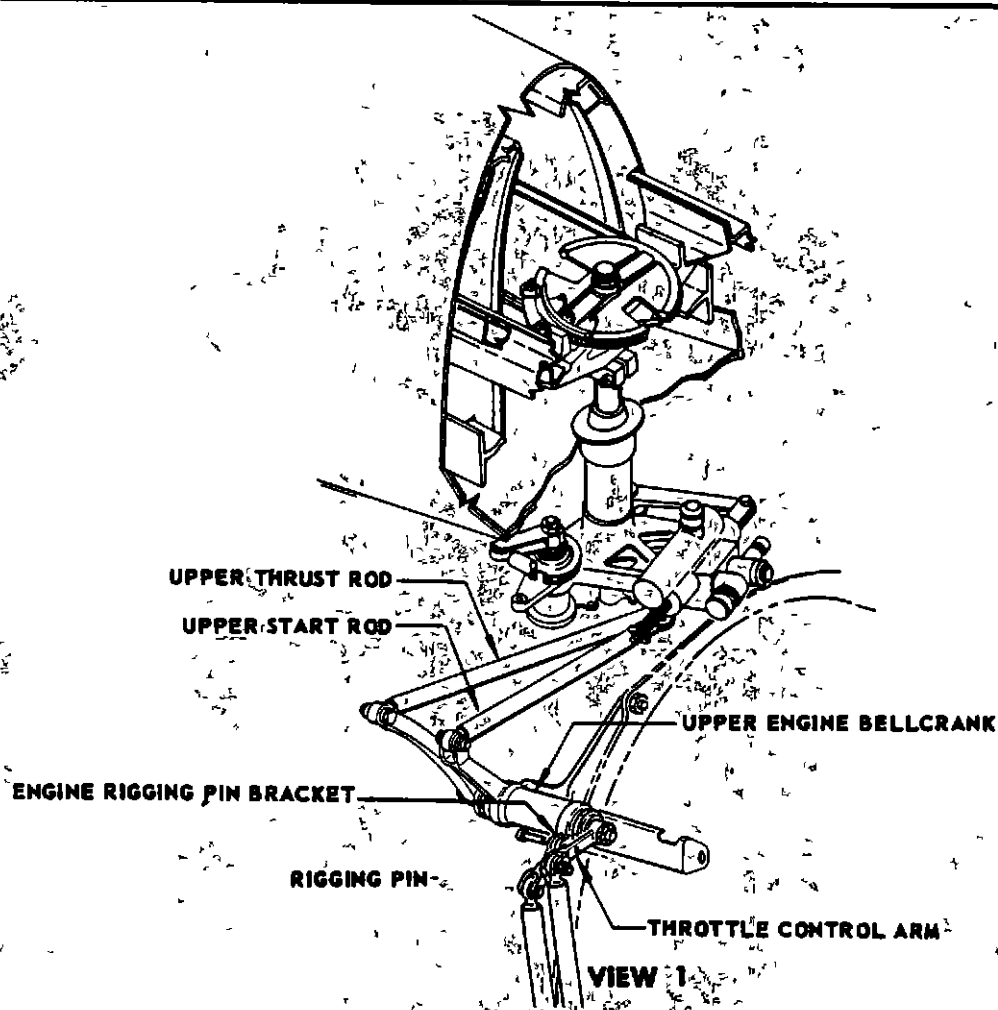
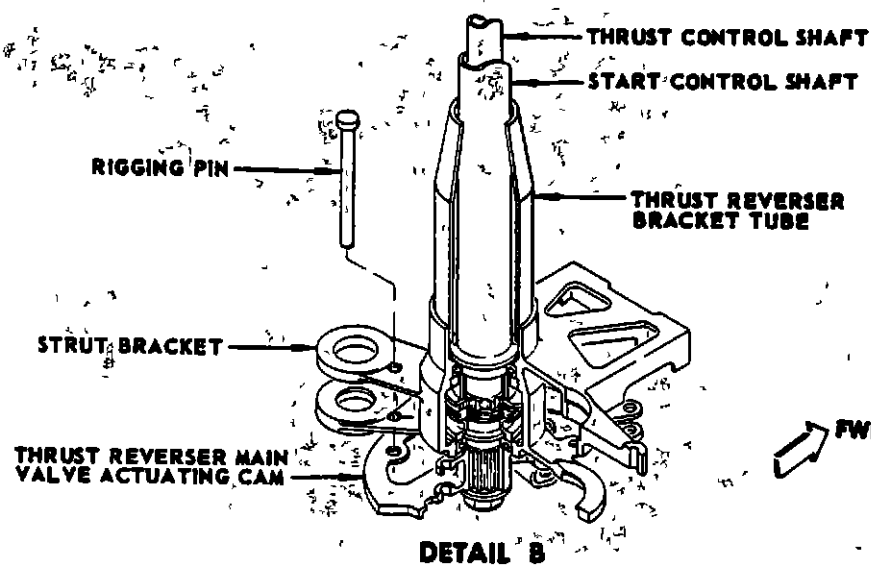


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Revised

Throttle System Rigging Pin Installation
Figure 210 (Sheet 1 of 2)

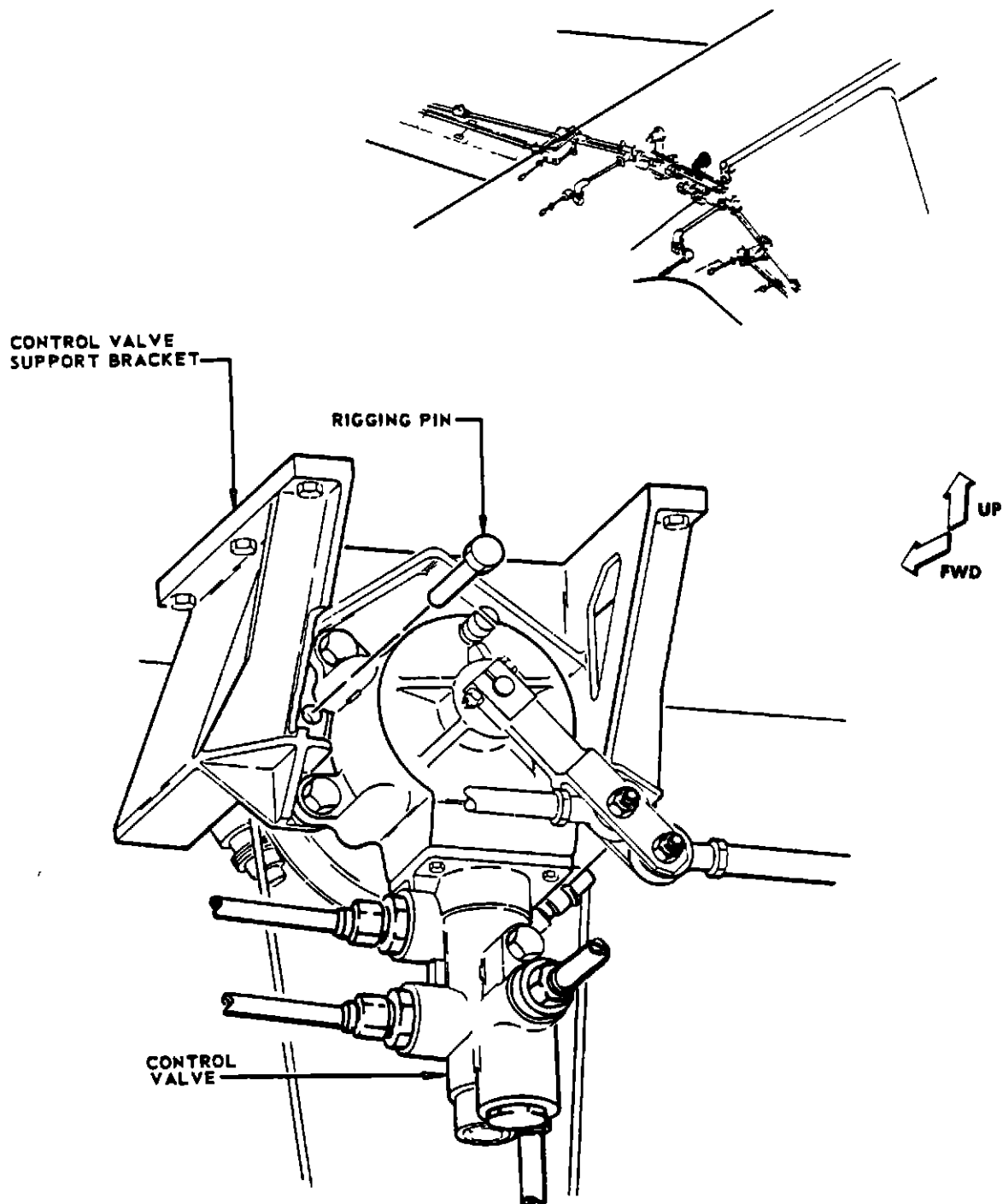
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Throttle System Rigging Pin Installation
 Figure 210 (Sheet 2 of 2)

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THRUST LEVER FRICTION BRAKE - APPROVED REPAIRS

1. General

- A. The friction brake shoe assemblies attached to the thrust lever brake crank may occasionally require replacement due to breakage or loss of tension of the leaf springs, and/or uneven wear of the brake shoes. Replacement may be made on the airplane without removing the thrust levers or thrust lever friction brake crank from the control stand.

2. Prepare for Friction Brake Shoe Replacement

- A. Remove left stabilizer trim control wheel tie rod nut (15, figure 801) and pull stabilizer trim control wheel tie rod (9) from stabilizer trim control wheel shaft (1).
- B. Remove left and right stabilizer trim control wheels (8).
- C. Remove left and right upper access covers (7).
- D. Remove left and right lower access panels (10).
- E. Remove right upper access panels (12 and 13).
- F. Remove switch guard (11).
- G. Remove start lever detents (11, figure 802) from cover assemblies (2).
- H. Remove forward and aft cover tie straps (1 and 13, figure 802).
- I. Remove forward and aft cover angles (3 and 8, figure 802).
- J. Disconnect Mach trim warning light cover (14, figure 801).
- K. Lift cover assemblies (2, figure 802) from control stand.
- L. Detach eyebolt (5) from friction brake crank (3) by removing bolt (4).

3. Replace Friction Brake Shoes

- A. Remove the four bolts which secure thrust lever friction brake shoe assemblies to crank and remove four brake shoe assemblies and the two backup leaf springs.

CAUTION USE CARE IN HANDLING ALL LOOSENED PARTS. LOST PARTS MAY CAUSE CONTROL LEVER INTERFERENCE IN THE AISLE STAND.

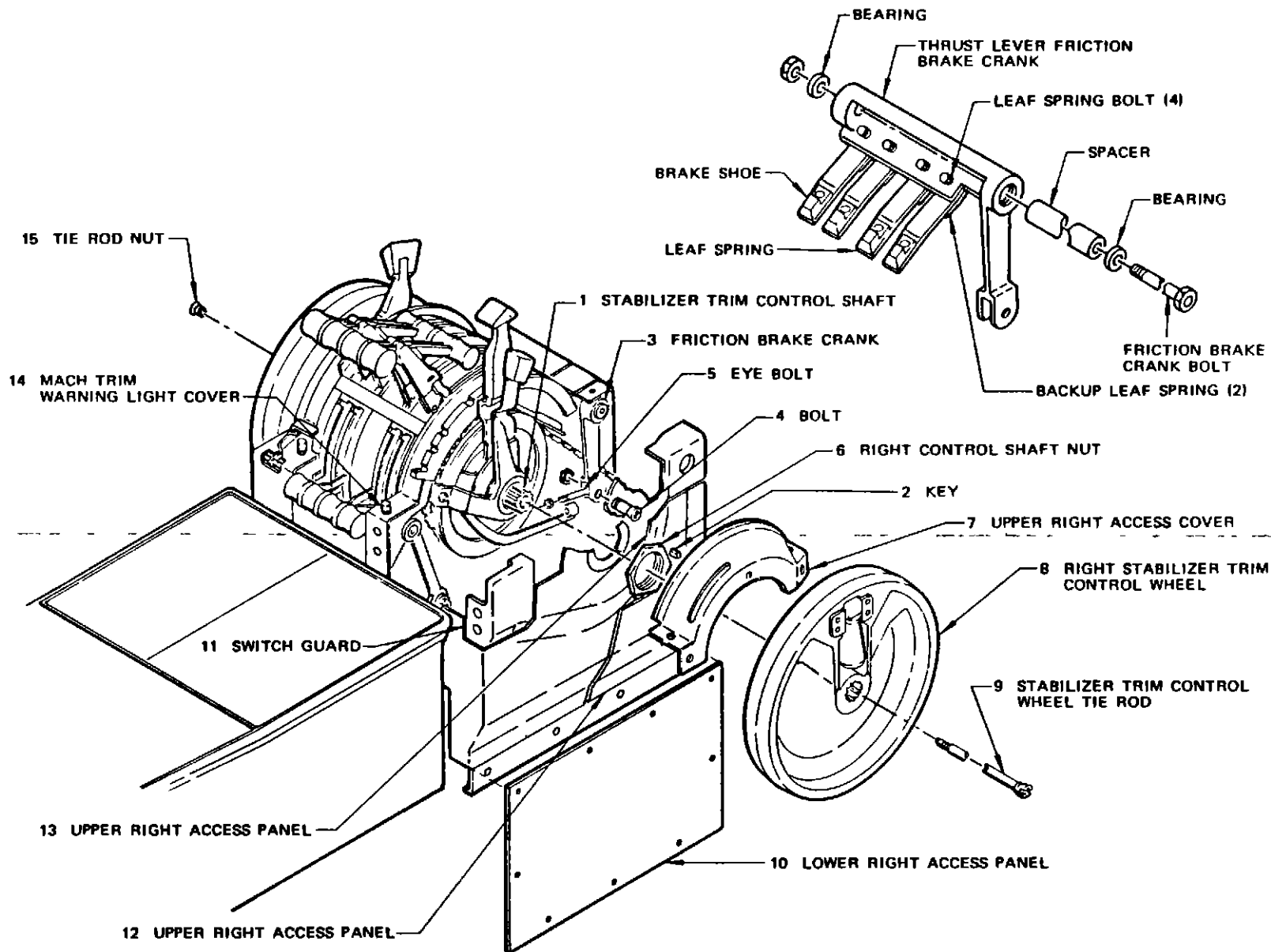
NOTE: There are four individual shoe assemblies, one for each thrust lever, and they may be replaced individually. This replacement may also require loosening of the second bolt through the backup leaf spring.

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- B. Install the four replacement friction brake shoe assemblies with their two backup leaf springs. Secure with four bolts with a washer under both the bolt head and locknut.
- C. Bend leaf springs so each brake shoe contacts the brake drums with equal load.
- D. Adjust eyebolt (5) so, with the friction brake handle in OFF position and brake shoes just contacting brake drums, the friction brake bolt (4) can be installed.

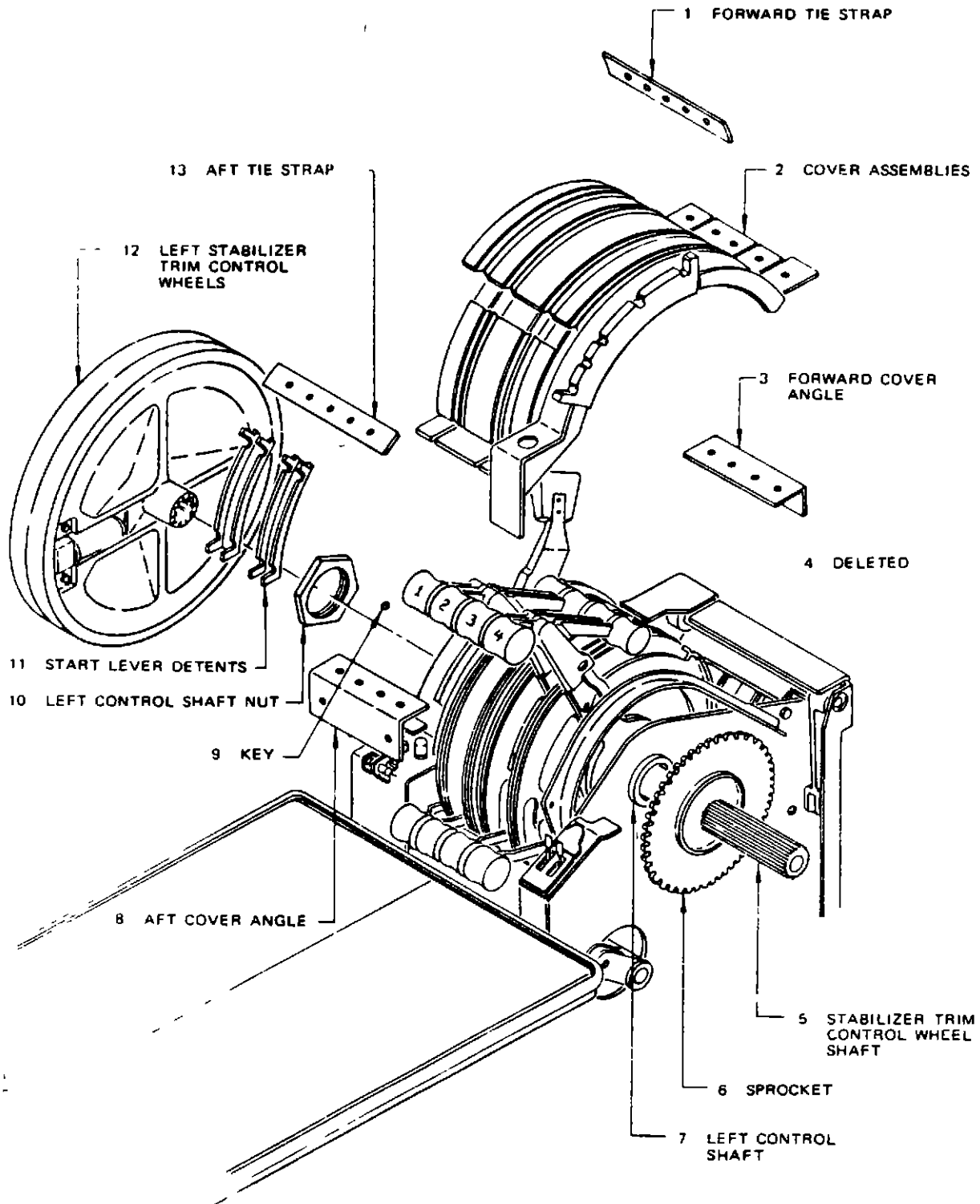
4. Restore Airplane to Normal

- A. Connect eyebolt (5) to friction brake crank (3) by installing bolt (4).
- B. With the brake ON, check that the load required to move each thrust lever is increased by 2 to 4 pounds above the load with the brake OFF.
- C. Install cover assemblies (2, figure 802) on control stand.
- D. Install Mach trim warning light cover (14, figure 801) on cover assembly (2, figure 802).
- E. Install forward and aft cover angles (3 and 8, figure 802).
- F. Install forward and aft cover tie straps (1 and 13, figure 802).
- G. Install start lever detents (11, figure 802).
- H. Install switch guard (11).
- I. Install upper right access panels (12 and 13).
- J. Install left and right lower access panels (10).
- K. Install left and right upper access covers (7).
- L. Install left and right stabilizer trim control wheels (8) with crank handles located 90 (± 15) degrees apart.
- M. Install stabilizer trim control wheel tie rod (9) in right end of stabilizer trim control wheel shaft (1) and install tie rod nut (15).
- N. Check for correct operation and full movement of thrust and start levers.



Installation of Control Stand Access Panels
and Friction Brake Shoes
Figure 801

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Installation of Control Stand Center Components
 Figure 802

ENGINE CONTROL DRUM AND SHAFT ASSEMBLY - MAINTENANCE PRACTICES1 Removal/Installation Engine Control Drum and Shaft Assembly

A. General

- (1) The engine control drum and shaft assemblies for the inboard and outboard engines are identical except for differences in mounting brackets. Therefore, only one procedure for removal/installation is given.
- (2) No detailed procedure for installing new bearings in the engine control drum and shaft assembly is given; however, during installation of the drum and shaft assembly new bearings may be installed as necessary.

B. Equipment and Materials

- (1) Tensiometer - 0 to 100 pounds capacity
- (2) Lock Assembly, Leading Edge Flap - F70144 or equivalent
- (3) Kit-Wrench Engine Control - F71435 or equivalent

C. Remove Engine Control Drum and Shaft Assembly (See figure 201.)

- (1) Remove power plant. See Chapter 71, Power Plant.
- (2) Remove access panel 3716 or 1739 from nacelle strut. See Chapter 12, Access Doors and Panels.
- (3) Clamp thrust levers in idle no load position
- (4) Clamp start levers in cutoff no load position.
- (5) Loosen engine control cables by use of turnbuckles in wing leading edge.
 - (a) For access to turnbuckles in wing leading edge, lower wing leading edge flaps.
 - 1) Pressurize utility hydraulic system.
 - 2) Position flap control lever to DOWN.



- 3) Disconnect electrical connections from leading edge flap bypass valves and disconnect pushrod from leading edge flap valve. Install leading edge flap lock assembly.

WARNING: ASSURE THAT LEADING EDGE FLAP LOCK ASSEMBLY IS PROPERLY INSTALLED TO PREVENT INJURY TO PERSONNEL OR DAMAGE TO AIRPLANE.

NOTE: Leading edge flap bypass valves and leading edge flap valve are located against the forward bulkhead in the left wheel well.

Access to turnbuckles for inboard engines are under flaps No. 1 and 2, for outboard engines under slats No. 6 and 7.

- (6) Deleted.
 - (7) Disconnect upper thrust rod from thrust reverser main valve actuating cam.
 - (8) Disconnect upper start rod from engine start shaft crank.
 - (9) Remove lockring and remove cap nut from upper end of throttle control shaft. Use spanner wrench F71435-1 or equivalent.
 - (10) Remove throttle drum from throttle control shaft.
 - (11) Disconnect throttle control cables from throttle drum and tag cables to ensure correct replacement.
 - (12) Break lockwire and remove throttle shaft plug from lower end of shaft.
 - (13) Remove thrust reverser main valve actuating cam from lower end of throttle control shaft.
 - (14) Remove throttle control shaft lower bearing from shaft by pushing down on shaft. Also, remove shaft seal.
- NOTE:** The thrust reverser main valve actuating cam stop on the strut bracket may have a clip and shim attached. If this clip interferes with bearing removal, it should be removed.
- (15) Remove throttle control shaft by lowering clear of throttle shaft upper bearing and concentric engine start shaft.
 - (16) Remove cable guards and remove start control cables from engine start drum. Tag cables to ensure correct replacement.
 - (17) Remove lockring and engine start shaft nut from lower end of engine start shaft. Use wrench F71435-2 or equivalent.

- (18) Remove spacer (23) from engine start shaft.
- (19) Remove engine start shaft crank (16) from engine start shaft (2).
- (20) Remove spacer (15) from engine start shaft (2).
- (21) Remove lockwire and engine start nut (14) from strut bracket (13). Use wrench F71435-3 or equivalent.
- (22) Remove lockring (25).

NOTE Engine start shaft (2) may have to be moved down to remove lockring.

- (23) Remove engine start drum retaining nut (9) from engine start shaft (2). Hold retaining nut (9), use spanner wrench F71435-4 or equivalent, and turn start shaft from lower end using spline wrench F71435-5 or equivalent.

CAUTION INSURE START SHAFT MOVES DOWN AS START DRUM RETAINING NUT LOOSENS. OTHERWISE SUPPORT BRACKET MAY BE DAMAGED.

- (24) Remove engine start shaft lower bearing (24) by pushing down with engine start shaft.

NOTE Removal may require driving bearing from shaft.

- (25) Lower engine start shaft (2) until clear of upper support bracket (3) and remove engine start drum (10) and engine start shaft upper bearing (11).

NOTE If bearing sticks to shaft, move shaft downward and drive bearing from shaft at thrust reverser bracket tube (12).

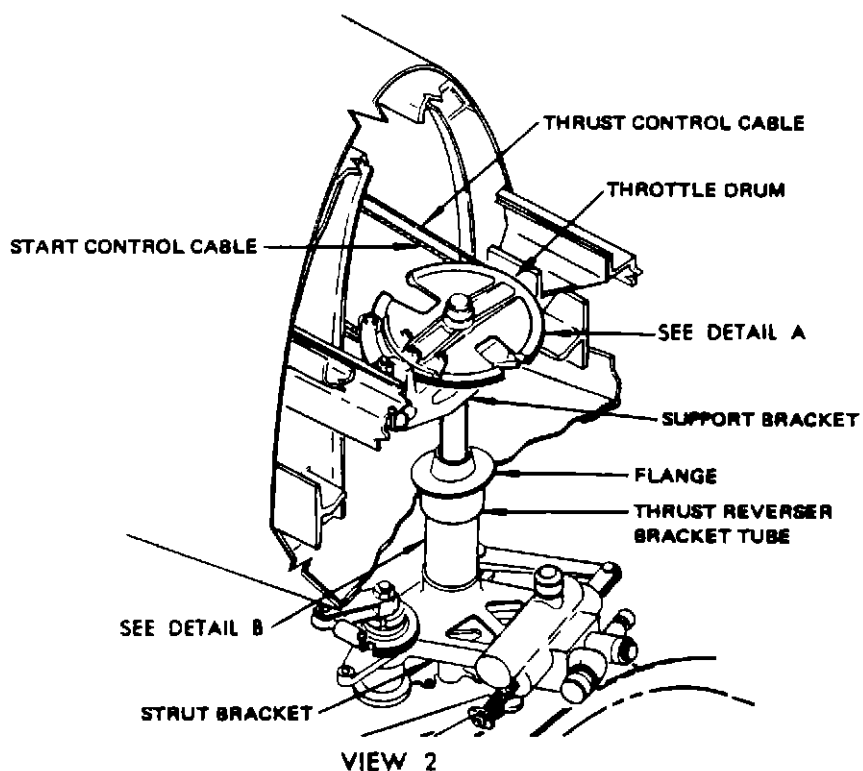
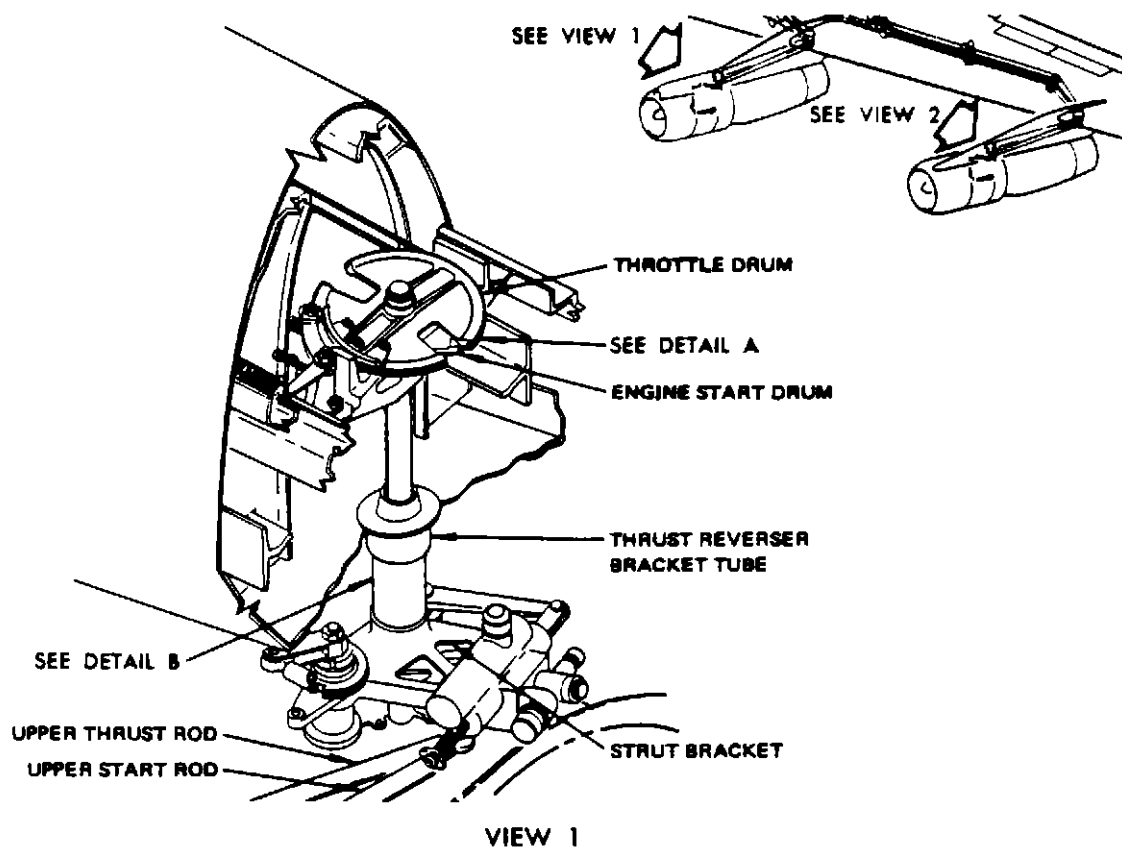
- (26) Remove engine start shaft (2) by lowering through thrust reverser bracket tube (12).
- (27) Remove upper throttle shaft bearing (4) by removing support bracket (3).

D. Install Engine Control Drum and Shaft Assembly.

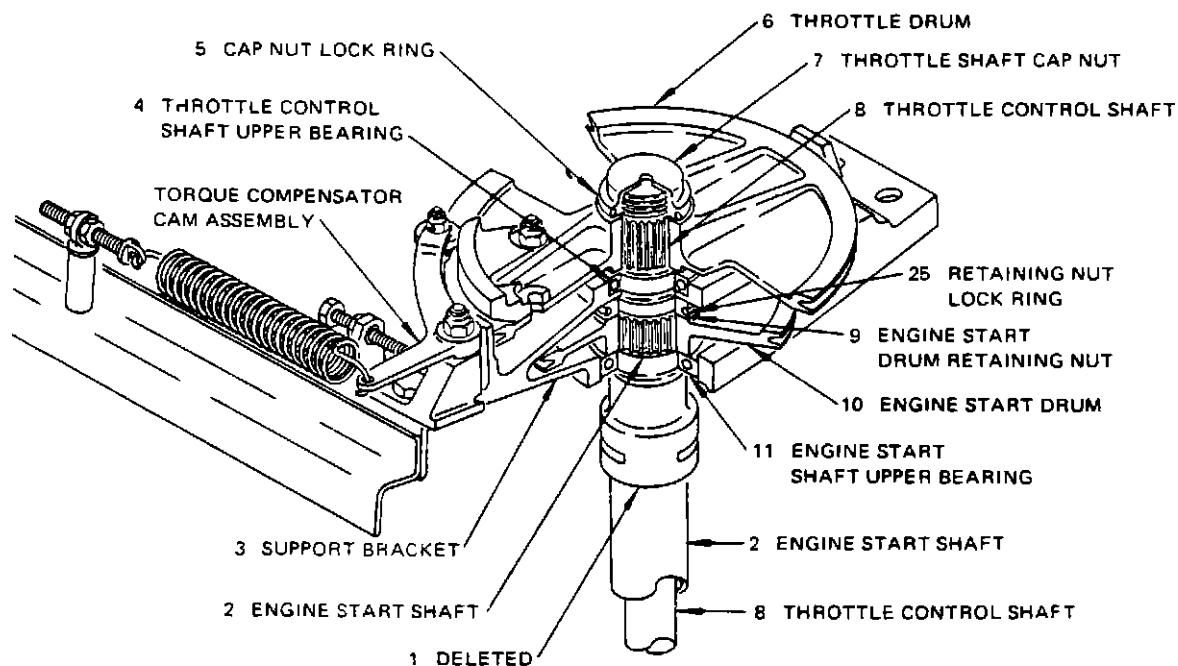
- (1) Install assembly of upper support bracket (3, figure 201) and upper throttle shaft bearing (4).

CAUTION TO PREVENT A POSSIBILITY OF BEARING SEIZURE, POSITION BEARING WITH BALL LOADING SLOT UPWARD.

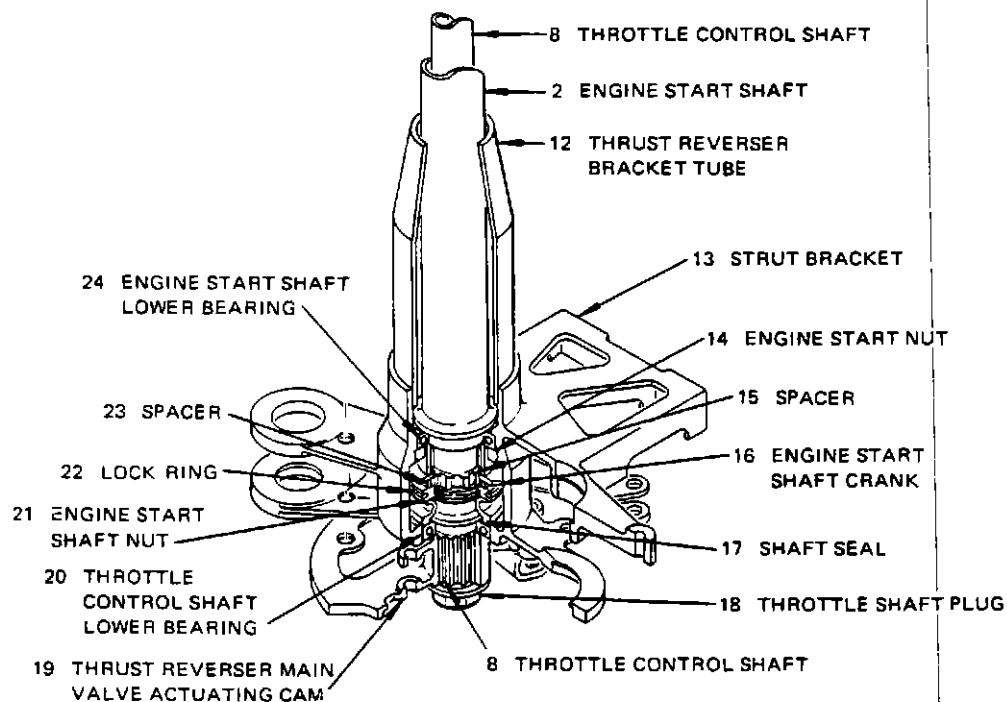
IN THE FOLLOWING ASSEMBLY STEPS, ENSURE THAT ALL COMPONENTS MOVE FREELY. IF BINDING OCCURS, CHECK WHETHER THE UPPER SUPPORT BRACKET (3) IS INSTALLED WITH THE CASTING AND LETTERED PART NUMBER UPWARD AND TO THE RIGHT FOR INBOARD ENGINES AND UPWARD AND TO THE LEFT FOR OUTBOARD ENGINES. IT MAY BE NECESSARY TO ROTATE (3) 180 DEGREES HORIZONTALLY TO ACHIEVE A FREE FIT.



Engine Control Drum and Shaft Assembly
Figure 201 (Sheet 1)



DETAIL A



DETAIL B



EFFECTIVITY

TURBOFAN

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- (2) To facilitate lockring installation mark location of respective lockring holes of start and throttle shafts on engine start and throttle drums and engine start shaft crank.
- (3) Position engine start shaft (2) inside thrust reverser bracket tube (12) leaving upper end of shaft below upper support bracket (3).
- (4) Place engine start shaft upper bearing (11) in position on engine start shaft (2).

CAUTION TO PREVENT A POSSIBILITY OF BEARING SEIZURE, POSITION BALL BEARING WITH BALL LOADING SLOT UPWARD.

NOTE A spherical bearing installed on some airplanes may be positioned with either side upward.

- (5) Position engine start drum (10) inside upper support bracket (3) and push engine start shaft (2) upward through drum (10) until two threads of shaft show above drum.
- (6) Install engine start drum retaining nut (9) on engine start shaft, torque within 290 to 410 pound-inches, and install lockring (25) on nut. Torque may be increased to 660 pound-inches to align lockring holes. To facilitate lockring installation, hole in shaft may be vertically elongated to 0.15 inch. Apply torque on lower end of start shaft Use spanner wrench F71435-4 and wrench F71435-5 or equivalent.
- (7) Install engine start shaft lower bearing (24) on engine start shaft.

CAUTION TO PREVENT A POSSIBILITY OF BEARING SEIZURE, POSITION BEARING WITH BALL LOADING SLOT UPWARD.

- (8) Install engine start nut (14) in strut bracket (13), torque within 290 to 410 pound-inches and lockwire. Use wrench F71435-3 or equivalent
- (9) Position spacer (15) around shaft (2) below lower bearing (24) and install engine start shaft crank (16) on engine start shaft (2).
- (10) Position spacer (23) around shaft (2) below crank (16), install engine start shaft nut (21) on shaft and torque within 290 to 410 pound-inches Use wrench F71435-2 or equivalent.
- (11) Install lockring (22) on engine start shaft nut (21). Torque may be increased to 660 pound-inches to align lockring holes. To facilitate lockring installation, hole in shaft may be vertically elongated to 0.15 inch.

NOTE Lock ring tang should not protrude thru engine start shaft or interference with throttle control shaft will result. Check that lock ring tang is flush with inner surface of engine start shaft within +0.005/-0.02 inch. Trim tang end if necessary and paint with EMS 10-11, Type I primer.



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- (12) Connect start control cables to engine start drum and install cable guards. Remove tags from cables.
- (13) Install throttle control shaft (8) in mounting position by inserting upward through concentric engine start shaft (2) and through upper throttle shaft bearing (4).
- (14) Connect thrust control cables to throttle drum (6) and remove tags from cables.
- (15) Mount throttle drum (6) on splines on throttle control shaft (8).
- (16) Install throttle shaft cap nut (7) on throttle control shaft (8) and tighten finger tight.
- (17) Install shaft seal (17) on lower end of engine start shaft (2).
- (18) Position throttle control shaft lower bearing (20) around shaft (8) and against shaft seal (17).

CAUTION TO PREVENT A POSSIBILITY OF BEARING SEIZURE, POSITION BALL BEARING WITH BALL LOADING SLOT UPWARD.

NOTE A spherical bearing installed on some airplanes may be positioned with either side upward.

- (19) Install thrust reverser main valve actuating cam (19) on throttle control shaft (8).

NOTE New bearings may be installed on cam before installation if desired.

- (20) Install throttle shaft plug (18) on lower end of throttle control shaft (8), torque within 290 to 410 pound-inches.
- (21) Hold throttle shaft cap nut (7) and apply torque at throttle shaft plug (18) on lower end of throttle shaft. Use spanner wrench F71435-1 or equivalent and torque within 290 to 410 pound-inches.

NOTE Insure throttle shaft cap nut clamps throttle drum and does not bottom on throttle shaft. If nut bottoms on shaft, cutoff 0.03 inch from upper end of throttle shaft.

- (22) Install lockring (5) on throttle shaft cap nut (7). Torque may be increased to 660 pound-inches to align lockring holes. To facilitate lockring installation, hole in shaft may be vertically elongated to 0.15 inch.
- (23) Lockwire throttle shaft plug (18) at lower end of throttle shaft.

NOTE If clip and shim were removed from thrust reverser main valve actuating cam stop, it should be replaced. Lockwire retaining screw

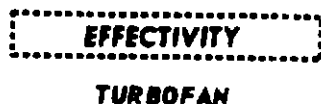


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EFFECTIVITY

TURBOFAN

- (24) Attach upper start rod to engine start shaft crank (16). Install with adjustable end away from crank.
- (25) Attach upper thrust rod to thrust reverser main valve actuating cam (19). Install with adjustable end away from cam.
- (26) Deleted
- (27) Insert rigging pin through strut bracket (13) and thrust reverser main valve actuating cam (19).
- (28) Insert rigging pin through engine start shaft crank (16) and strut bracket (13).
- (29) Adjust throttle and start control cables so with thrust levers in idle no load position and start levers in cutoff no load position and respective rigging pins fit freely when the cables are rigged to tension specified in 76-2-0 figure 201A. Measure cable load with tensiometer.
- (30) Remove rigging pins.
- (31) Remove clamps from engine thrust levers.
- (32) Remove clamps from engine start levers.
- (33) Remove leading edge flap lock assembly. Connect electrical connectors to leading edge flap bypass valves and connect pushrod to leading edge flap valve.
- (34) Replace power plant. See Chapter 71, "Power Plant."
- (35) Adjust throttle system. Refer to 76-2-0, "Adjust Throttle System."
- (36) Replace access panels. See Chapter 12, "Access Doors and Panels."



ENGINE CONTROL BELL CRANK ASSEMBLY - MAINTENANCE PRACTICES

1. Removal/Installation Engine Control Bell Crank Assembly

A. General

- (1) Two bell crank assemblies are mounted on each engine. Since these assemblies are identical in appearance and operation except for crank arms and supporting structure, therefore, only one procedure for removal/installation is given.

B. Equipment and Materials

- (1) Rigging pins are MS20392-4 or AN5 bolts.

C. Remove Engine Control Bell Crank Assembly.

- (1) Open engine right cowl panel.
- (2) Install rigging pin through support bracket and thrust reverser main valve actuating cam on engine control drum and shaft assembly.
- (3) Install rigging pin through support bracket and engine start crank on engine control drum and shaft assembly
- (4) Detach engine start and thrust control rods from bell crank assembly. (See figure 201.)

NOTE: Air ducts may be disconnected as necessary for access.

- (5) Release fasteners attaching bell crank assembly to supporting structure and remove bell crank assembly.

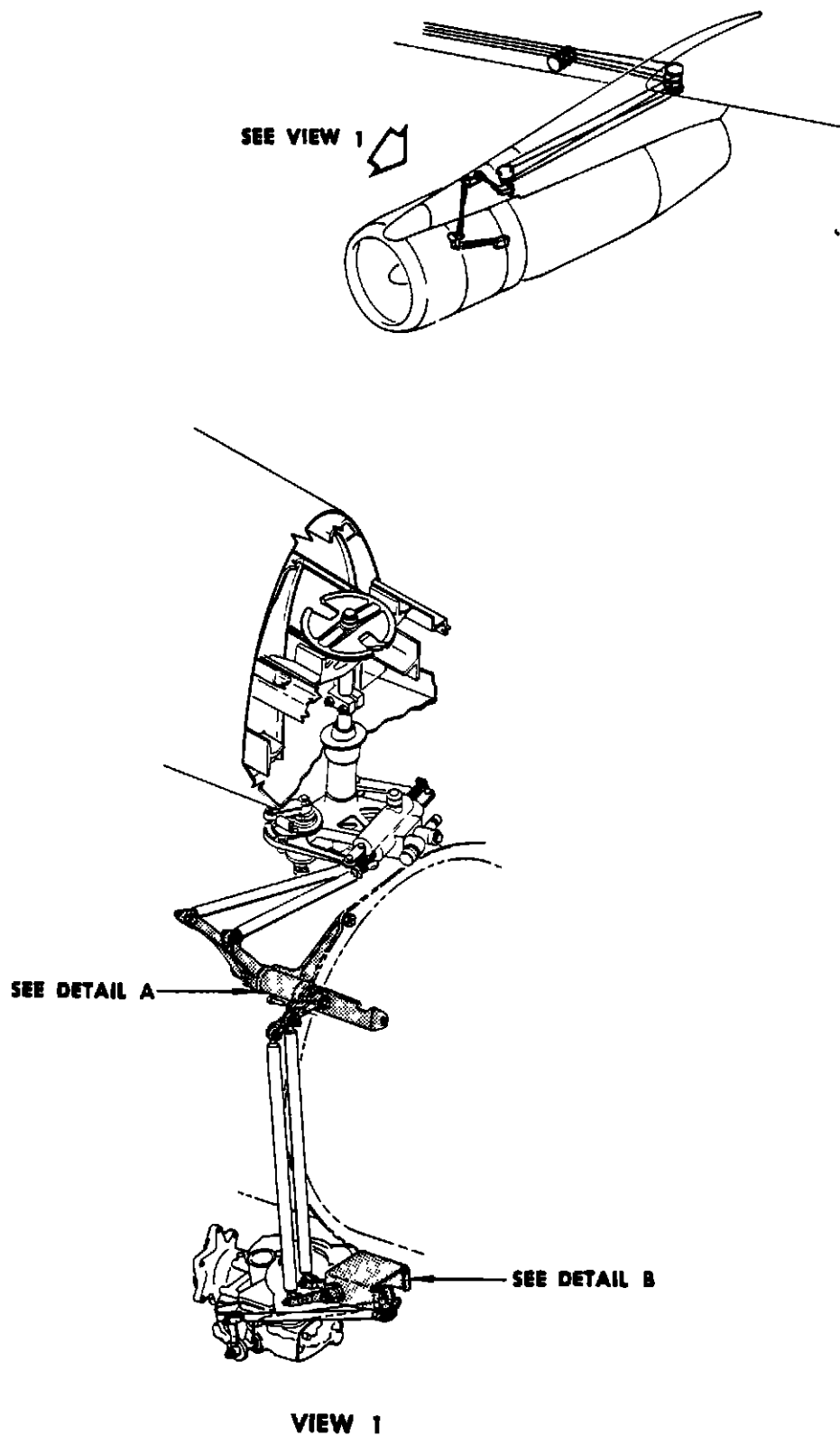
NOTE. Removal of upper bell crank assembly requires disconnecting the right forward engine support link. See Chapter 71, "Power Plant - General."

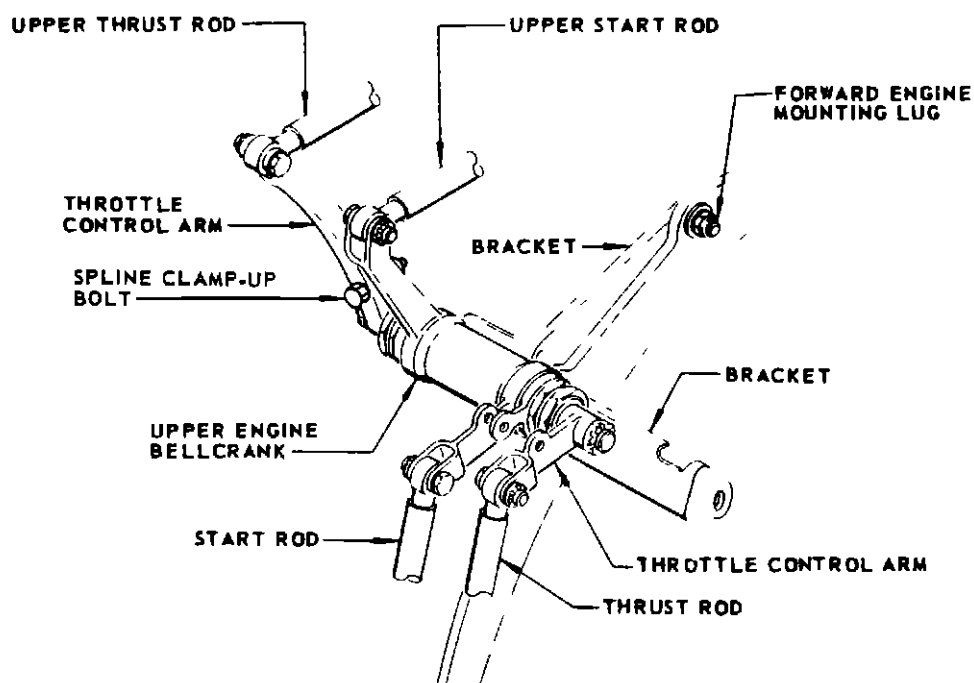
D. Install Engine Control Bell Crank Assembly.

- (1) Support bell crank assembly in mounting position and install retaining bolts.

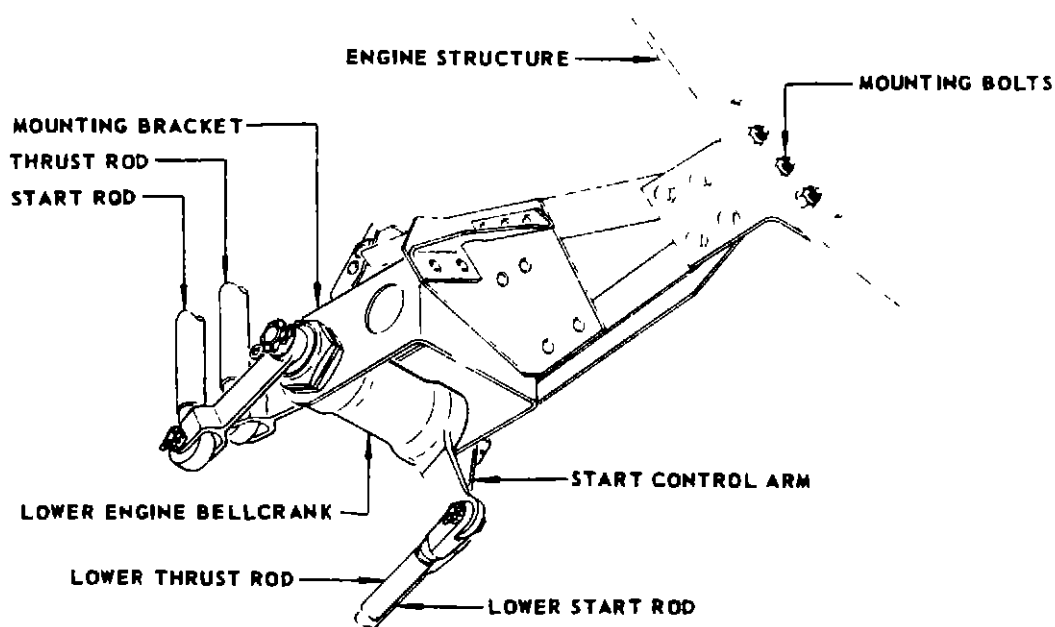
NOTE: For installation of upper bell crank assembly retaining bolts see Chapter 71, "Power Plant - General."

- (2) Connect engine start and thrust control rods to bell crank assembly
- (3) Remove rigging pins.
- (4) Close engine cowl panel. (See figure 201.)





DETAIL A
TYPICAL UPPER ENGINE CONTROL BELL CRANK



DETAIL B
TYPICAL LOWER ENGINE CONTROL BELL CRANK



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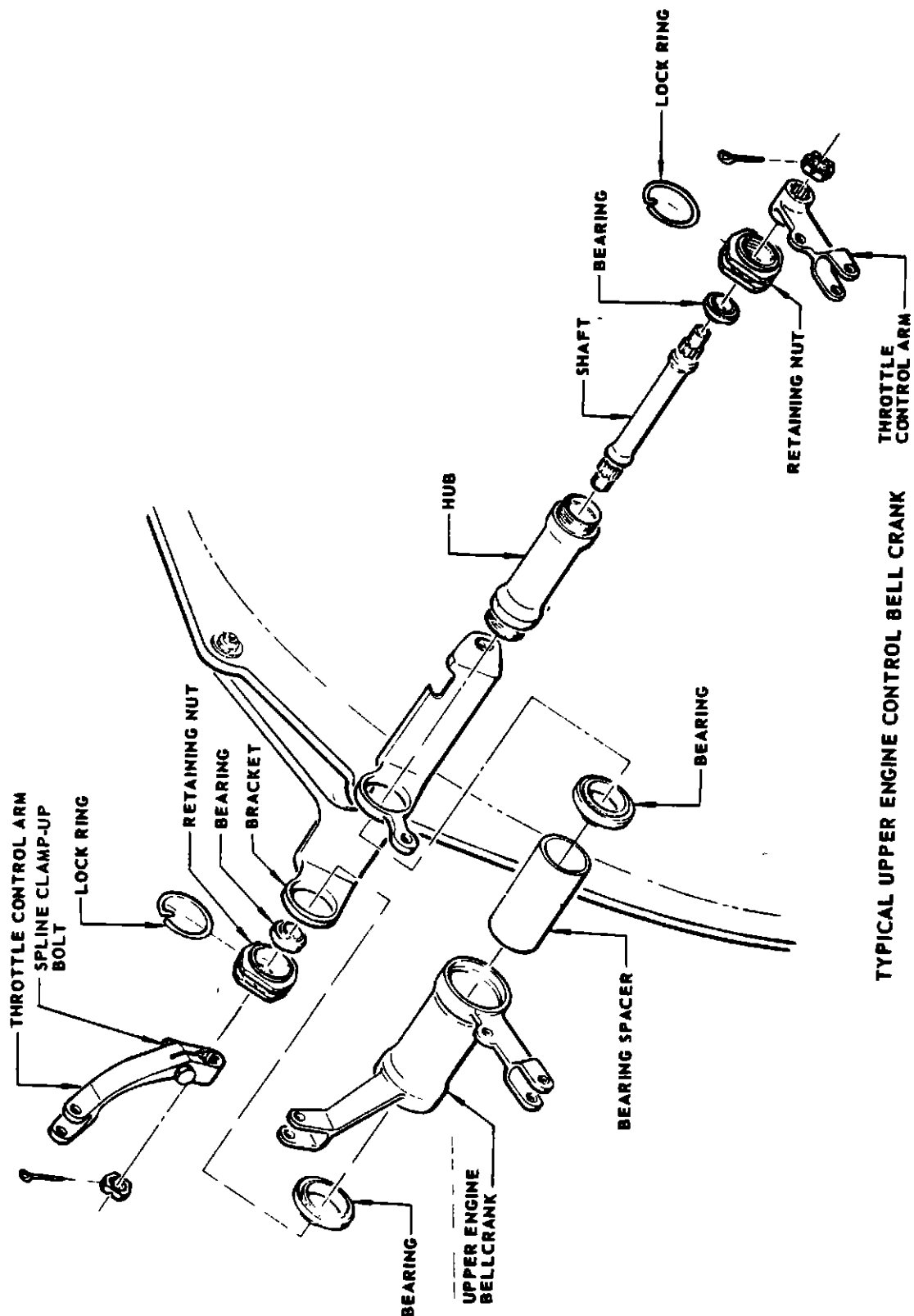
2. Approved Repairs Engine Control Bell Crank Assembly

A. Replace Bearings Engine Control Bell Crank Assembly.

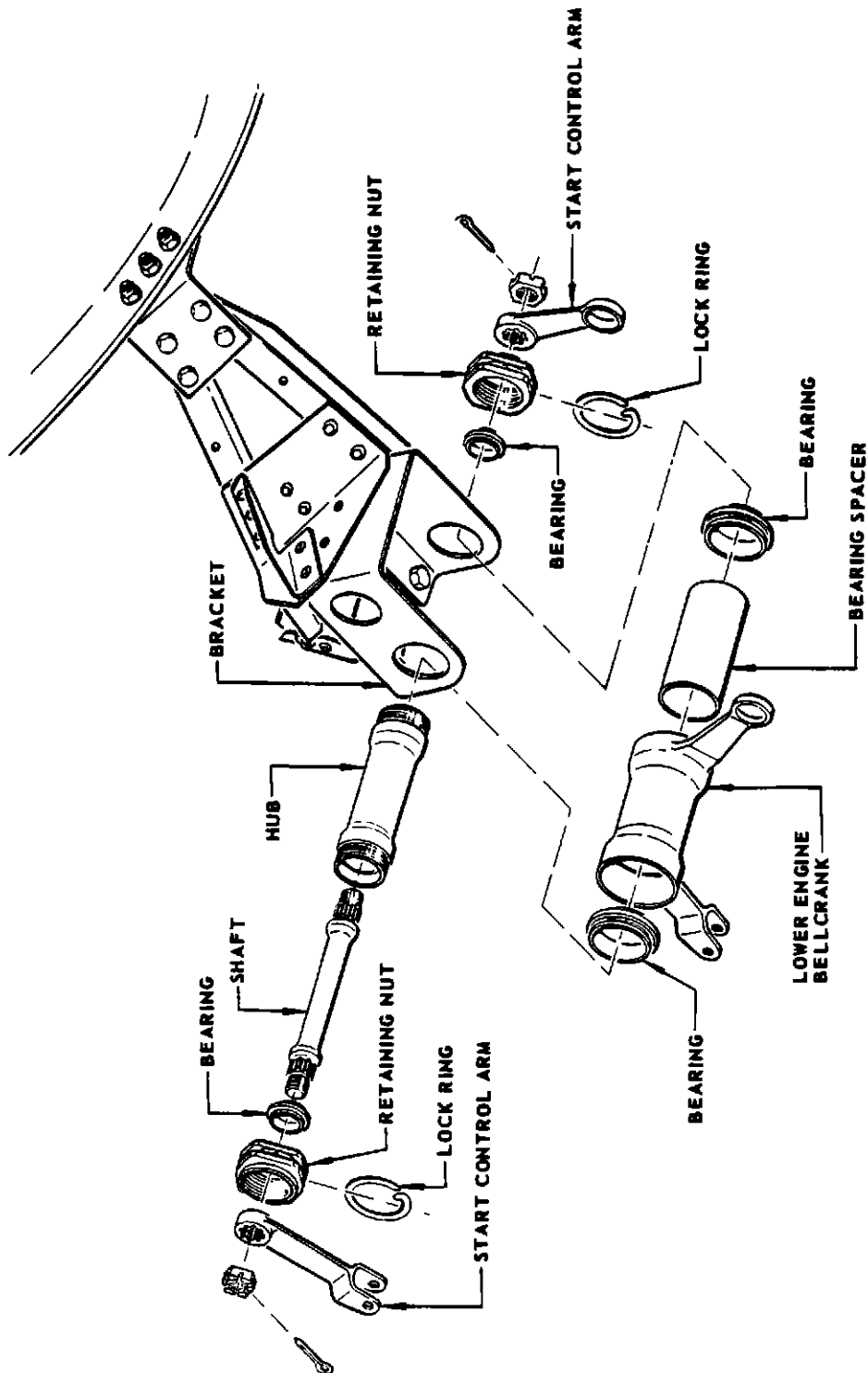
- (1) Remove bell crank assembly from engine

NOTE: Upper bell crank assembly may be disassembled without disconnecting bracket from engine.

- (2) Remove retaining nut from each end of bell crank shaft and remove arm from each end of shaft. (See figure 202.) Prior to removing the upper throttle control arm of the upper bell crank, loosen the spline clamp-up bolt.
- (3) Remove bearing from each end of bell crank shaft and remove shaft.
- (4) Remove retaining nut lock ring and retaining nut from each end of bell crank hub.
- (5) Support bell crank and remove bell crank hub.
- (6) Remove bell crank from mounting bracket.
- (7) Remove bearing from each end of bell crank.
- (8) Install new bearing in each end of bell crank.
- (9) Support bell crank in mounting position inside mounting bracket and hub.
- (10) Install retaining nut on each end of hub. Tighten within 290 to 410 pound-inches torque.
- (11) Install lock ring in each retaining nut.
- (12) Position bell crank shaft inside hub.
- (13) Install new bearing on each end of shaft.
- (14) Position throttle arm on each end of shaft and install retaining nuts and cotter keys. Do not exceed 410 pound-inches torque on nuts to align cotter pin holes.
- (15) Tighten spline clamp-up bolt on the upper throttle control arm of the upper bell crank.
- (16) Install bell crank assembly on engine.



TYPICAL UPPER ENGINE CONTROL BELL CRANK



TYPICAL LOWER ENGINE CONTROL BELL CRANK

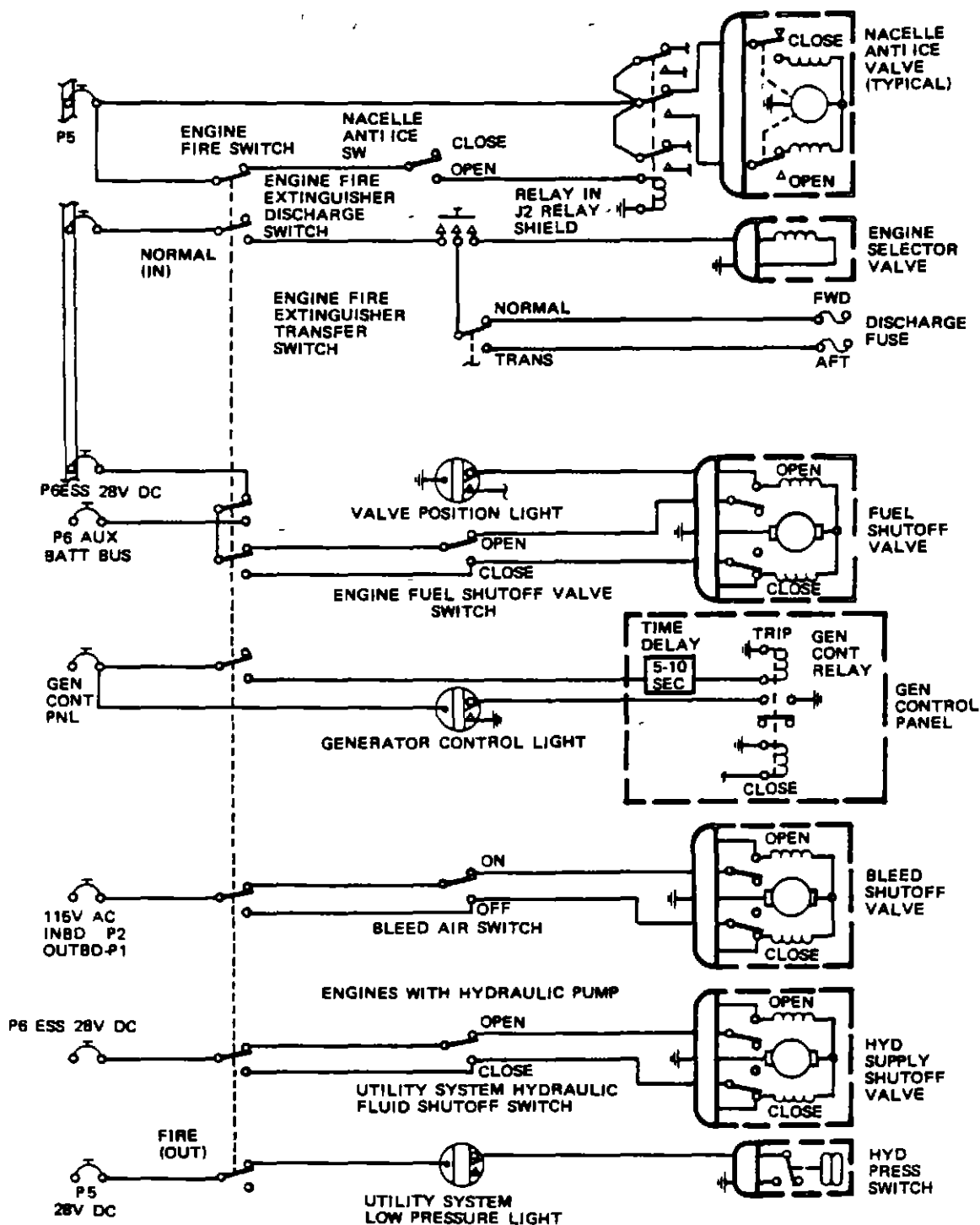


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ENGINE FIRE EMERGENCY SHUTDOWN - DESCRIPTION AND OPERATION

1 General

- A Emergency fire shutdown is initiated by receipt of a fire signal in the control cabin. The fire signal consists of a continuously sounding fire alarm bell and lighting of appropriate red fire warning light on pilot's light shield. Emergency fire shutdown consists of shutting off engine and isolating it from other systems. Emergency shutoff is accomplished by moving thrust lever to idle and positioning start lever to cut off, which shuts off fuel control unit. The fire alarm bell is silenced by depressing switch marked BELL CUTOFF. Pulling the fire switch will actuate all applicable engine bleed air, fuel and hydraulic shutoff valves, close generator field relay, and arm the fire extinguisher discharge switch. (See figure 1.) Activation of fire extinguisher discharge switch will then direct fire extinguisher discharge to correct nacelle.
- B The fuel shutoff valve will begin closing as soon as fire switch is pulled. A valve-in-transit light will come on until valve is closed. If all engines are shut down, a relay will connect battery to provide power to operate engine fuel shutoff valve. There is a 5 to 10 second time delay in generator shutdown so that power will be provided long enough to close other shutoff valves in case of final engine shutdown.
- C The fire extinguisher discharge switch is located just beneath engine fire switch. When fire switch is pulled, fire extinguisher discharge switch is armed. Holding fire extinguisher discharge switch in for 1 second will discharge contents of one of fire extinguisher bottles into the nacelle. If second fire extinguisher bottle is needed for discharge to same engine, place engine fire extinguisher transfer switch to TRANS position and hold fire extinguisher discharge switch in for 1 second. See Fire Protection, Chapter 26.



Engine Fire Switch Diagram
Figure 1

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ENGINE FIRE SHUTDOWN - MAINTENANCE PRACTICES

1. Test Fire Shutdown Handle

A. General

- (1) The following test procedure is written to provide an operational test of the fire shutdown handle action on the following items :
 - (a) NACELLE ANTI-ICE valves.
 - (b) FUEL SHUTOFF valves.
 - (c) GENERATOR CONTROL relays.
 - (d) ENGINE BLEED AIR shutoff valves.
 - (e) HYDRAULIC SUPPLY shutoff valve.
 - (f) HYDRAULIC LOW PRESSURE warning circuit.
- (2) The test of the engine fire extinguishing selector valve and engine fire extinguishing system are described in chapter 26-2-0 "Maintenance Practices" paragraph 2C.

B. Test

- (1) Connect external power to airplane.
- (2) Open hydraulic access door 1348 and remove hydraulic supply shutoff access panel 1349. See chapter 12 "Access doors and panels".
- (3) Remove nacelle strut access panels 1705 (inboard) and 1740 (outboard). See chapter 12 "Access doors and panels".
- (4) Make sure that generator control relays are closed and generator control lights are extinguished.
- (5) Place NACELLE ANTI-ICE switches ON.
- (6) Place NACELLE VALVE selector in LH position and make sure that the four VALVE OPEN lights are ON.
- (7) Place all ENGINE FUEL SHUTOFF valve switches in OPEN position. Verify that the blue position light for each engine shutoff valve is ON during valve transition period. Verify that the light goes out when the valve has completed the opening cycle.
- (8) Place ENGINE BLEED AIR switches in the ON position.
- (9) Place UTILITY SYSTEM HYDRAULIC FLUID shutoff switch in the OPEN position.



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- (10) Place HYDRAULIC INTERCONNECT VALVE switch in the CLOSED position. Make sure that the UTILITY SYSTEM LOW PRESSURE lights are ON.
- (11) Check that the HYDRAULIC SUPPLY shutoff valves (engines 2 and 3) position indicators on the valves show OPEN.
- (12) Check that the four ENGINE BLEED AIR valves position indicators on the valves show OPEN.
- (13) Pull fire switch of engine 3.
- (14) Check that FUEL SHUTOFF valve position light is ON during valve transition period and goes out when the valve has completed its closing cycle.
- (15) Check that all four generator control lights are ON.
- (16) Check that the four ENGINE BLEED AIR valve position indicators show CLOSED.
- (17) Check that the engine 2 and 3 HYDRAULIC SUPPLY shutoff valve position indicators show CLOSED.
- (18) Check that the engine 2 and 3 UTILITY SYSTEM LOW PRESSURE lights are out.
- (19) Check that the NACELLE ANTI-ICE valve open lights are out.
- (20) Push back all engine fire switches.
- (21) Check that all four generator control lights remain ON.
- (22) Reset all four generator control relays.
- (23) Check that the four NACELLE ANTI-ICE lights are ON.
- (24) Place the four NACELLE ANTI-ICE switches OFF.
- (25) Check that the four NACELLE ANTI-ICE lights are out.
- (26) Place the NACELLE ANTI-ICE valve selector OFF.
- (27) Place all ENGINE FUEL shutoff valve switches in CLOSED position. Verify that the blue position light for each valve is ON during valve transition period.
- (28) Check that the engine 2 and 3 HYDRAULIC SUPPLY shutoff valves position indicators show the OPEN position.
- (29) Check that all ENGINE BLEED AIR valve position indicators show OPEN.
- (30) Install access panels and doors.



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- (31) Place all ENGINE BLEED AIR switches OFF.
- (32) Place HYDRAULIC SYSTEM INTERCONNECT valve switch in the OPEN position.
- (33) Disconnect external electrical power.

