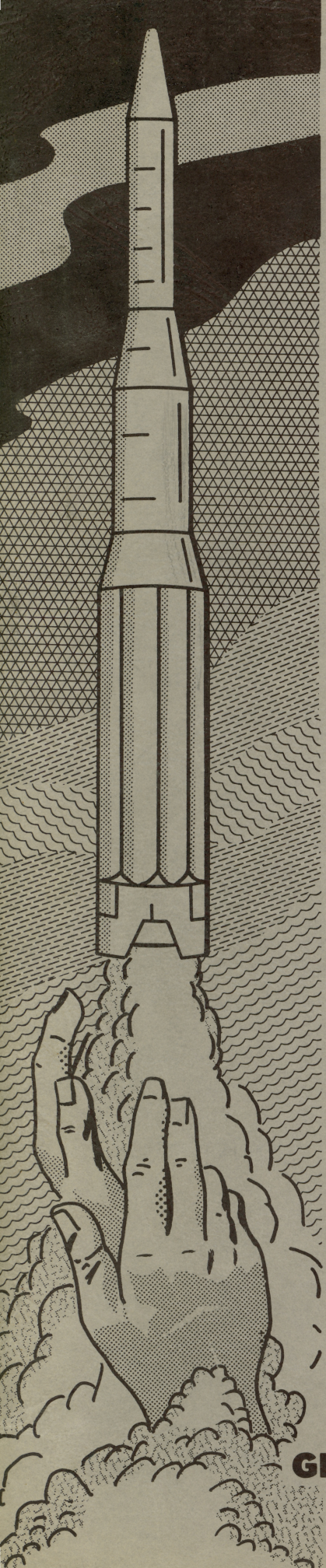


HANDLING, TRANSPORTING AND ERECTION INSTRUCTIONS SATURN S-1 STAGE, SA-1

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

NASA

GEORGE C. MARSHALL SPACE FLIGHT CENTER
HTTP://HEROICRELICS.ORG
HUNTSVILLE ALABAMA

TABLE OF CONTENTS

Paragraph — Page

LIST OF ILLUSTRATIONS 3

INTRODUCTION 5

CHAPTER I TRANSPORTATION, HANDLING, AND ERECTION AT STATIC TEST TOWER ... 7

1. PREPARING BOOSTER FOR ERECTION 7

1.1 Positioning Transporter (J-AF-12004) 7

1.2 Installing Bumper Assembly (D-10426438), Two Bumpers (D-10426434), and Two Cable Assemblies (J-10424771) 7

1.3 Removal Procedure Rear Ring Sections (J-AF-12004-2-0) 11

2. ERECTING BOOSTER 20

2.1 Positioning Transporter and Attaching Erection Cables 20

2.2 Removing Booster from Transporter and Positioning on Tower Thrust Ring 28

3. REMOVING BOOSTER FROM TEST TOWER 35

3.1 Preparing Booster for Removal 35

3.2 Removing Booster from Tower Thrust Ring and Positioning on Transporter 37

3.3 Installation Procedure Rear Ring Sections (J-AF-12004-2-0) 40

3.4 Removing Bumper Assembly (D-10426438), Two Bumpers (D-10426434) and Two Cable Assemblies (J-10424771) 44

CHAPTER II TRANSPORTATION, HANDLING, AND ERECTION AT CAPE CANAVERAL 47

1. PREPARING BOOSTER FOR ERECTION 47

1.1 Preparing Service Structure for Erection 47

1.2 Positioning Transporter (J-AF-12004) 47

1.3 Installing Beam Weldment (J-10426675) and Forward Sling Assemblies (J-10426668) 51

TABLE OF CONTENTS (Con.)

Paragraph Page

1.4 Removal Procedure Forward Ring Sections (J-AF-12004-3-0) 54

1.5 Removal Procedure Rear Ring Sections (J-AF-12004-2-0) 60

2. ERECTING BOOSTER 64

2.1 Positioning Transporter and Attaching Cables 64

2.2 Removing Booster from Transporter and Positioning on Launch Pedestal . 72

3. REMOVING BOOSTER FROM LAUNCH PEDESTAL 79

4. REMOVING RING SECTIONS WITH FIN I IDENTIFICATION AND PRESERVING ALL RING DETAILS AND ATTACHING HARDWARE 80

4.1 Removing Forward and Rear Ring Sections with Fin I Identification from Transporter 80

4.2 Preserving Forward and Rear Ring Details and Attaching Hardware 82

CHAPTER III GENERAL INSTRUCTIONS FOR THE S-I TRANSPORTER 83

LIST OF ILLUSTRATIONS

Figure	Title	Page
1.	Positioning Equipment at Static Test Tower	8
2.	Removing Doors and Plates	9
3.	Installing Bumpers and Cable Assemblies	10
4.	Positioning Horizontal Platform and Personnel	12
5.	Removal of Rear Ring Sections (J-AF-12004-2-0)	13
6.	Rear Ring Section Attaching Points	14
7.	Removal of Rear Ring Section at Outrigger No. 2	18
8.	Identification of Fin Line and Outrigger Numbers	19
9.	Erection Beam Installation	21
10.	Attaching Erection Beam and Cable Assemblies	23
11.	Connecting Aft Cable Assembly	25
12.	Forward Support Clamps	27
13.	Lifting Booster off Transporter	29
14.	Booster Stabilization Preparatory to Lifting off Transporter	31
15.	Booster in Vertical Position	33
16.	Positioning Booster on Support Brackets	36
17.	Preparing Service Structure for Erection	48
18.	Positioning Equipment at Firing Site	49
19.	Preparing Booster for Erection	52
20.	Installation of Beam Weldment and Forward Sling Assemblies	53
21.	Removing Forward Ring Sections (J-AF-12004-3-0)	55
22.	Forward Ring Section Attaching Points	56
23.	Forward Ring Section Removal Procedures	57
24.	Attaching Aft and Forward Sling Assemblies	65

LIST OF ILLUSTRATIONS (Con.)

Figure	Title	Page
25.	Connecting Erecting Beam and Forward Sling Assemblies	68
26.	Lifting Booster off Transporter	69
27.	S-I Stage Center-of-Gravity Diagram	71
28.	Removing Aft Cable Assembly and Positioning Booster on Launch Pedestal	75
29.	Booster-to-Launch Pedestal Orientation Diagram	77
30.	Positioning Booster on Support Arms and Holddown Arms	78
31.	Rear Ring Support Clamps	81

INTRODUCTION

This manual provides the necessary instructions for transporting, handling, and erecting the Saturn S-I Booster, effectivity SA-1 and is divided into three chapters. Chapter I contains instructions at the static test tower. Chapter II contains instructions at the Cape Canaveral firing site. Chapter III contains operating instructions for the Saturn S-I Transporter.

Chapter I consists of step-by-step procedures for removing the rear ring sections, positioning and erecting the Booster in the static test tower, preservation of tooling, positioning the Booster on the transporter, and reassembly of the rear ring sections to the Booster after static test firing.

Chapter II consists of step-by-step procedures for removing the forward and rear ring sections, positioning and erecting the Booster from the launch pedestal, and preservation of tooling for shipping.

A complete manual containing general instructions for the Saturn S-I Transporter and including a separate Table of Contents, List of Illustrations, and Introduction is inserted in this manual as Chapter III.

Equipment essential to proper handling of the Booster at the static test tower and at the Cape Canaveral firing site includes the following: transporter, towing tractor, gantry crane, mobile crane, fork lift, horizontal and transportation ring platforms. Special hardware assures safe and efficient handling of the Booster during removal and erection.

This publication is a combined effort of the M-LOD, M-TEST, and M-F&AE Divisions.

CHAPTER I

TRANSPORTATION, HANDLING, AND ERECTION AT STATIC TEST TOWER

1. PREPARING BOOSTER FOR ERECTION.

1.1 Positioning Transporter (J-AF-12004).

1.1.1 Position transporter on north side of static test tower at a right angle to deflector pit and aline with deflector pit bridging at a distance which will provide sufficient working area around the transporter for the mobile crane and fork lift. (See figure 1 for the relative positions of the equipment.)

1.1.2 Lock transporter brakes and chock wheels.

1.2 Installing Bumper Assembly (D-10426438), Two Bumpers (D-10426434), and Two Cable Assemblies (J-10424771).

1.2.1 Move tractor and tow bar clear of the forward end of the booster.

1.2.2 Using fork lift, raise transportation ring platform and personnel to a height necessary for attaching bumper assembly (D-10426438), two bumpers (D-10426434), and cable assemblies (J-10424771). (See figure 2.)

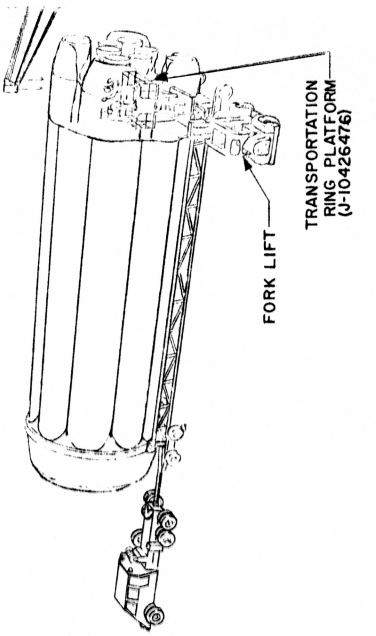
1.2.1.1 Remove doors (D-10411708) and plates (D-10411753) attached to interstage fairing and second stage adapter to gain access to bumper and forward sling assembly attaching points. Attaching points are at I-beams No. 3, 4, 5, 6, and 7.

1.2.1.2 Remove attaching hardware that secures interstage fairing to second stage adapter at attaching points for bumper assemblies and forward sling assemblies as shown in figure 2.

NOTE: All doors and attaching hardware to be packaged and stored. This hardware will be installed after the booster has been erected in the test tower. See figure 2 for list of attaching hardware.

1.2.1.3 Install bumper assembly (D-10426438) in accordance with detail A, figure 3.

1.2.1.4 Install bumpers (D-10426434) in accordance with detail B, figure 3.



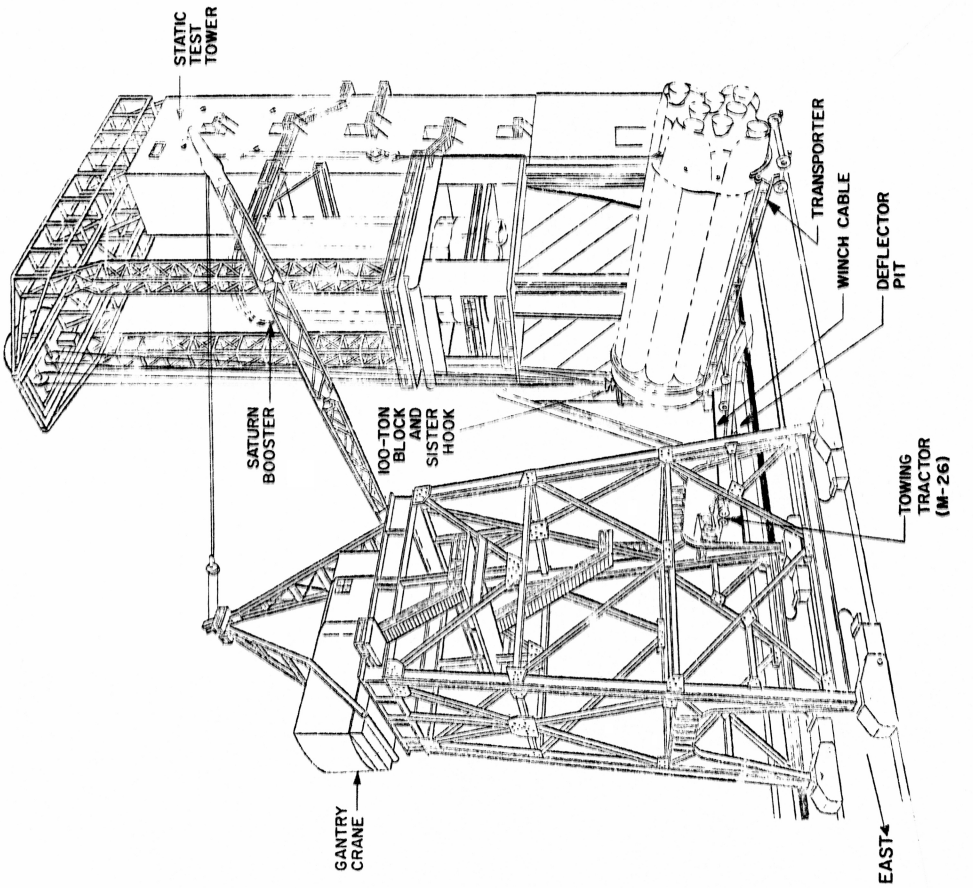


FIG.1 POSITIONING EQUIPMENT AT STATIC TEST TOWER

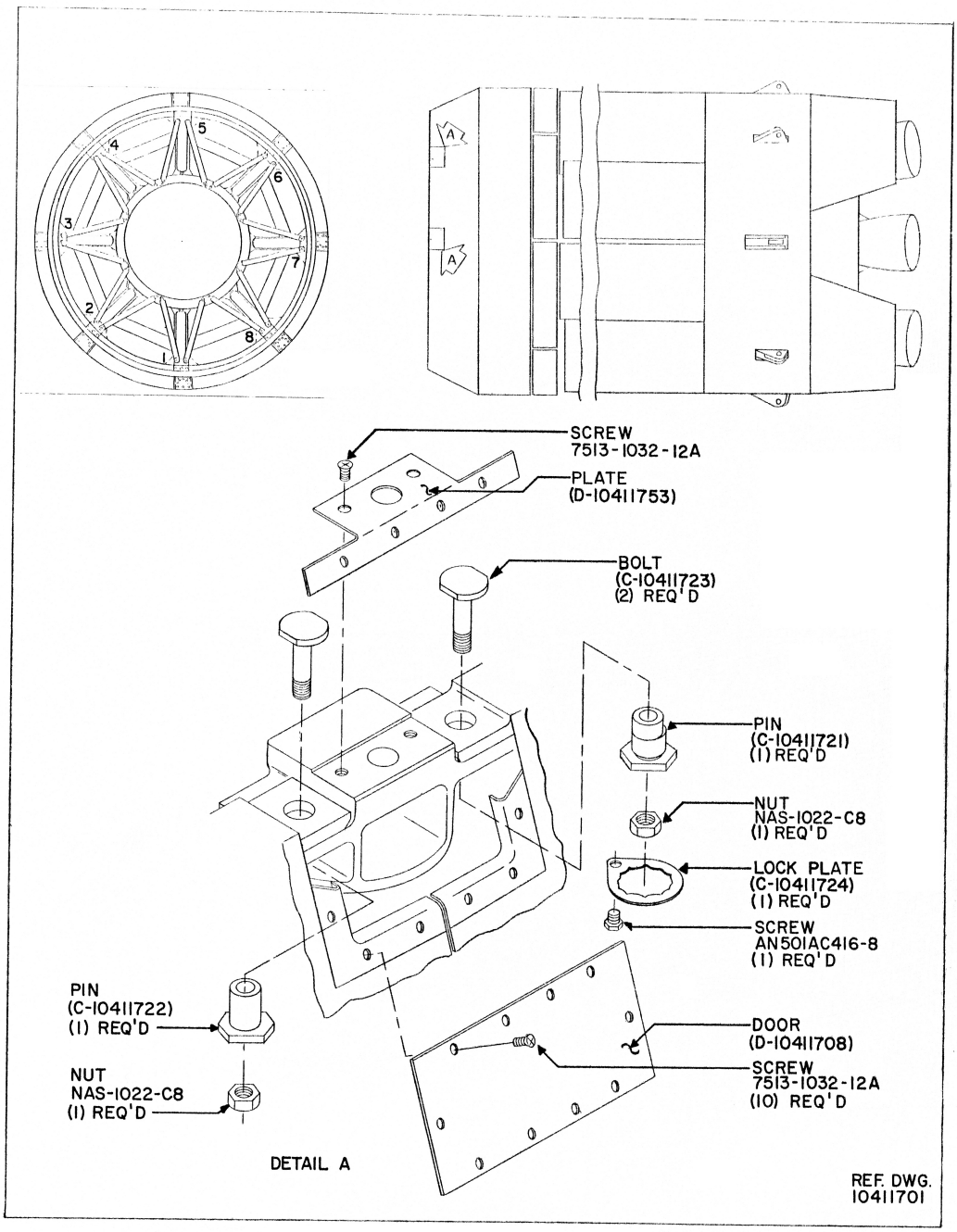
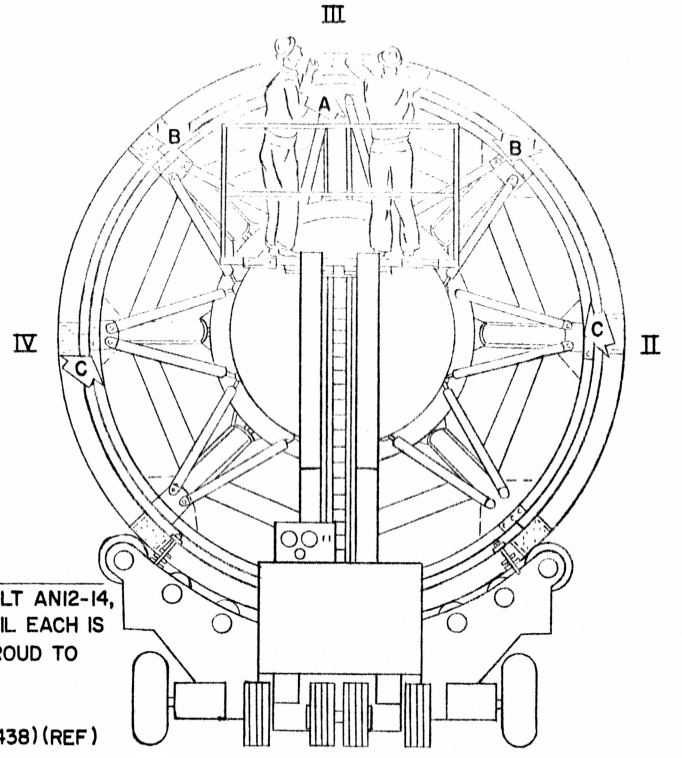
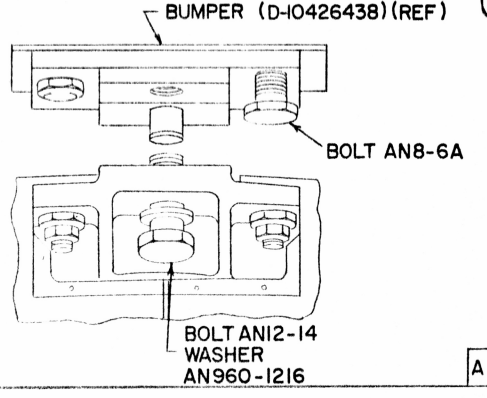


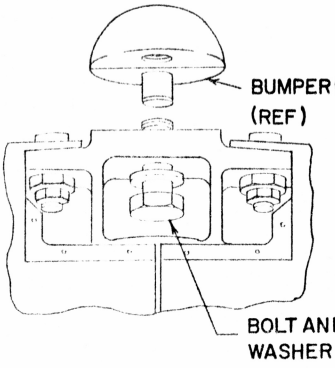
FIG.2 REMOVING DOORS AND PLATES



AFTER BUMPER IS SECURED BY BOLT AN12-14, UNSCREW BOTH BOLTS (AN8-6A) UNTIL EACH IS SEATED AGAINST BOLT HOLDING SHROUD TO BRACKET.



A

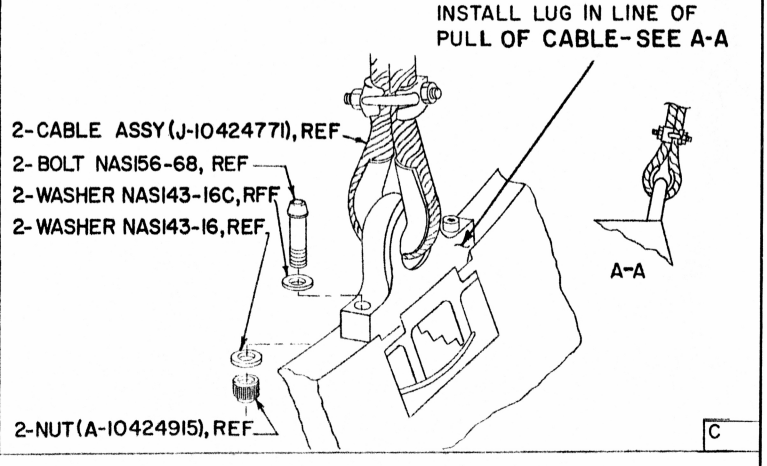


B

NOTE: WHENEVER CABLE ASSEMBLY (10424771) IS ATTACHED, NEW BOLTS, WASHER, AND NUTS SHALL BY INSTALLED, USED HARDWARE TO BE DISCARDED.

NOTE: WIPE OFF ALL LUBRICANT FROM BOOSTER PARTS WITH CLEAN RAGS AT TIME OF REMOVAL OF SLING ASSEMBLIES

TORQUE HEAD OF BOLT (NAS 156-68) TO 6000 INC LBS. (500 FT. LBS.). LUBRICATE THREADS, SHANK OF BOLT, AND EACH SIDE OF WASHERS BEFORE INSTALLATION WITH MOLYKOTE TYPE "G."



C

FIG. 3. INSTALLING BUMPERS AND CABLE ASSEMBLIES

1.2.1.5 Install cable assemblies (J-10424771) in accordance with instructions in detail C, figure 3. Tie cable assemblies together to prevent damage to booster.

WARNING: Correct installation of cable assemblies (J-10424771) is extremely important. New bolts, washers, and nuts shall be used. Lubricating the shank and threads of the bolts (NAS156-68) and each side of the washers (NAS143-16 and NAS143-16C) and obtaining a torque value of 600-inch pounds (500 foot pounds) from the head of bolts is mandatory to prevent shearing of the attaching hardware during erection.

1.2.1.6 Quality Control Division shall inspect the installation of the cable assemblies (J-10424771), check and record the torque values of bolts (NAS156-68).

1.3 Removal Procedure Rear Ring Sections (J-AF-12004-2-0).

1.3.1 Position mobile crane so that the two crane hooks are directly above the rear ring. The crane boom can now be maneuvered for removal of all rear ring sections.

1.3.2 Using mobile crane, raise and position the horizontal platform and personnel on top of the booster just forward of the rear ring so that the platform is resting firmly in proper position for removal of the rear ring section with Fin III identification. (See figure 4.) Working from the horizontal platform, complete the following procedures:

1.3.2.1 Connect ring handling brackets to rear ring section with Fin III identification with nuts and bolts. (See figure 5, detail A.)

1.3.2.2 Lower crane hooks to work area and connect to choker lines. Connect choker lines to ring handling brackets and put slight tension on crane cables. (See figure 5, detail A.)

1.3.2.3 Disconnect tee bracket from outrigger No. 5 by loosening set screws and removing connecting pin. (See figure 6.)

1.3.3 Using fork lift, raise and position the transportation ring platform and personnel as necessary on each side of the booster at the rear ring separation and tee attachment points. (See figure 4.) Working from the transportation ring platform, complete the following procedures to remove rear ring section with Fin III identification:

1.3.3.1 Disconnect tee brackets at outriggers No. 4 and 6 from rear ring by removing four bolts and washers through base of each tee bracket to the ring. (See figure 6.)

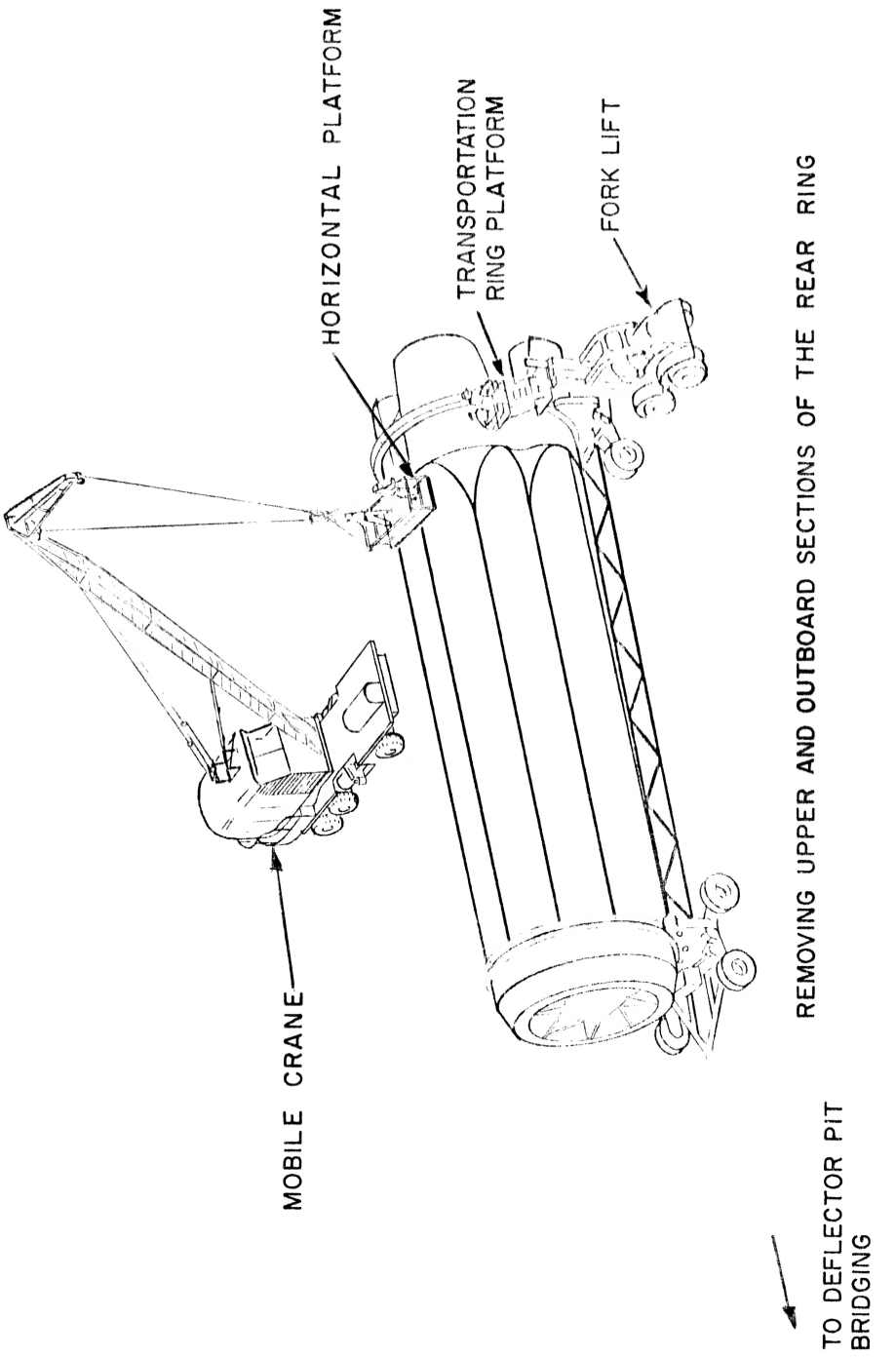
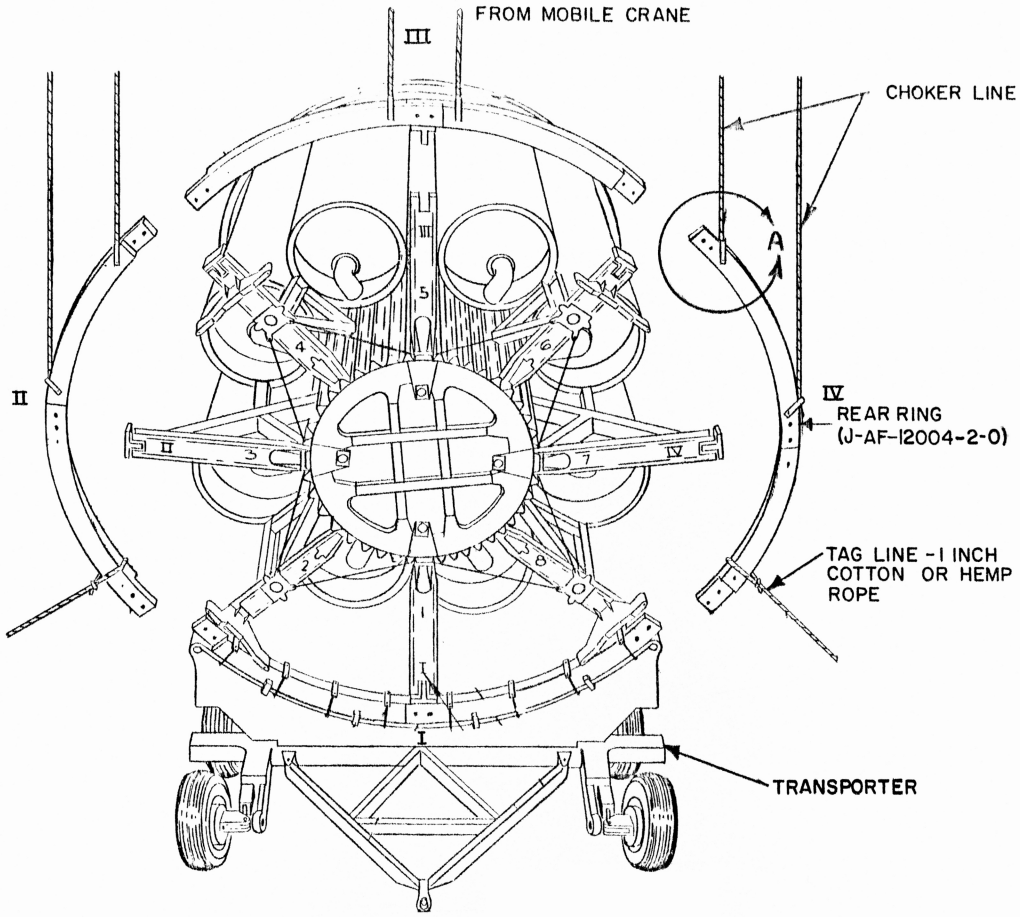


FIG. 4. POSITIONING HORIZONTAL PLATFORM AND PERSONNEL



AFT VIEW LOOKING FORWARD

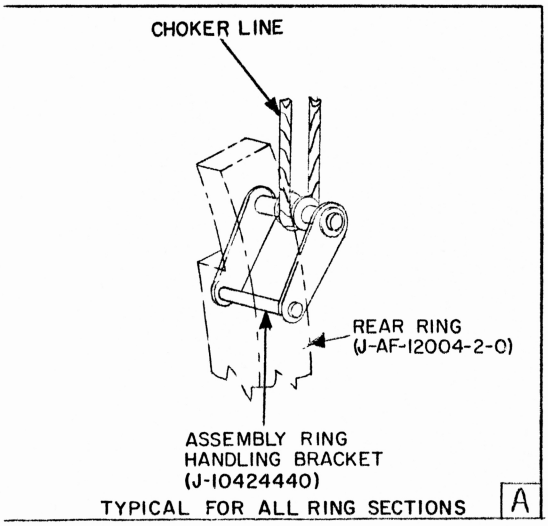
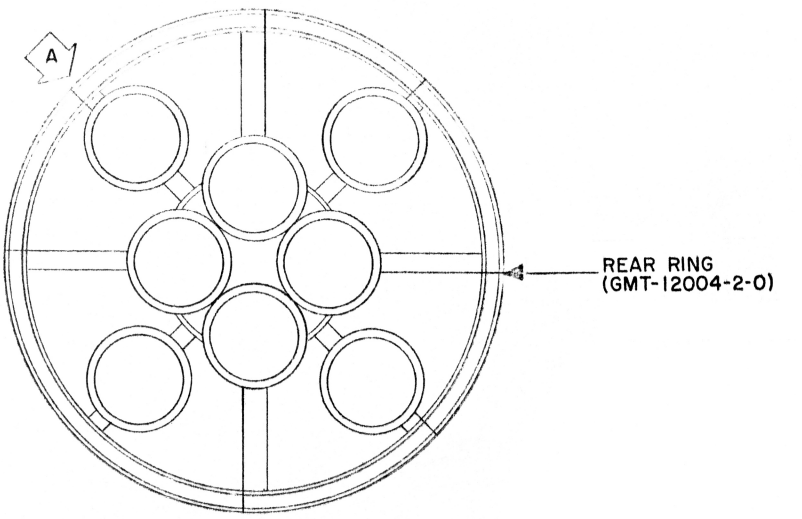
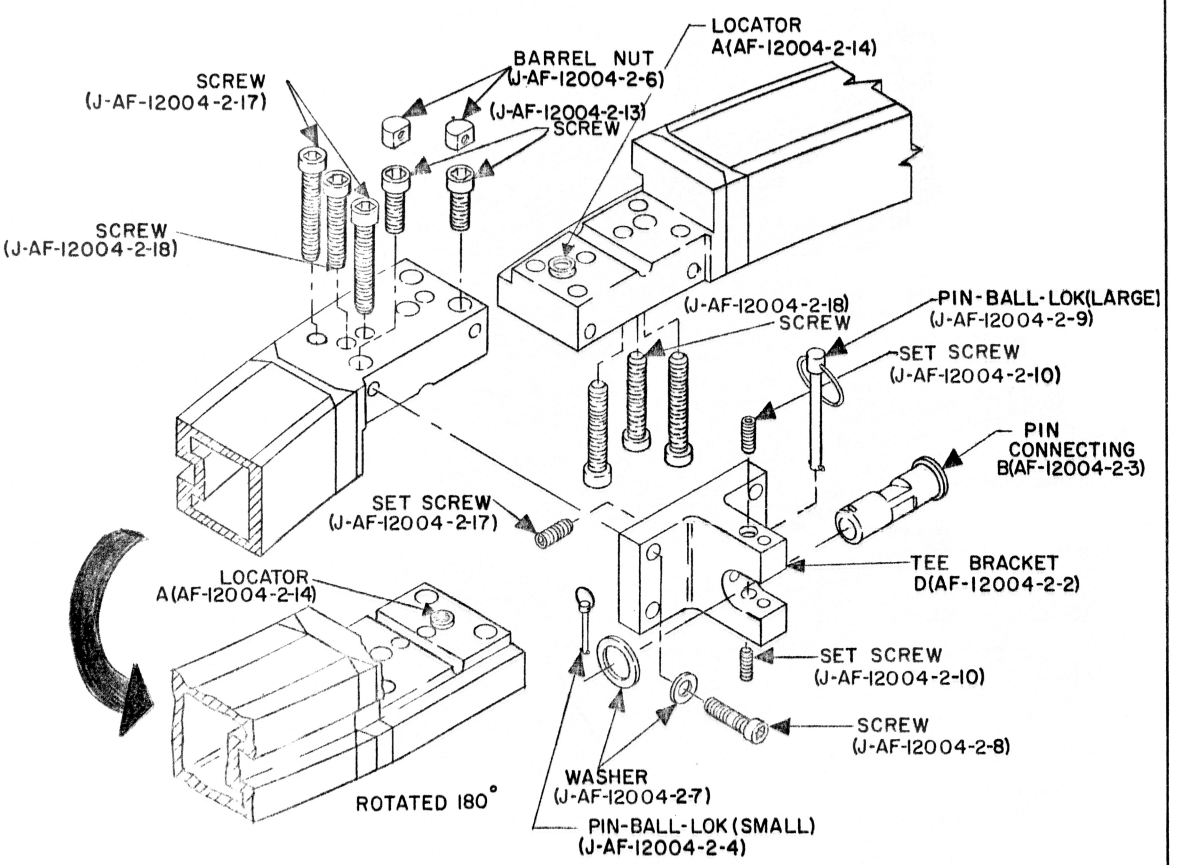


FIG. 5 REMOVAL OF REAR RING SECTIONS





DETAIL A
TYPICAL AT OUTRIGGERS NO.2,4,6 AND 8

FIG.6 REAR RING SECTION ATTACHING POINTS

1.3.3.2 Remove the $4\frac{1}{2}$-inch screws (J-AF-12004-2-18) from end holes of each ring section, insert these screws in holes on opposite side of ring sections, and tighten screws to pull locators (A-AF-12004-2-14) to the disconnecting position. (See figure 6.)

NOTE: One $4\frac{1}{2}$-inch screw (J-AF-12004-2-18) and one locator (A-AF-12004-2-14) are located in the end hole of each ring section; therefore, when the ring sections are connected, one screw is on the forward side of the rear ring and one screw is on the aft side of the rear ring at each splice joint. Screws (J-AF-12004-2-18) and locators (A-AF-12004-2-14) remain with the ring sections.

1.3.3.3 Disconnect rear ring section with Fin III identification from rear ring sections at outriggers No. 4 and 6 by removing two barrel nuts (J-AF-12004-2-6) and six screws (J-AF-12004-2-17) at each end. (See figures 5 and 6.)

1.3.3.4 Connect tag line to rear ring section with Fin III identification and hoist off of booster and lower into working area. Use tag line to control swinging movement. (See figure 5.)

1.3.3.5 Disconnect ring handling brackets from rear ring section with Fin III identification and remove choker lines from mobile crane hooks.

1.3.3.6 Using mobile crane, lower horizontal platform and personnel to the ground.

1.3.4 Using fork lift, raise and position transportation ring platform and personnel to a height as necessary for removal of rear ring section with Fin IV identification. (See figure 4.) Working from the transportation ring platform, complete the following procedures:

1.3.4.1 Connect ring handling brackets to rear ring section with Fin IV identification with bolts and nuts. (See figure 5.)

1.3.4.2 Using mobile crane with two hooks, lower crane hooks to work area and connect to choker lines.

1.3.4.3 Connect choker lines to ring handling brackets on rear ring section with Fin IV identification and put slight tension on crane cables. (See figure 5.)

1.3.4.4 Disconnect tee bracket from rear ring section at outrigger No. 7 by removing four bolts from base of tee. Remove two bolts only from base of tee bracket at outrigger No. 8. (See figure 6.)

NOTE: The remaining two bolts through the base of the tee bracket at outrigger No. 8 will remain installed until erection cables are connected and slight lifting forces are obtained from the tower and gantry cranes.

1.3.4.5 Disconnect rear ring section with Fin IV identification by performing the applicable procedures outlined in paragraphs 1.3.3.2 and 1.3.3.3.

1.3.4.6 Connect tag line to lower end of rear ring section with Fin IV identification. (See figure 5.)

1.3.4.7 Lower personnel and transportation ring platform with fork lift and clear immediate area preparatory to hoisting rear ring section free of booster.

1.3.4.8 With personnel positioned to maintain a taut tag line, lift rear ring section with Fin IV identification free of the booster and lower into working area with mobile crane. (See figure 5.)

1.3.4.9 Disconnect ring handling brackets from rear ring section and remove choker lines from mobile crane hooks.

1.3.4.10 Using fork lift, raise transportation ring platform and personnel to a height as necessary and disconnect tee brackets from outriggers No. 6 and 7 by loosening set screws and removing connecting pins. (See figure 6.)

1.3.4.11 Lower transportation ring platform and personnel to the ground with fork lift.

1.3.5 Using fork lift, raise and position transportation ring platform and personnel to a height as necessary for removal of rear ring section with Fin II identification. (See figure 4.) Working from the transportation ring platform, complete the following procedures:

1.3.5.1 Connect ring handling brackets to rear ring section with Fin II identification with bolts and nuts. (See figure 5.)

1.3.5.2 Using mobile crane with two hooks, lower crane hooks to work area and connect choker lines. (See figure 5.)

1.3.5.3 Connect choker lines to ring handling brackets on rear ring section with Fin II identification and put slight tension on crane cables. (See figure 5.)

1.3.5.4 Disconnect tee brackets from rear ring sections at outriggers No. 2 and 3 by removing four bolts at base of each tee bracket. (See figure 6.)

1.3.5.5 Disconnect rear ring section with Fin II identification by performing the applicable procedures outlined in paragraphs 1.3.3.2 and 1.3.3.3. (See figure 7.) (See figure 8 for identification of Fin Lines and outrigger numbers.)

1.3.5.6 Connect tag line to lower end of rear ring section with Fin II identification. (See figure 5.)

1.3.5.7 Insert two barrel nuts (J-AF-12004-2-6) in rear ring section with Fin I identification at outrigger No. 2 and secure tee bracket to rear ring section with two bolts. (See figure 6.)

NOTE: The two bolts through the base of the tee bracket at outrigger No. 2 will remain installed until the erection cables are connected and slight lifting forces are obtained from the tower and gantry cranes.

1.3.5.8 Lower personnel and transportation ring platform with fork lift and clear immediate area preparatory to hoisting rear ring section free of booster.

1.3.5.9 With personnel positioned to maintain a taut tag line, lift rear ring section with Fin II identification free of booster and lower into working area with mobile crane. (See figure 5.)

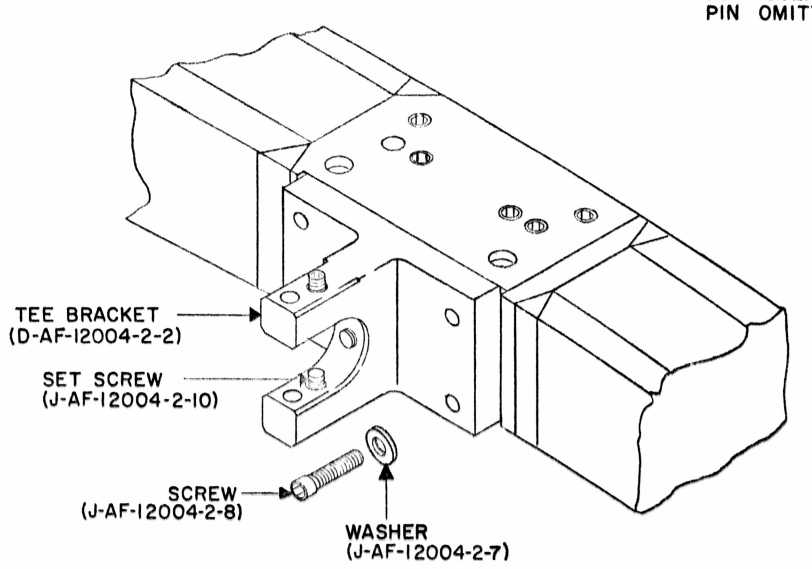
1.3.5.10 Disconnect ring handling brackets from rear ring section and remove choker lines from mobile crane hooks.

1.3.5.11 Using fork lift, raise transportation ring platform and personnel to a height as necessary and disconnect tee brackets from outriggers No. 3 and 4 by loosening set screws and removing connecting pins. (See figure 6.)

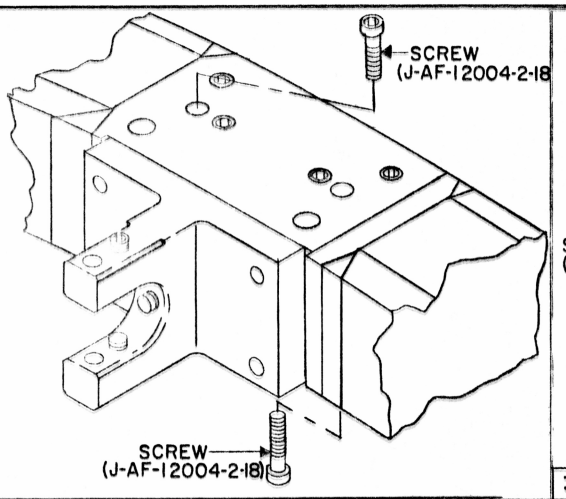
1.3.5.12 Lower personnel and transportation ring platform with fork lift and clear the area preparatory to moving transporter onto the deflector pit bridging.

NOTE: The aft end of the booster is now resting on three points, tee brackets No. 1, 2 and 8 of the rear ring section with Fin I identification. Tee brackets No. 2 and 8 at outriggers No. 2 and 8, respectively, are still connected to their outrigger beams and have two of the four bolts through their base to the ring sections still installed. Tee bracket No. 1 is intact

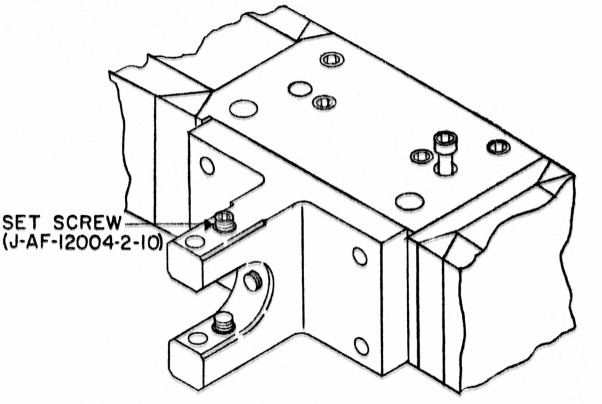
NOTE: OUTRIGGER & CONNECTING PIN OMITTED FOR CLARITY.



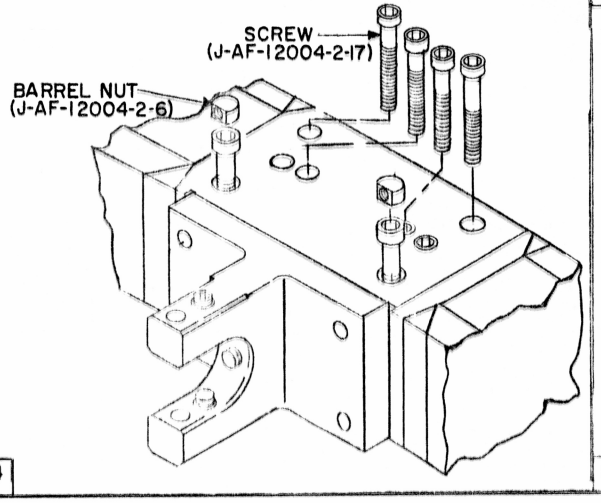
1



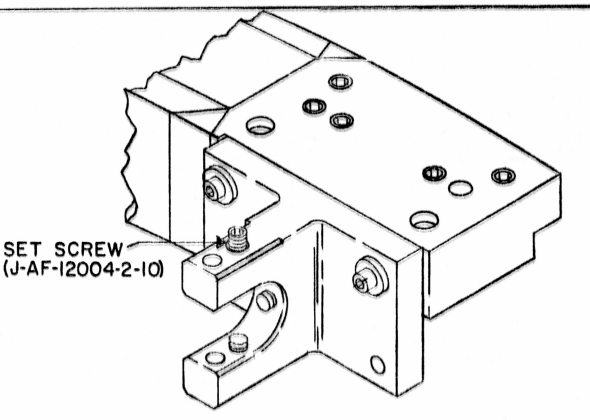
2



3



4



5

FIG. 7. REMOVAL OF REAR RING SECTION AT OUTRIGGER NO.2

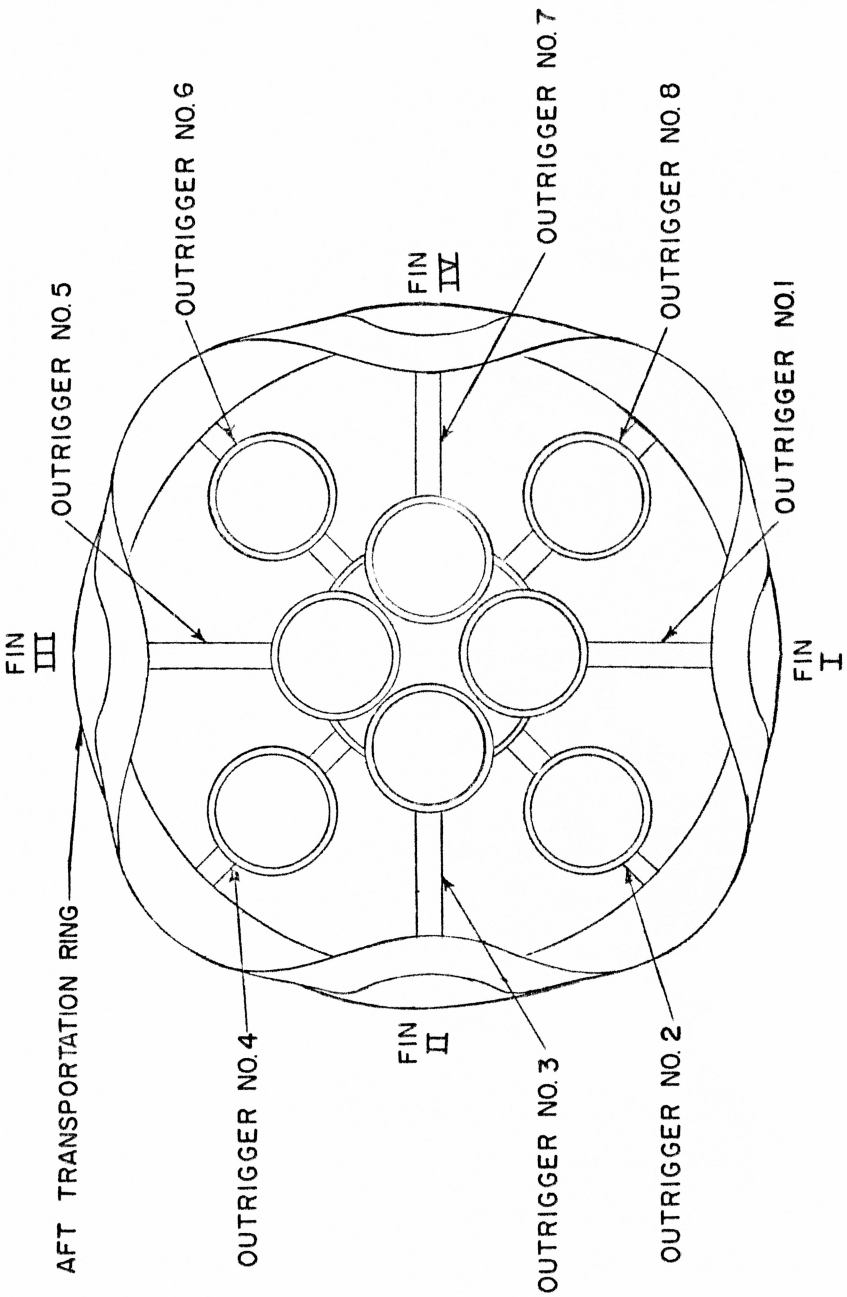


FIG. 8 IDENTIFICATION OF FIN LINE AND OUTRIGGER NUMBERS

1.3.5.12 NOTE: (Con.)

and will not be disconnected until erection cables are connected and slight lifting forces are obtained from the tower and gantry crane. Transporter is now ready to be towed to a position where the second stage adapter is directly under the tower crane.

1.3.6 Clean mating surfaces of rear ring segments and tee brackets with dry-cleaning solvent, Federal Specification P-S-661, in accordance with paragraph 3.2.1 of Military Specification MIL-P-116 and apply P-3 corrosion preventive, Military Specification MIL-C-16173, to mating surfaces.

1.3.7 Immerse attaching hardware for rear ring segments in P-9 preservative lubricating oil, Military Specification MIL-L-644.

1.3.8 Move ring details to adequate storage area, place on cross ties, or equivalent, and cover with a tarpaulin.

2. ERECTING BOOSTER.

2.1 Positioning Transporter and Attaching Erection Cables.

2.1.1 Using gantry crane, place erection beam (J-10427055) on load platform of static test tower.

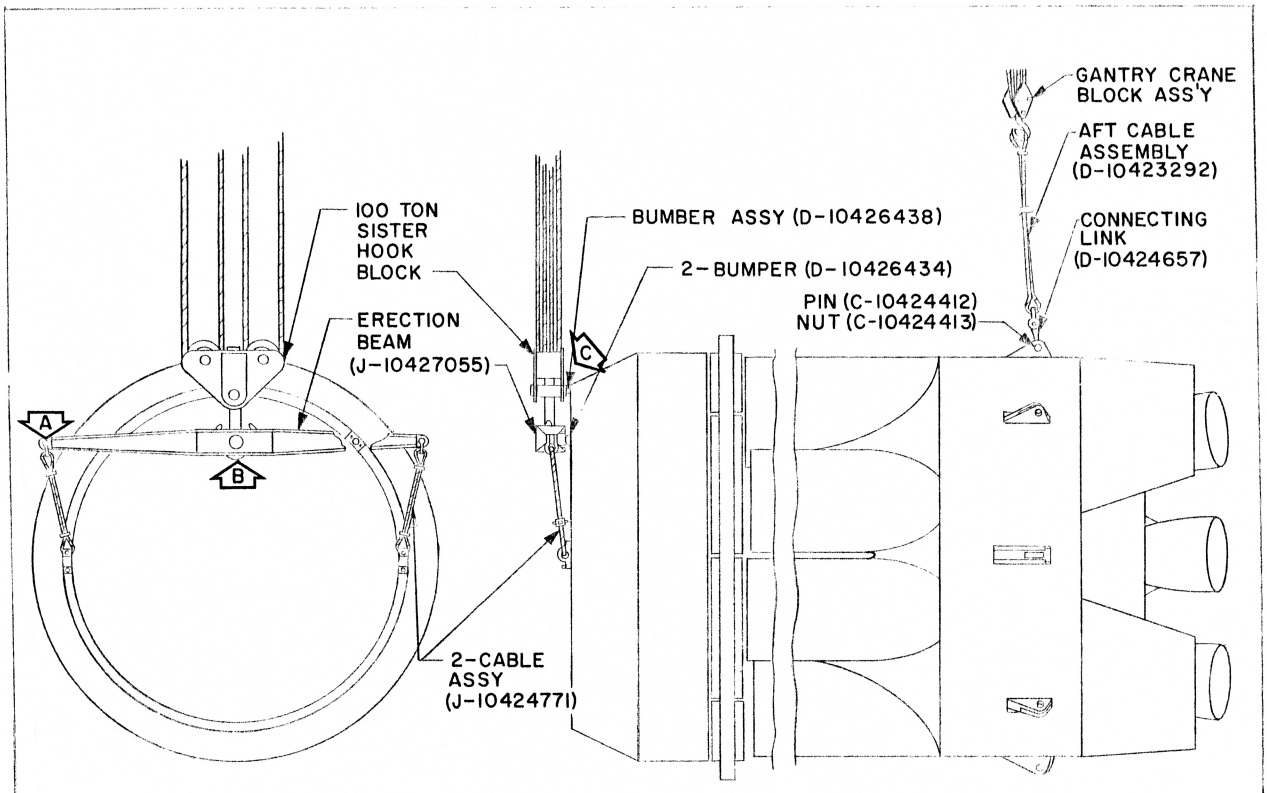
2.1.2 Using tower crane, lower 100-ton sister block and sister hook to the load platform and connect the erection beam (J-10427055) to the 100-ton sister block and sister hook with pin (C-10423816), stop (C-10423817), and screw (MS35301-111). (See figure 9, detail B.)

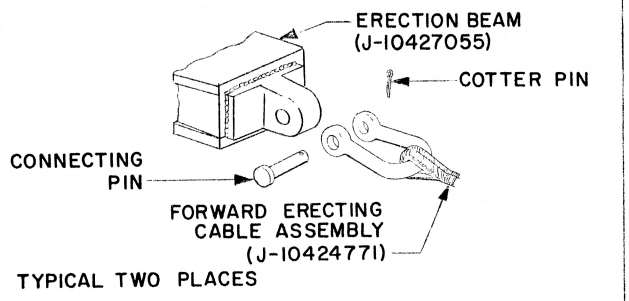
2.1.3 Place deflector pit bridging over deflector pit using gantry crane.

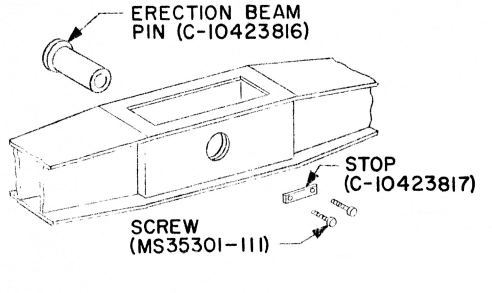
2.1.4 Using towing tractor, position the transporter carrying the booster as close as possible to and in alinement with the deflector pit bridging. After locking the drawbar on the towing tractor in horizontal position, disconnect it from the transporter. Position towing tractor on the south side of deflector it in a direct line with transporter at a convenient distance from deflector pit. Secure towing tractor with chock blocks, let out sufficient slack in winch cable, attach cable to front of transporter, and position transporter on deflector pit bridging as follows:

2.1.4.1 Using towing tractor winch, carefully pull transporter onto deflector pit bridging to a position where the second stage adapter is 24 inches short of being directly under the tower crane. (See figure 1.)

NOTE: Use gantry crane to hold transporter drawbar in horizontal position.







NOTE:
BUMPER ASSEMBLY 10426438 IS NOT DESIGNED TO RESIST EXCESSIVE LOADS. TOWER CRANE CABLES SHALL NEVER BE LESS THAN 90° FROM THE HORIZONTAL CENTERLINE OF THE BOOSTER SO THAT THE SISTER HOOK HAS SOME VISABLE SPACE BETWEEN IT AND THE BUMPER ASSEMBLY. C

FIG.9 ERECTION BEAM INSTALLATION

2.1.4.2 When transporter is positioned on bridging as shown in figure 1, lock transporter brakes and chock all wheels. Position and lock drawbar rigidly and remove gantry crane hook.

2.1.4.3 Disconnect towing tractor winch cable from transporter, remove chocks from towing tractor, wind up cable, and remove towing tractor from test tower area.

2.1.5 Due to the high shear loads imposed on attaching bolts and other hardware, attaching the cables is a critical part of the preparations for erecting the booster. The following procedures must be adhered to closely:

2.1.5.1 Position mobile crane with horizontal platform and personnel on south side of deflector pit in front of booster. (See figure 10.)

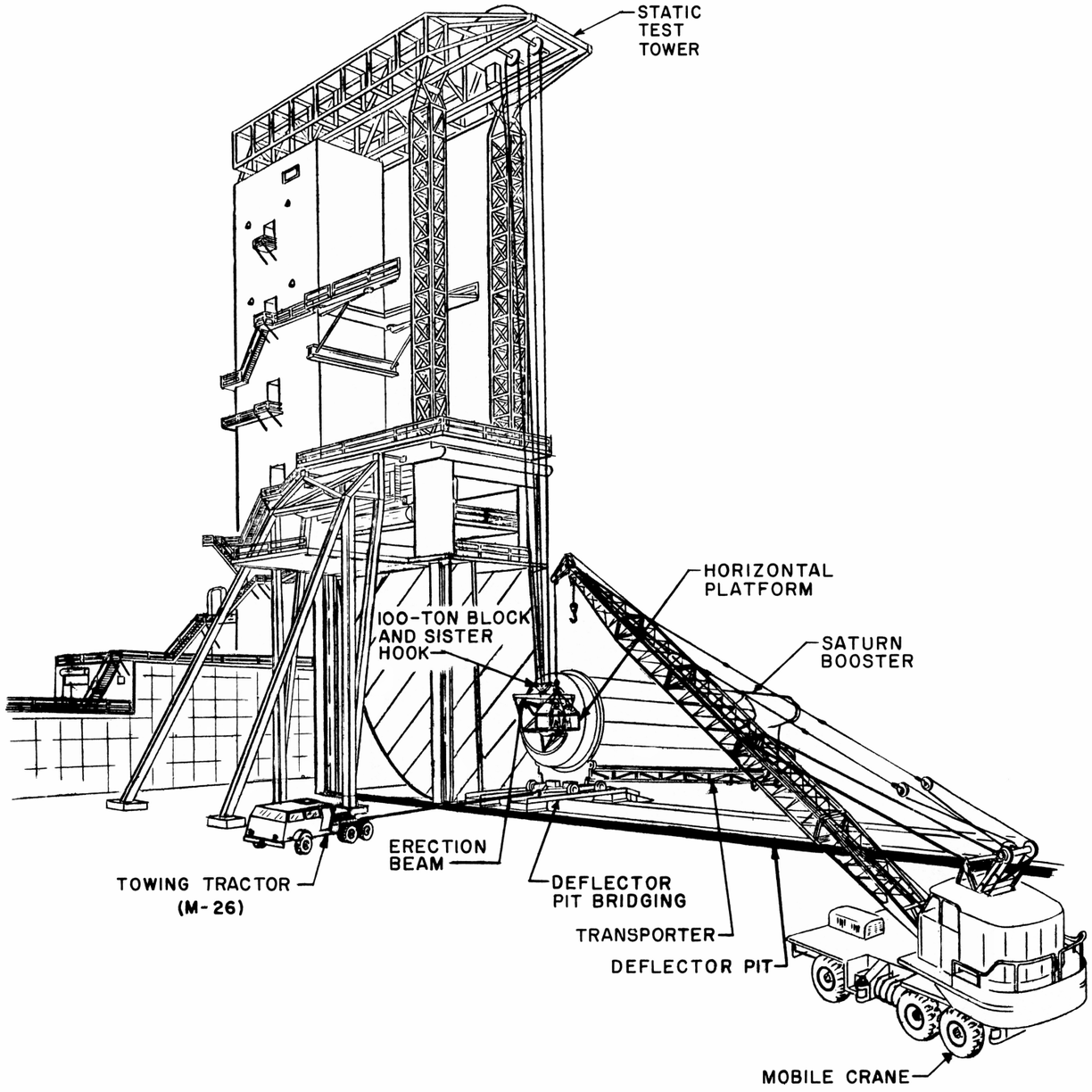
2.1.5.2 Lower 100-ton sister hook block and erection beam to a point in front of booster where personnel can stabilize the erection beam. (See figure 10.) Untie cable assemblies (J-10424771) from second stage adapter and connect to erection beam. (See figure 3.)

2.1.5.3 Maintaining a slight tension on the cable assemblies, raise the erection beam until the erection beam rests against bumper assemblies (D-10426434). (See figure 9.)

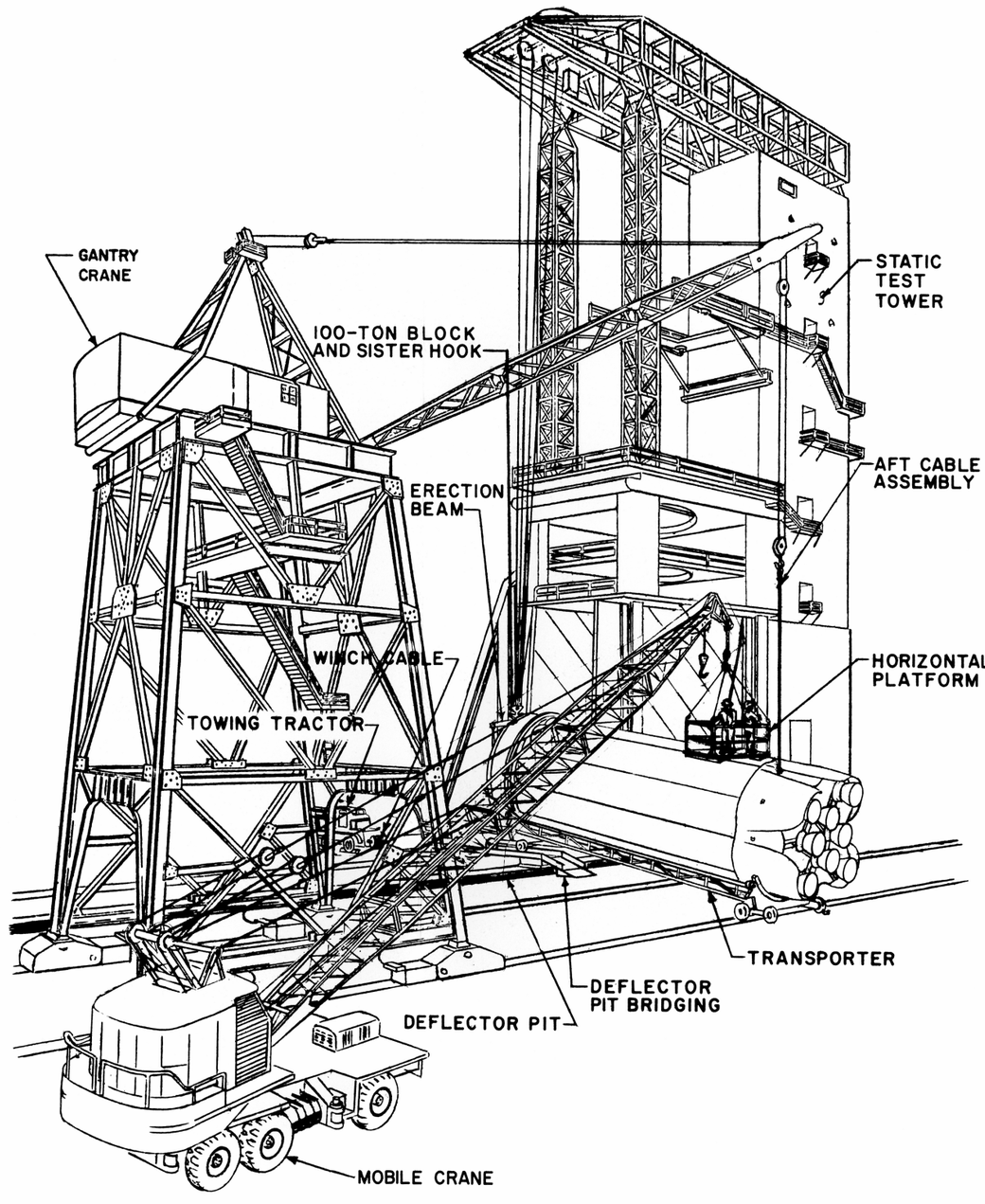
CAUTION: The 100-ton sister hook block must not contact bumper assembly (D-10426438) as this creates a negative angle between the tower crane cables and the horizontal centerline of the booster. This would result in damage to the bumper assembly and the second stage adapter ring. To insure against this type of damage, maintain a visible space between the 100-ton sister hook block and the bumper assembly at all times. (See figure 9 for the desired relative position of the block, bumper assembly, and tower crane cables.)

2.1.5.4 Move mobile crane, horizontal platform, and personnel to north side of deflector pit adjacent to booster in line with outriggers. (See figure 10.)

2.1.5.5 Using mobile crane, position horizontal platform near outrigger No. 5 at Fin Line III and attach aft cable assembly to outrigger No. 5. (See figure 10 for positioning platform and figure 11 connecting aft cable assembly.) (See figure 8 for identification of Fin Lines and outrigger numbers.)

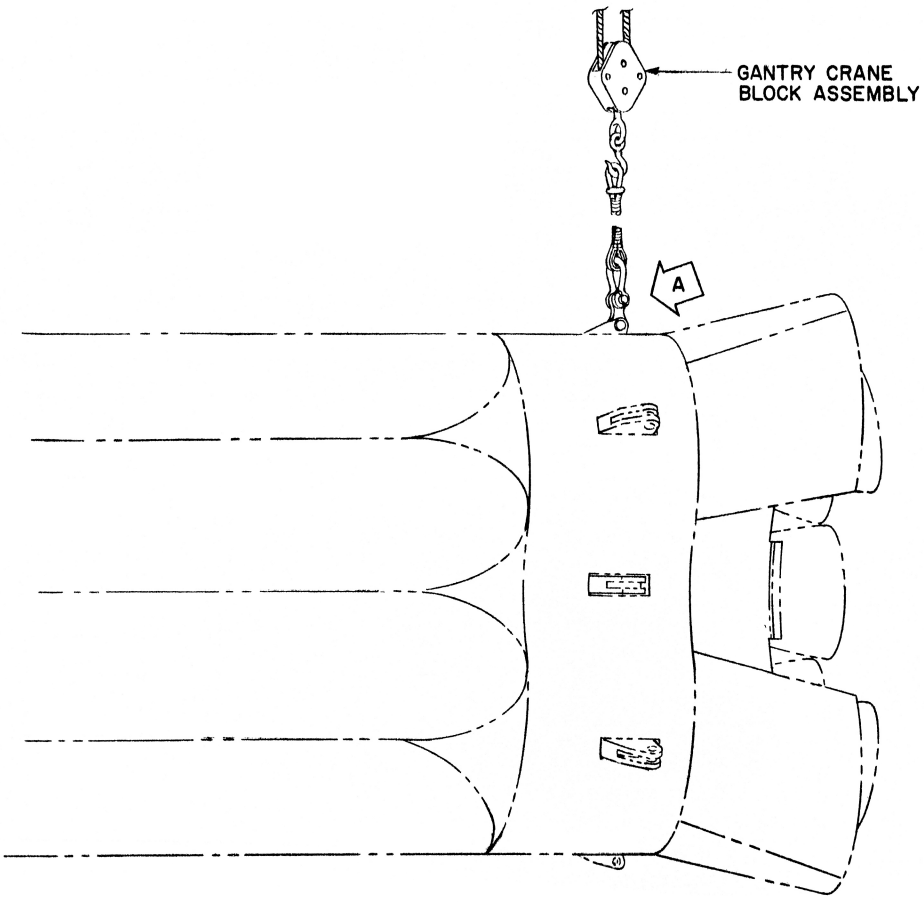


STEP 1
ATTACHING CABLE ASSEMBLIES TO ERECTION BEAM



STEP 2
ATTACHING AFT CABLE ASSEMBLY TO OUTRIGGER NO. 5

FIG. 10 ATTACHING ERECTION BEAM AND CABLE ASSEMBLIES



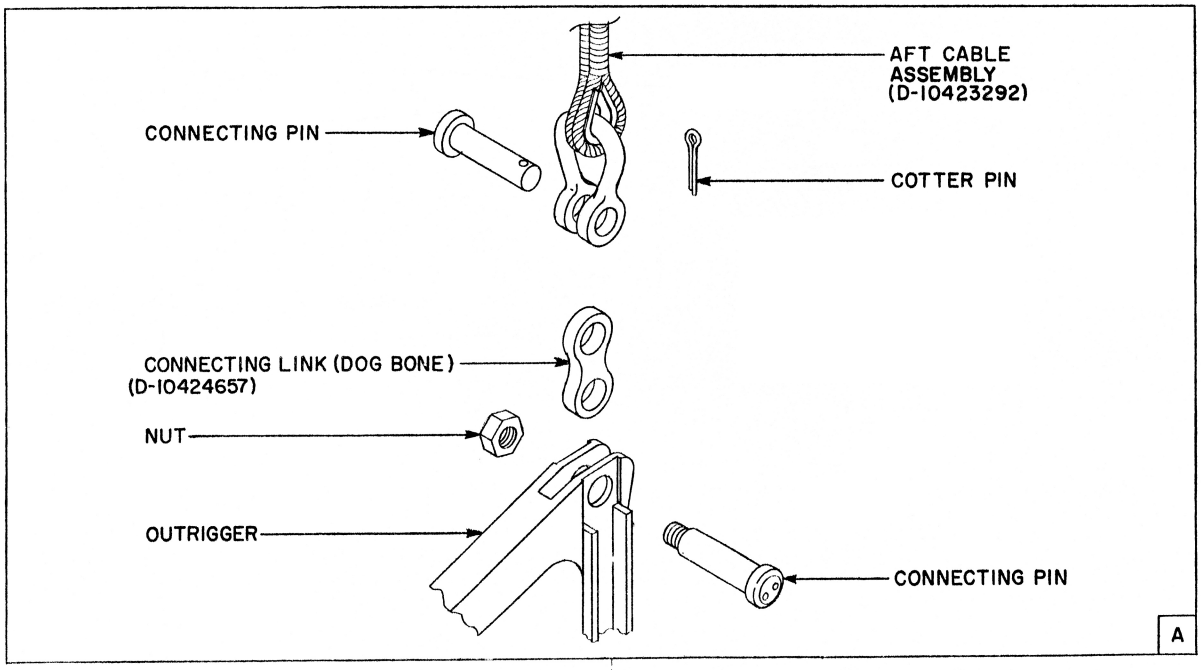


FIG. 11. CONNECTING AFT CABLE ASSEMBLY

2.1.5.6 Lower gantry crane block assembly and attach aft cable assembly to block assembly. (See figure 10.)

NOTE: Prior to the following procedures, substantial lifting forces must be obtained from the tower and gantry cranes to support the booster. The lifting forces should not, however, be great enough to lift the booster as this would cause binding of the hardware yet to be removed from the forward and rear rings.

2.1.5.7 Remove large Bal-lok pin and loosen the forward and aft set screws in tee bracket at outrigger No. 1. The set screw through base of the tee is to remain fixed. Connecting pin remains in outrigger No. 1. (See figure 6.)

2.1.5.8 Using fork lift, raise and position the transportation ring platform and personnel as necessary on each side of the booster at outriggers No. 2 and 8 of rear ring.

2.1.5.9 Remove two remaining bolts through base of each tee bracket at outriggers No. 2 and 8. (See figure 6.)

2.1.5.10 Disconnect tee brackets from outriggers No. 2 and 8 by loosening set screws and removing connecting pins. (See figure 6.)

NOTE: Booster retains the horizontal position and lower section of rear ring remains attached to transporter.

2.1.5.11 Attach two tag lines to each outrigger No. 3 and 7.

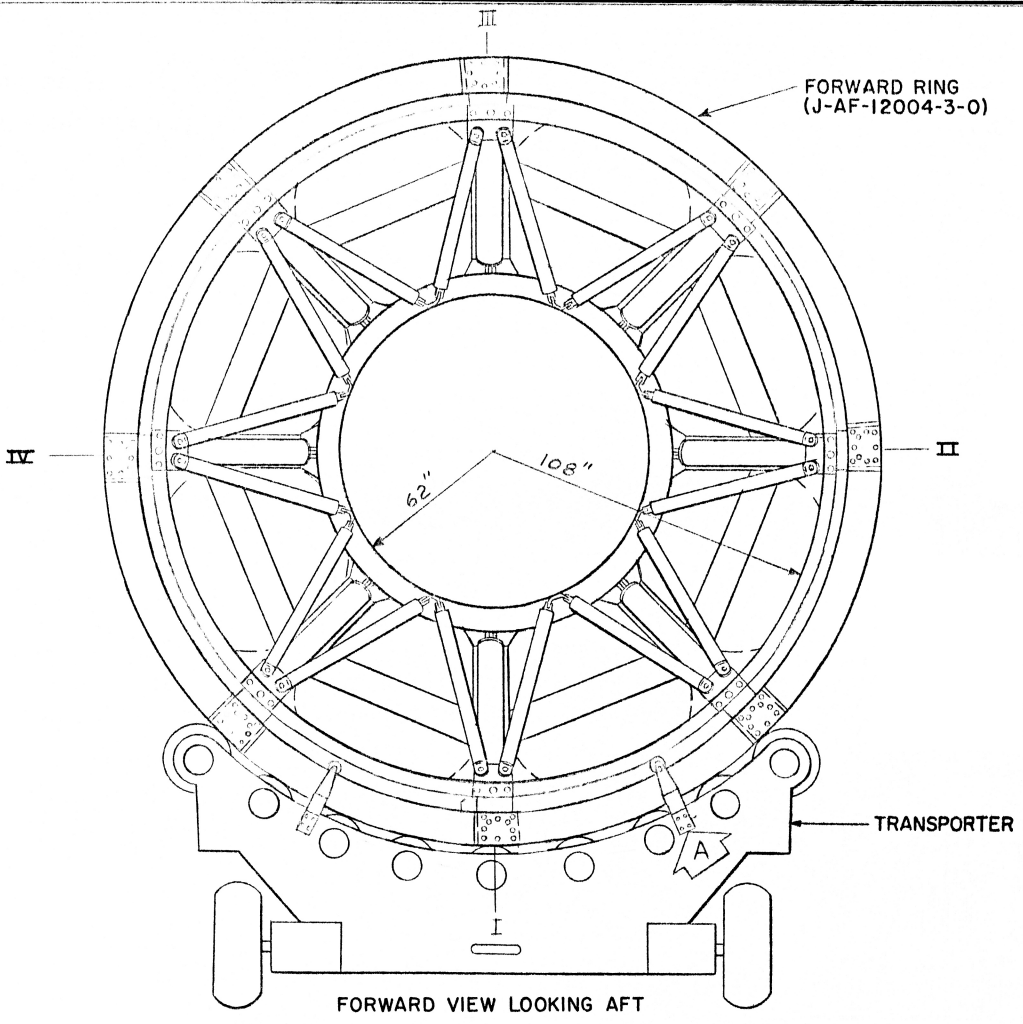
NOTE: Tag lines to be 1-inch diameter hemp rope, or equal, approximately 75 feet long.

2.1.5.12 Place tee brackets on transportation ring platform. Lower personnel and transportation ring platform with fork lift and clear immediate area near rear ring.

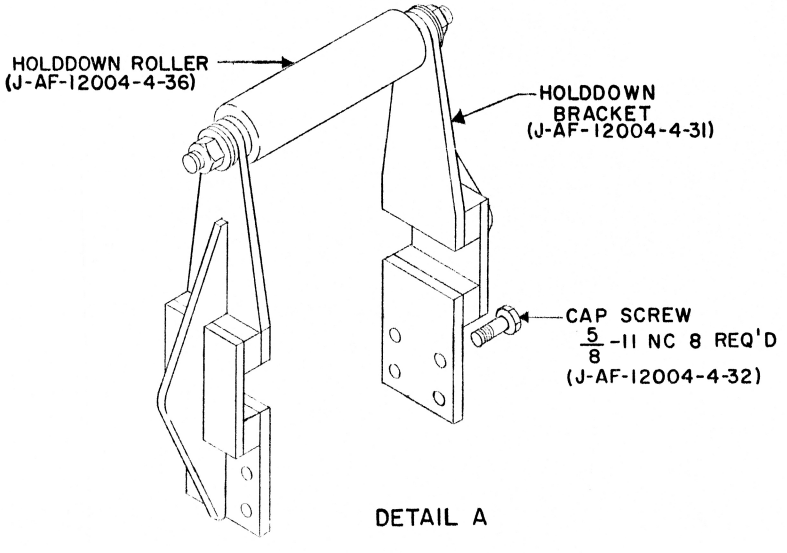
2.1.5.13 Remove support clamps from forward ring and transporter. (See figure 12.)

2.1.5.14 Clean mating surfaces of support clamps and tee brackets with dry cleaning solvent, Federal Specification P-S-661, in accordance with paragraph 3.2.1 of Military Specification MIL-P-116 and apply P-3 corrosion preventive, Military Specification MIL-C-16173, to mating surfaces.

2.1.5.15 Immerse attaching hardware for support clamps and tee brackets in P-9 preservative lubricating oil, Military Specification MIL-L-644.



FORWARD VIEW LOOKING AFT



DETAIL A

FIG.12 FORWARD SUPPORT CLAMPS

2.1.5.16 Move support clamps and tee brackets to adequate storage area, place on cross ties, or equivalent, and cover with a tarpaulin.

2.2 Removing Booster from Transporter and Positioning on Tower Thrust Ring.

2.2.1 Have men hold each of the four tag lines to prevent undue movement of booster as it is raised from the transporter. (See figure 13.)

2.2.1.1 Using tower crane and gantry crane, apply a slight lifting force to raise booster approximately ½-inch above the bottom set screw located in tee bracket at rear outrigger No. 1. (See figures 13 and 14.)

bar

2.2.1.2 Connect towing tractor to the aft end of transporter using tow bar.

2.2.1.3 Using tractor, move transporter forward or aft until the connecting pin in outrigger No. 1 is floating free in the slot of tee bracket at outrigger No. 1. This stabilizes booster preparatory to lifting clear of transporter. (See figures 13 and 14.)

2.2.2 With tower crane and gantry crane lifting simultaneously, hoist booster off transporter to a height that will clear the rear ring section. (See figure 13.)

2.2.3 Using towing tractor, remove transporter from static test area. Clean and preserve transporter using applicable specifications outlined in paragraphs 1.2.5 and 1.2.6.

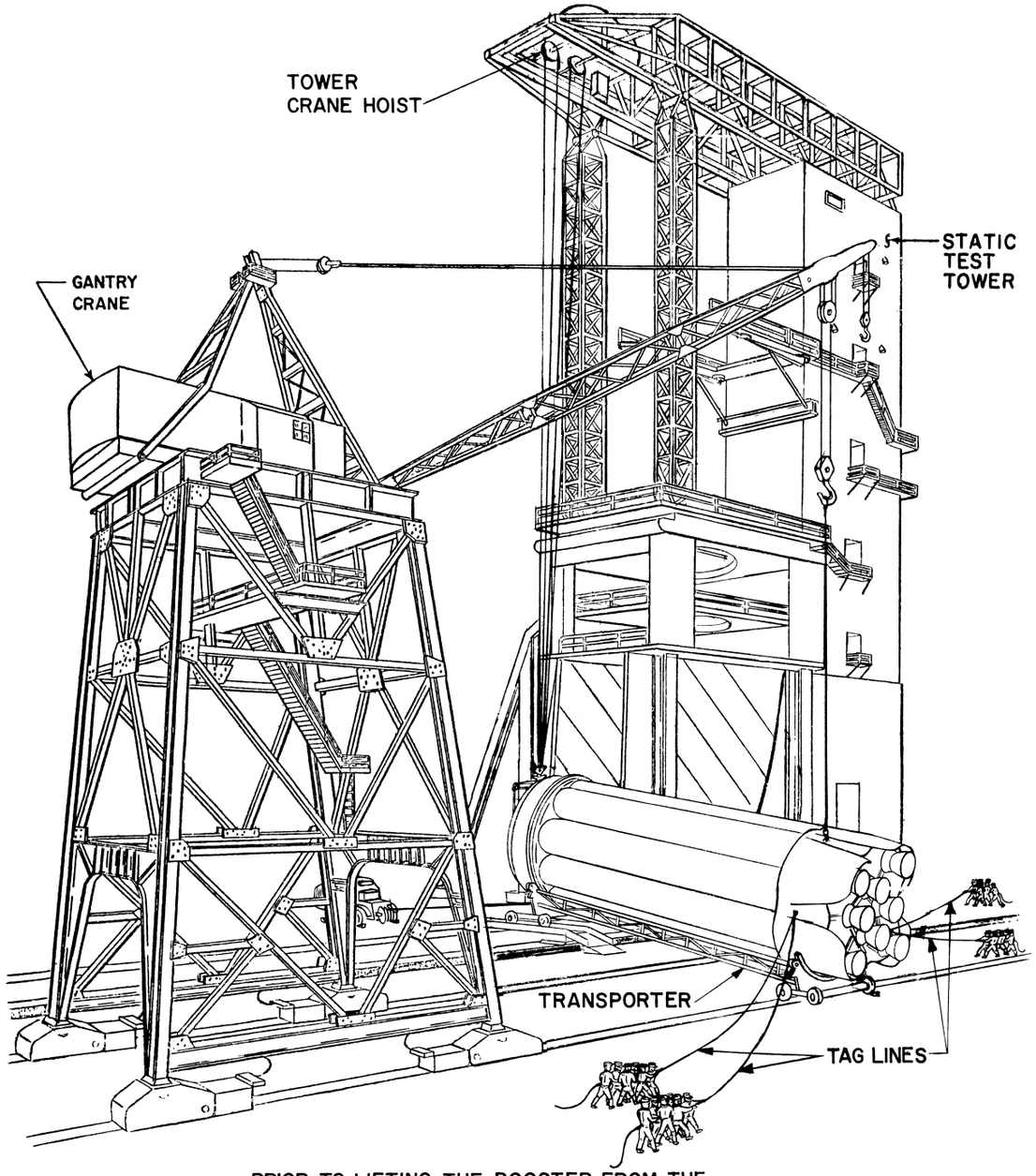
2.2.4 With the booster still in horizontal position, but free of the transporter, remove pin in outrigger No. 1. Attach tag line to outrigger No. 1 if conditions warrant. (See figure 14.)

2.2.5 Using tower crane, hoist booster into vertical position. Use gantry crane to stabilize booster and take up slack during maneuver. (See figure 15.)

2.2.6 Using mobile crane and horizontal platform to gain access to outrigger, disconnect aft cable assembly from outrigger No. 5 at Fin Line III. (See figure 15.) Attach tag line to outrigger No. 5 if conditions warrant.

2.2.7 Lower horizontal platform using mobile crane. Remove mobile crane and horizontal platform from static test area.

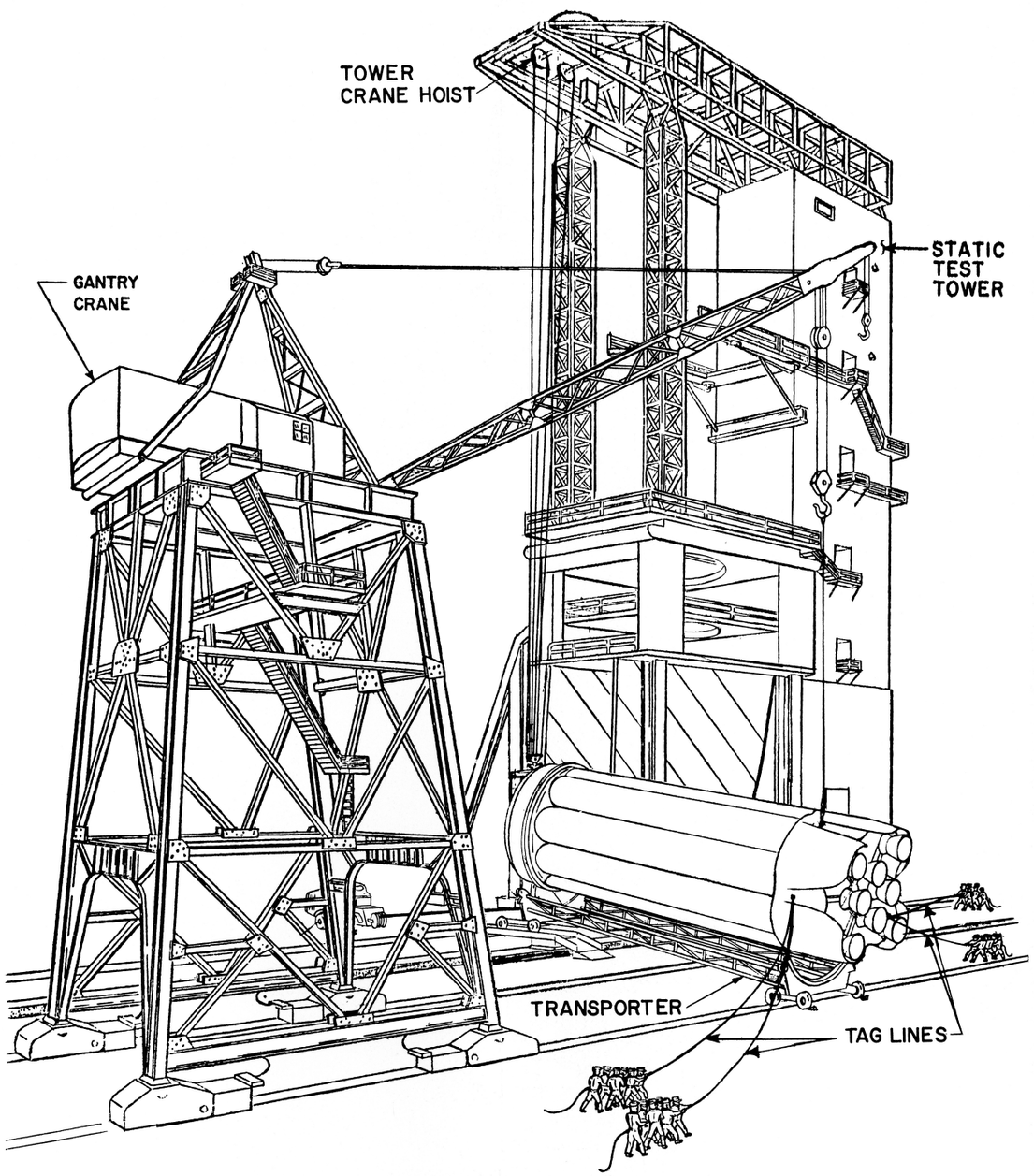
2.2.8 Using tower crane, hoist booster to a height sufficient to clear main load platform; move booster horizontally to a position vertically over opening of main load platform; transfer tag lines to personnel on main load platform; lower booster and position it a few feet above thrust ring. (See figure 15.)



PRIOR TO LIFTING THE BOOSTER FROM THE TRANSPORTER STABILIZE THE BOOSTER SO THAT THE PIN THROUGH OUTRIGGER NO.1 IS FLOATING IN THE RECESS OF TEE BRACKET.

STEP 1

STABILIZING BOOSTER PREPARATORY TO LIFTING OFF TRANSPORTER



STEP 2

LIFTING BOOSTER OFF TRANSPORTER

FIG.13 LIFTING BOOSTER OFF TRANSPORTER

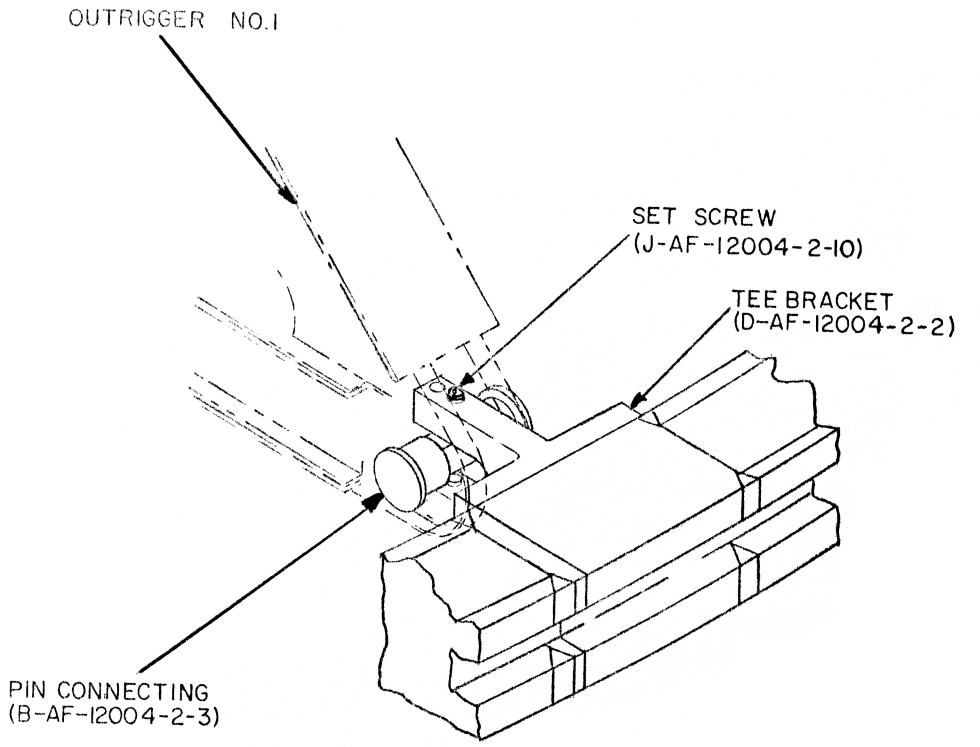
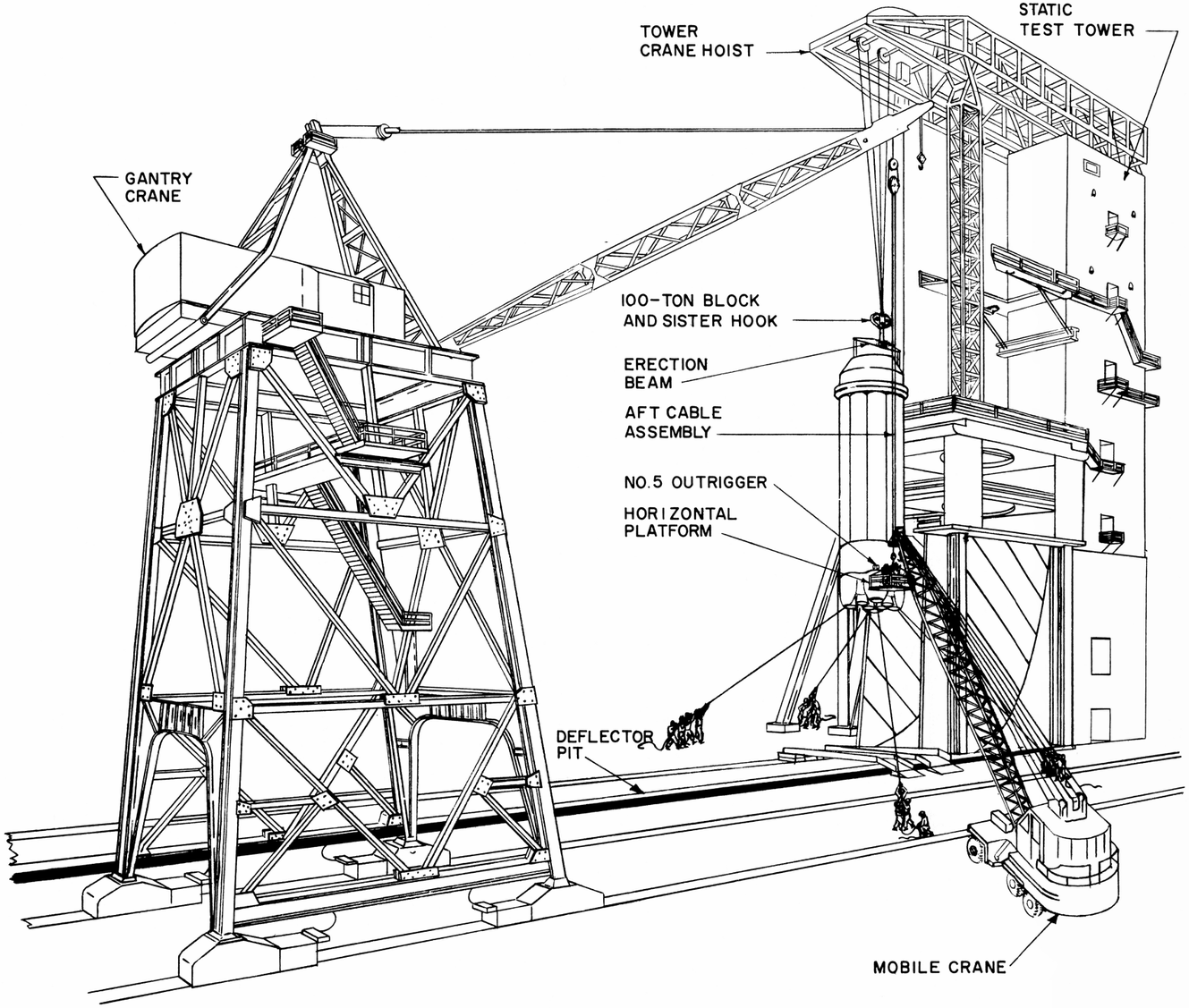
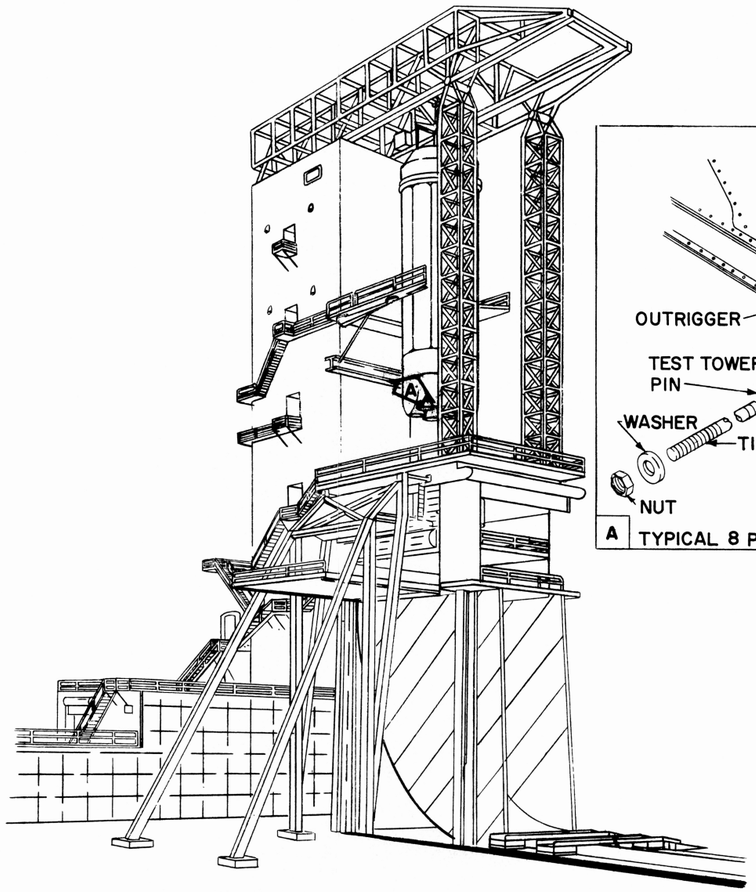


FIG. 14. BOOSTER STABILIZATION PREPARATORY TO LIFTING OFF TRANSPORTER



STEP 1
DETACHING AFT CABLE ASSEMBLY FROM
OUTRIGGER NO. 5



STEP 2
POSITIONING BOOSTER ON TEST TOWER

FIG. 15 BOOSTER IN VERTICAL POSITION

2.2.9 Using tag lines, aline booster outriggers with respective test tower support brackets. (See figure 15.)

2.2.10 Remove tag lines and lower booster through main load platform onto thrust ring, using personnel to steady booster and guide outriggers into support brackets. (See figure 16.)

2.2.11 Insert test tower pins (figure 16) in support brackets in accordance with instructions from M-TEST LAB.

2.2.12 Using gantry crane, remove deflector pit bridging from test tower area.

2.2.13 Remove gantry crane from test tower area.

2.2.14 Disconnect cable assemblies (J-10424771) from second stage adapter. Raise erection beam with cable assemblies attached clear of booster and lower to the ground. (See figure 3.)

CAUTION: Care must be exercised in disconnecting cable assemblies to prevent damage to the second stage adapter.

2.2.15 The removal of bumper assembly (D-10426438) and bumpers (D-10426434) and the installation of original hardware at I-beams No. 3, 4, 5, 6, and 7 is essentially the reverse of instructions as outlined in paragraphs 1.2.1.1 through 1.2.1.4. (See figures 3 and 4.)

2.2.16 Clear test tower area.

3. REMOVING BOOSTER FROM TEST TOWER.

3.1 Preparing Booster for Removal.

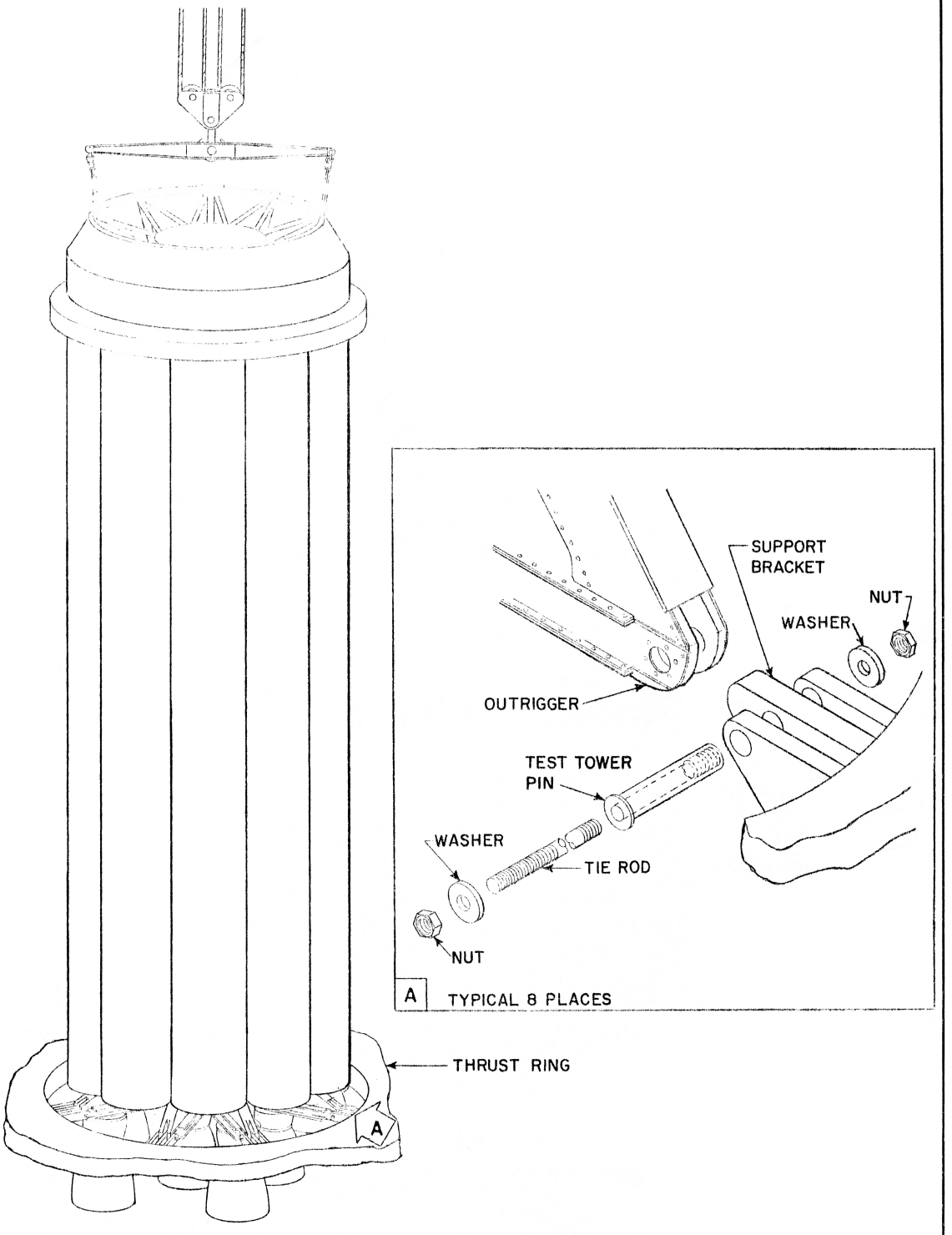
3.1.1 Place deflector pit bridging over deflector pit using gantry crane.

3.1.2 Using towing tractor, position the transporter as close as possible to and in alinement with the deflector pit bridging. Attach gantry crane to drawbar and support the drawbar in a horizontal position.

3.1.3 Disconnect tractor from transporter and move the tractor to the south side of the deflector pit with the tractor winch facing and in line with the transporter. (See figure 1.)

3.1.4 Attach winch to transporter drawbar and winch transporter into position on the deflector pit bridging. (See figure 1.)

3.1.5 When transporter is positioned on deflector pit bridging as shown in figure 1, lock transporter brakes and chock all wheels.



NOTE:
SHROUD NOT SHOWN FOR CLARITY

FIG. 16. POSITIONING BOOSTER ON SUPPORT BRACKET

3.1.6 Lock drawbar in rigid position and disconnect gantry crane. Move tractor to north side of test tower and attach to aft end of transporter.

3.1.7 Using tower crane, lower 100-ton sister block and sister hook, with erection beam and cable assemblies (J-10424771) attached, to a position directly above the second stage adapter.

3.1.8 Remove doors and necessary flight hardware at outriggers No. 3, 4, 5, 6, and 7 as outlined in paragraphs 1.2.1.1 and 1.2.1.2.

3.1.9 Install bumper assembly (D-10426438) in accordance with detail A, figure 3.

3.1.10 Install bumpers (D-10426434) in accordance with detail B, figure 3.

3.1.11 Lower erection beam with cable assemblies attached in position and install cable assemblies (J-10424771) using new bolts, washers, and nuts in accordance with instructions in detail C, figure 3.

WARNING: Correct installation of cable assemblies (J-10424771) is extremely important. New bolts, washers, and nuts shall be used. Lubricating the shanks and threads of bolts (NAS156-68) and each side of the washers (NAS143-16 and NAS143-16C) and obtaining a torque value of 6000 inch pounds (500 foot pounds) from the head of bolts is mandatory to prevent shearing of the attachment hardware during removal of booster from test tower and positioning on transporter.

3.1.12 Quality Control Division shall inspect the installation of the cable assemblies (J-10424771), check and record the torque values of bolts (NAS156-68).

3.1.13 Removal of test tower pins from thrust ring support brackets will be performed in accordance with instructions from M-TEST LAB.

3.1.14 Use personnel to steady booster and to guide outriggers free of thrust ring support brackets.

3.1.15 Attach two tag lines to outriggers No. 3, two to outriggers No. 7, and one each to outriggers No. 1 and 5 if conditions warrant.

NOTE: Tag lines to be 1-inch diameter hemp rope, or equal, approximately 75 feet long.

3.2 Removing Booster from Tower Thrust Ring and Positioning on Transporter.

3.2.1 Prior to removing booster from tower thrust ring, check that the following parts are available:

3.2.1.1	Rear ring section with Fin I identification	(1) required
	NOTE: Rear ring section with Fin I identification is attached to transporter.	
3.2.1.2	Rear ring section with Fin II identification	(1) required
3.2.1.3	Rear ring section with Fin III identification	(1) required
3.2.1.4	Rear ring section with Fin IV identification	(1) required
3.2.1.5	Tee brackets with set screws installed (J-AF-12004-2-2)	(6) required
	NOTE: One tee bracket is attached to rear ring section with Fin I identification and one tee bracket is attached to rear ring section with Fin III identification.	
3.2.1.6	Screw (J-AF-12004-2-8)	(32) required
3.2.1.7	Screw (J-AF-12004-2-13)	(8) required
3.2.1.8	Screw (J-AF-12004-2-17)	(32) required
3.2.1.9	Barrel nut (J-AF-12004-2-6)	(8) required
3.2.1.10	Connecting pin (B-AF-12004-2-3)	(8) required
3.2.1.11	Washer (J-AF-12004-2-5)	(8) required
3.2.1.12	Bal-lok pin (J-AF-12004-2-9)	(8) required
3.2.1.13	Bal-lok pin (J-AF-12004-2-24)	(8) required
3.2.1.14	Bracket (J-AF-12004-4-31)	(4) required
3.2.1.15	Screw (J-AF-12004-4-32)	(16) required
3.2.1.16	Bolt (J-AF-12004-4-33)	(2) required
3.2.1.17	Washer (J-AF-12004-4-34)	(4) required
3.2.1.18	Washer (J-AF-12004-4-35)	(4) required
3.2.1.19	Roller (D-AF-12004-4-36)	(2) required
3.2.1.20	Tubing (J-AF-12004-4-37)	(2) required
3.2.1.21	Hex Nut (J-AF-12004-4-38)	(2) required

3.2.2 Clean mating surfaces of all rear ring sections, tee brackets, support clamps, and attaching hardware with dry-cleaning solvent, Federal Specification P-S-661, in accordance with paragraph 3.2.1 of Military Specification MIL-P-116 and apply a light coat of P-9 preservative lubricating oil, Military Specification MIL-L-644, to all mating surfaces and attaching hardware.

3.2.3 Raise booster to a height of a few feet above thrust ring.

3.2.4 Using tower crane, move booster horizontally to a position vertically over the deflector pit bridging. (See figure 15.)

3.2.5 Have men hold each tag line to prevent undue movement of the booster. (See figure 15.)

3.2.6 Lower booster to a height sufficient to allow attachment of aft cable assembly. (See figure 15.)

3.2.7 Using mobile crane, position horizontal platform and attach aft cable assembly (D-10423292) to outrigger No. 5. (See figure 11.) (See figure 8 for identification of Fin Lines and outrigger numbers.)

3.2.8 Lower horizontal platform and personnel to the ground and move mobile crane and horizontal platform clear of transporter area.

3.2.9 Using tower crane and gantry crane, simultaneously lower booster to a horizontal position directly above transporter. (See figure 13.)

3.2.10 Load tee brackets for outriggers No. 2 and 8, connecting pins, small and large Bal-lok pins for outriggers No. 1, 2, and 8 on transportation ring platform.

NOTE: The tee brackets are match-marked for proper location.

3.2.11 Using fork lift, raise and position the transportation ring platform and personnel as necessary on each side of the booster at tee attachment points of outriggers No. 1, 2, and 8.

3.2.12 Install connecting pin through outrigger bushings at outrigger No. 1, 2, and 8. Secure connecting pins with small Bal-lok pins. See figure 6 for pin locations.

3.2.13 Install tee brackets to outriggers No. 2 and 8. Secure with large Bal-lok pins. See figure 6 for pin locations.

3.2.14 Lower transportation ring platform and personnel to the ground and clear of the area.

3.2.15 Lower booster to reasonable height directly over the transporter so that the connecting pin in outrigger No. 1 is directly above the tee bracket on the bottom rear ring section.

3.2.16 Using towing tractor that is attached to the aft end of transporter, move transporter forward or aft as necessary to position the connecting pin in outrigger No. 1 directly above and in the center of the tee bracket slot on the bottom rear ring section. (See figure 14.)

3.2.17 Lower booster onto transporter; guide connecting pin at outrigger No. 1 into slot of tee bracket at Fin Line I of rear ring section. (See figure 14.)

NOTE: The forward ring is now in position on transporter.

3.2.18 Install two bolts only through base of each tee bracket at outriggers No. 2 and 8 to secure tee brackets to ring section. (See figure 7.)

3.2.19 Adjust set screws in tee brackets at outriggers No. 1, 2, and 8 to center connecting pin in center of tee bracket notch. (See figure 6.)

3.2.20 Install all support clamps that secure the forward ring to the transporter. (See figure 12.)

3.2.21 Using mobile crane, raise horizontal platform and personnel as necessary to disconnect aft cable assembly (D-10423292) from outrigger No. 5. (See figure 11.)

3.2.22 Lower horizontal platform and personnel to the ground and move mobile crane and horizontal platform clear of transporter area.

3.2.23 Using gantry crane, position horizontal platform and personnel in front of booster in a position to disconnect erection beam. (See figure 10.)

3.2.24 Disconnect two cable assemblies (J-10424771) from erection beam. Tie cable assemblies together to prevent damage to booster. (See figure 3.)

3.2.25 Using gantry crane, lower horizontal platform and personnel to the ground.

3.2.36 Raise erection beam to clear booster.

3.3 Installation Procedure Rear Ring Sections (J-AF-12004-2-0).

3.3.1 Using towing tractor, position transporter on north side of static test tower at a right angle to deflector pit and aline with deflector pit bridging at a distance which will provide sufficient working area around the transporter for the mobile crane and fork lift. (See figure 1.)

3.3.2 Lock transporter brakes and chock wheels.

3.3.3 Connect ring handling brackets and choker lines to rear ring section with Fin II identification. (See figure 5, detail A.)

3.3.4 Attach tag line to lower portion of ring section. (See figure 5.)

3.3.5 Using mobile crane with two hooks, position rear ring section with Fin II identification opposite Fin II on booster. Control swinging motion with tag line. (See figure 5.)

3.3.6 Load two tee brackets and attaching hardware on transportation ring platform.

NOTE: Tee brackets are match-marked for outriggers No. 3 and 4.

3.3.7 Using fork lift, raise and position the transportation ring platform and personnel as necessary to a height sufficient to make ring splice connection at outrigger No. 2. (See figure 4.)

3.3.8 Fit rear ring section with Fin II identification to ring section attached to transporter in approximate location. Connect ring sections as follows:

3.3.8.1 Utilizing the 4 1/2-inch screw (J-AF-12004-2-18) and locator (A-AF-12004-2-14) in end holes of each ring section, aline ring sections by tapping screw heads to insert locators into matching holes of opposite ring section. (See figures 6 and 7.)

3.3.8.2 Install remaining two bolts through base of tee bracket at outrigger No. 2. (See figure 6.)

3.3.8.3 Install four 8-inch screws (J-AF-12004-2-17) and tighten to secure rear ring sections at outrigger No. 2. (See figure 7.)

3.3.8.4 Remove two bolts that secure tee bracket to rear ring section with Fin I identification at outrigger No. 2 and remove two barrel nuts (J-AF-12004-2-6) from ring section. (See figures 6 and 7.)

3.3.8.5 Install the remaining screws and tighten all screws to a torque of 700 foot pounds. (See figure 7.)

3.3.8.6 Remove two 4 1/2-inch screws (J-AF-12004-2-18) and install each screw in opposite side of rear ring. Tighten screws to a torque of 700 foot pounds. (See figure 7.)

3.3.8.7 Install two barrel nuts (J-AF-12004-2-6). (See figure 7.)

3.3.9 Position and install tee brackets to ring section at outriggers No. 3 and 4; install two bolts at outrigger No. 2, four bolts at outrigger No. 3, and two bolts at outrigger No. 4. (See figure 6.) (See figure 8 for identification of Fin Line and outrigger numbers.)

3.3.10 Install connecting pins and Bal-lok pins at outriggers No. 3 and 4. (See figure 6.)

3.3.11 Adjust set screws in tee brackets to center connecting pin in notch of tee brackets. (See figure 6.)

NOTE: It may be necessary to readjust set screws to make connection with ring section with Fin III identification.

3.3.12 Remove ring handling brackets and choker and tag lines from ring section with Fin II identification.

3.3.13 Connect ring handling brackets and choker lines to rear ring section with Fin IV identification. (See figure 5.)

3.3.14 Attach tag line to lower portion of ring section. (See figure 5.)

3.3.15 Using mobile crane with two hooks, position rear ring section with Fin IV identification opposite Fin IV on booster. Control swinging motion with tag line. (See figure 5.)

3.3.16 Load two tee brackets and attaching hardware on transportation ring platform.

NOTE: Tee brackets are match-marked for outriggers No. 6 and 7.

3.3.17 Using fork lift, raise and position the transportation ring platform and personnel as necessary to a height sufficient to make ring splice connection at outrigger No. 8. (See figure 4.)

3.3.18 Fit rear ring section with Fin IV identification to ring section attached to transporter in approximate location. Connect ring sections as follows:

3.3.18.1 Utilizing the 4 1/2-inch screw (J-AF-12004-2-18) and locator (A-AF-12004-2-14) in end holes of each ring section, aline ring sections by tapping screw heads to insert locators into matching holes of opposite ring section. (See figure 6.)

3.3.18.2 Install the remaining screws and tighten to a torque of 700 foot pounds. (See figure 6.)

3.3.18.3 Remove two 4 1/2-inch screws (J-AF-12004-2-18) and install each screw in opposite side of rear ring. Tighten screws to a torque of 700 foot pounds. (See figure 6.)

3.3.18.4 Install two barrel nuts (J-AF-12004-2-6) (See figure 6.)

3.3.19 Position and install tee brackets to ring section at outriggers No. 6 and 7; install two bolts at outrigger No. 8, four bolts at outrigger No. 7, and two bolts at outrigger No. 6. (See figure 6.) (See figure 8 for identification of Fin Line and outrigger numbers.)

3.3.20 Install connecting pins and Bal-lok pins at outriggers No. 6 and 7. (See figure 6.)

3.3.21 Adjust set screws in tee brackets to center connecting pin in notch of tee brackets. (See figure 6.)

NOTE: It may be necessary to readjust set screws to make connection with ring section with Fin III identification.

3.3.22 Remove ring handling brackets and choker and tag line from ring section with Fin IV identification.

3.3.23 Using mobile crane, raise and position the horizontal platform and personnel on top of the booster just forward of the rear ring so that the platform is resting firmly in proper position for installation of the upper section of the rear ring. (See figure 4.)

3.3.24 Connect ring handling brackets to ring section with Fin III identification with nuts and bolts and attach tag lines.

NOTE: Rear ring section with Fin III identification has center tee bracket attached.

3.3.25 Using mobile crane with two hooks, lower crane hooks to rear ring section and connect to choker lines.

3.3.26 Connect choker lines to ring handling brackets. Raise rear ring section with Fin III identification to a position where tee bracket is directly above outrigger No. 5. Control swinging movement of rear ring section with tag lines. (See figure 5.)

3.3.27 Install connecting pin in outrigger No. 5. (See figure 6.)

3.3.28 Lower rear ring section with Fin III identification utilizing connecting pin in outrigger No. 5 as a guide to position ring section. (See figure 5.)

3.3.29 Using a fork lift, raise and position the transportation ring platform and personnel as necessary on each side of booster at tee attachment points of outriggers No. 4 and 6. (See figure 4.)

3.3.30 Connect rear ring section with Fin III identification to rear ring sections with Fin II and Fin IV identifications in accordnace with procedures outlined in paragraphs 3.3.8.1 through 3.3.8.7 and paragraphs 3.3.18.1 through 3.3.18.4 respectively.

3.3.31 Install two bolts through base of tee brackets at outriggers No. 4 and 6. (See figure 6.)

3.3.32 Adjust set screws in tee brackets to center connecting pin in notch of tee bracket. (See figure 6.)

3.3.33 Remove ring handling brackets and choker and tag lines from rear ring section with Fin III identification.

3.3.34 Using mobile crane, remove horizontal platform and personnel from top of the booster.

3.3.35 Lower personnel and transportation ring platform to the ground using fork lift.

3.4 Removing Bumper Assembly (D-10426438), Two Bumpers (D-10426434), and Two Cable Assemblies (J-10424771).

3.4.1 Prior to removing bumper assembly (D-10426438), two bumpers (D-10426434), and two cable assemblies (J-10424771), check that the following parts are available. (See figure 2.)

3.4.1.1	Door (D-10411708)	(5) required
3.4.1.2	Plate (D-10411753)	(5) required
3.4.1.3	Screw (7513-1032-12A)	(60) required
3.4.1.4	Pin (C-10411721)	(2) required
3.4.1.5	Pin (C-10411722)	(2) required
3.4.1.6	Nut (NAS-1022-C8)	(4) required
3.4.1.7	Bolt (C-10411723)	(4) required
3.4.1.8	Lock Plate (C-10411724)	(2) required
3.4.1.9	Screw (AN501AC416-8)	(2) required

3.4.2 Using fork lift, raise and position the transportation ring platform and personnel to a height necessary for removal of bumper and cable assemblies. (See figure 3.)

3.4.3 Remove bumper assembly (D-10426438) from second stage adapter by removing bolt (AN12-14) and washer (AN960-1216). (See figure 3, detail A.)

3.4.4 Remove bumper (D-10426434) from second stage adapter at two places by removing bolt (AN14-14) and washer (AN945-14P). (See figure 3, detail B.)

3.4.5 Untie and remove cable assemblies (J-10424771) from second stage adapter. (See figure 3, detail C.)

3.4.6 Install all flight hardware that is called out in paragraphs 3.4.1.1 through 3.4.1.9. (See figure 2.)

3.4.7 Using fork lift, lower transportation ring platform and personnel to the ground.

3.4.8 Store bumper assembly (D-10416438), two bumpers (D-10426434), two cable assemblies (J-10414771), and attaching hardware.

NOTE: Transporter and booster are now ready to be moved from the test tower area.

CHAPTER II

TRANSPORTATION, HANDLING, AND ERECTION AT CAPE CANAVERAL

1. PREPARING BOOSTER FOR ERECTION.

NOTE: The actual time of erection should be scheduled at the time of day when the wind speed is slowest. The procedures outlined in this chapter recommend erection at wind speeds of 15 MPH or less. The following table shows loads imparted to the booster at different wind speeds.

TABLE I - EFFECTS OF WIND SPEED DURING ERECTION OF BOOSTER

WIND SPEED (MPH)	WIND FORCE ON BOOSTER (LBS)
5	100
10	350
15	800
20	1250
25	2250
30	3200
35	4375
40	5700
45	7200

1.1 Preparing Service Structure for Erection.

1.1.1 Position bridge crane at 160-foot level. (See figure 17.)

1.1.2 Lower 60-ton block from bridge crane and attach erecting beam (J-10423194). Raise 60-ton block and erecting beam clear of the work area. (See figure 17.)

1.1.3 Lower 40-ton block from bridge crane and attach aft cable assembly (D-10423292). (See figure 17.) Raise 40-ton block and aft cable assembly clear of the work area.

1.2 Positioning Transporter (J-AF-12004).

1.2.1 Using towing tractor, position transporter and booster in vicinity of launch pedestal, out of way of other equipment and with adequate clearance on all sides of transporter to maneuver fork lift and mobile crane. (See figure 18.)

1.2.2 Lock transporter brakes and chock wheels.

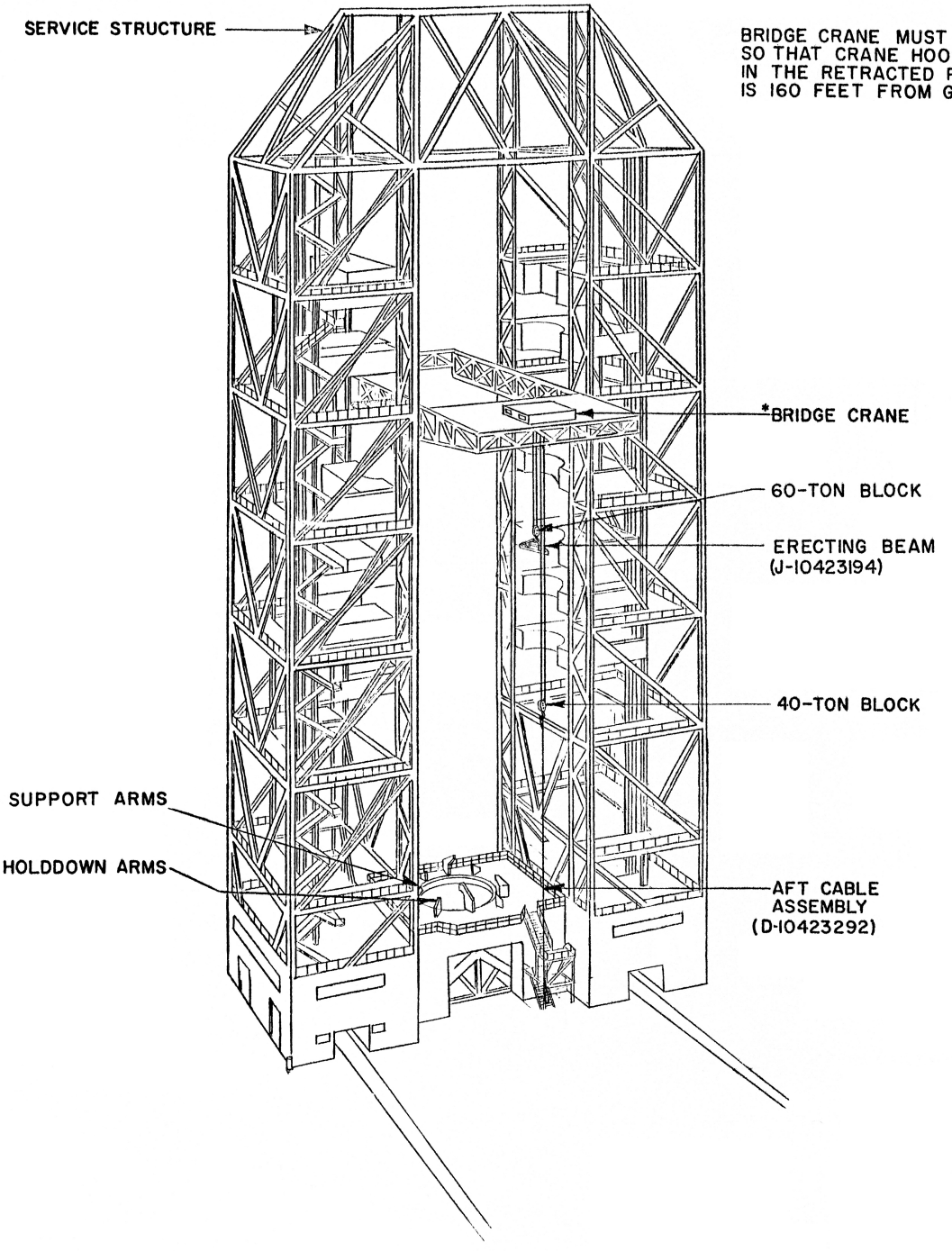


FIG. 17. PREPARING SERVICE STRUCTURE FOR ERECTION

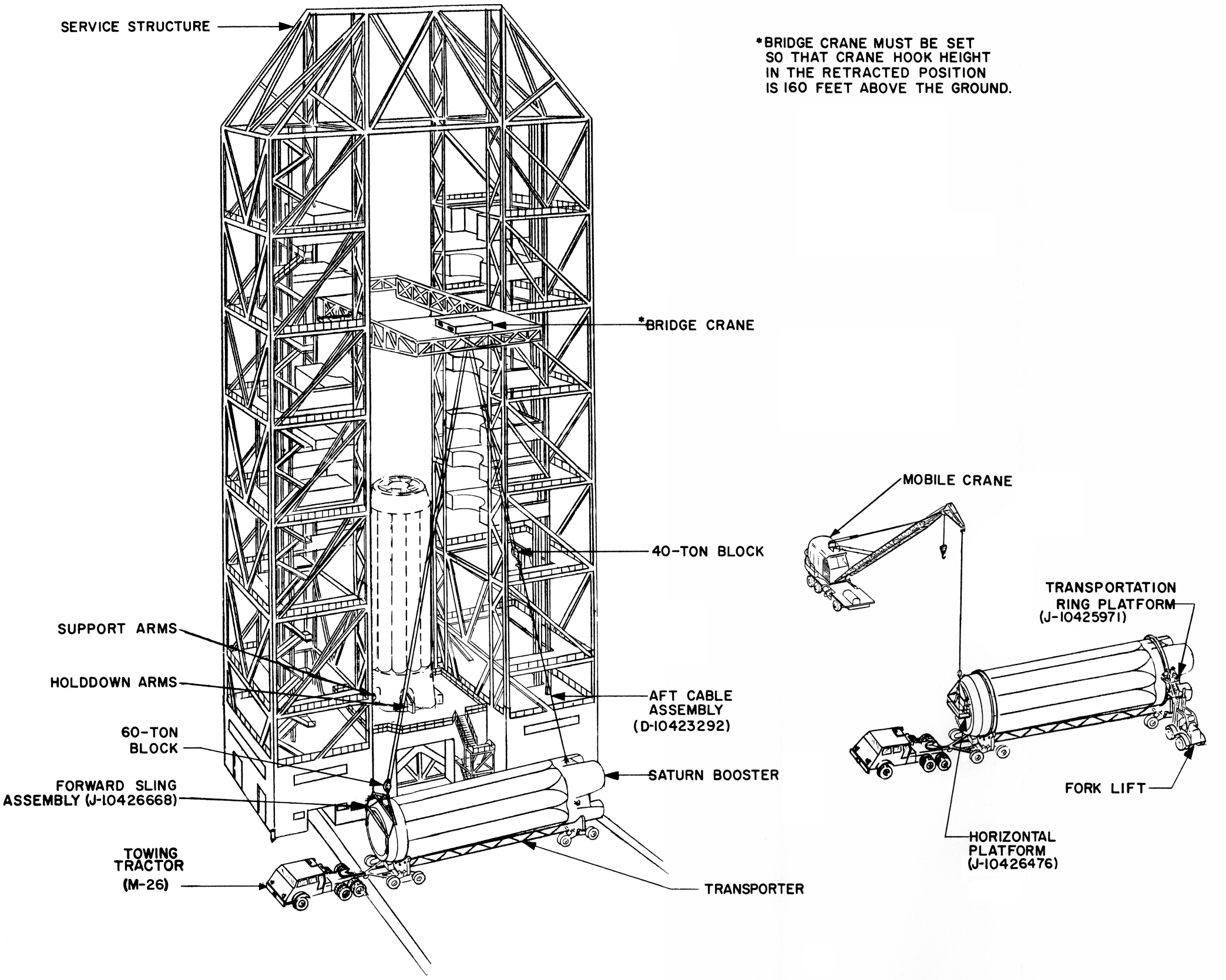


FIG.18 POSITIONING EQUIPMENT AT FIRING SITE

1.2.3 Disconnect tow bar from transporter and move towing tractor and tow bar to allow adequate clearance on all sides of transporter.

1.3 Installing Beam Weldment (J-10426675) and Forward Sling Assemblies (J-10426668).

1.3.1 Using fork lift, raise transportation ring platform and personnel to a height necessary for attaching beam weldment (J-10426675) and forward sling assemblies (J-10426668). (See figure 19, step 1.)

1.3.2 Remove doors (D-10411708) and plates (D-10411753) attached to interstage fairing and second stage adapter at outriggers No. 3, 4, 6, and 7, to gain access to beam weldment and forward sling assembly attaching points. (See figure 2.)

1.3.3 Remove attaching hardware that secures interstage fairing to second stage adapter at attaching points for beam weldment and forward sling assemblies as shown in figure 2.

1.3.4 Install mounting brackets (J-10427014 and J-10427097) on second stage adapter using two bolts (AN14C-32), washers (AN960-1416), and nuts (AN325-14) for each mounting bracket as shown in figure 20, detail B.

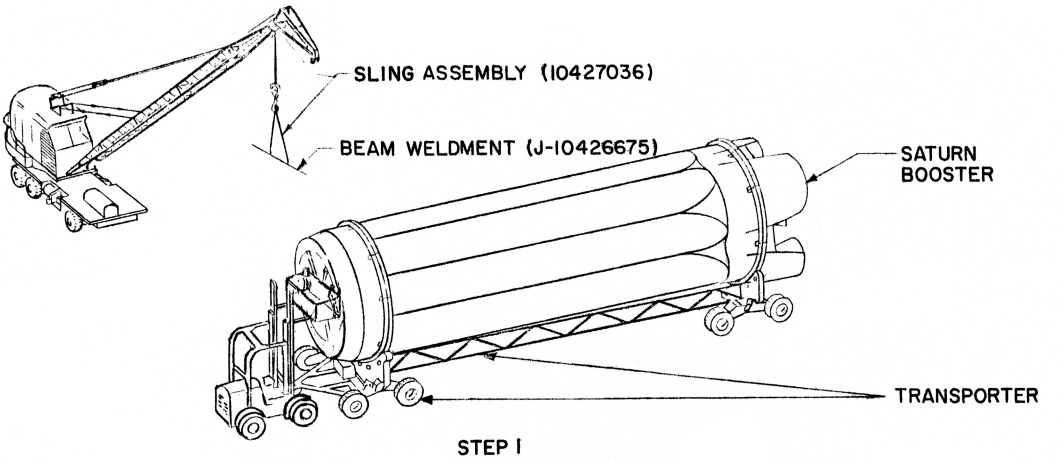
1.3.5 Using mobile crane and two sling assemblies (10427036), raise beam weldment (J-10426675) into position and attach beam weldment to mounting brackets (J-10427014 and J-10427097) with bolts (AN16C-54) and nuts (AN325-16) as shown in figures 19 and 20, detail B.

1.3.6 Attach forward sling assemblies (J-10426668) to second stage adapter at Fin Lines II and IV using bolts (NAS156-68), washers (NAS143-16 and NAS143-16C), and nuts (C-424316) as shown in Figure 20, detail A.

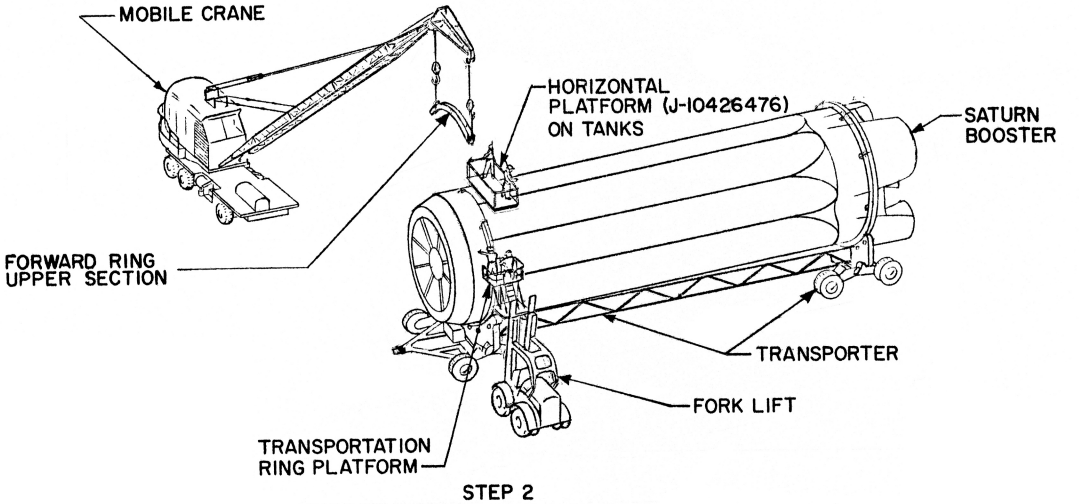
WARNING: Correct attachment of the forward sling assemblies (J-10426668) is extremely important. New bolts, washers, and nuts shall be used. Lubrication and torque values as defined in detail A, figure 20 are mandatory to avoid shearing of attaching hardware. Attachment lug must be in same line of pull as cable.

1.3.7 Quality Control Division shall inspect the installation of the sling assemblies (J-10426668). Check and record the torque values of bolts (NAS156-68).

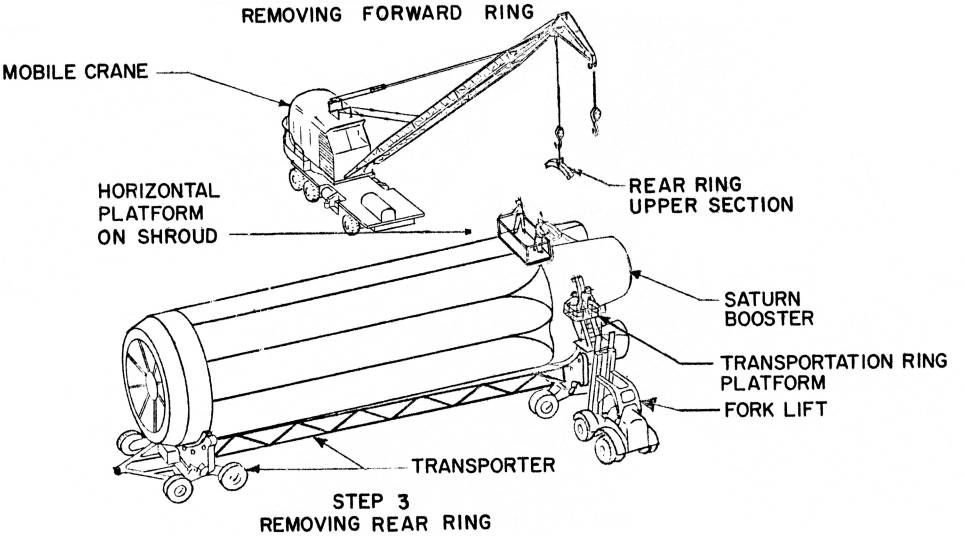
1.3.8 Tie forward sling assembly cables to beam weldment with rope or wire to avoid damaging second stage adapter.



STEP 1
CONNECTING FORWARD SLING ASSEMBLIES AND BEAM WELDMENT

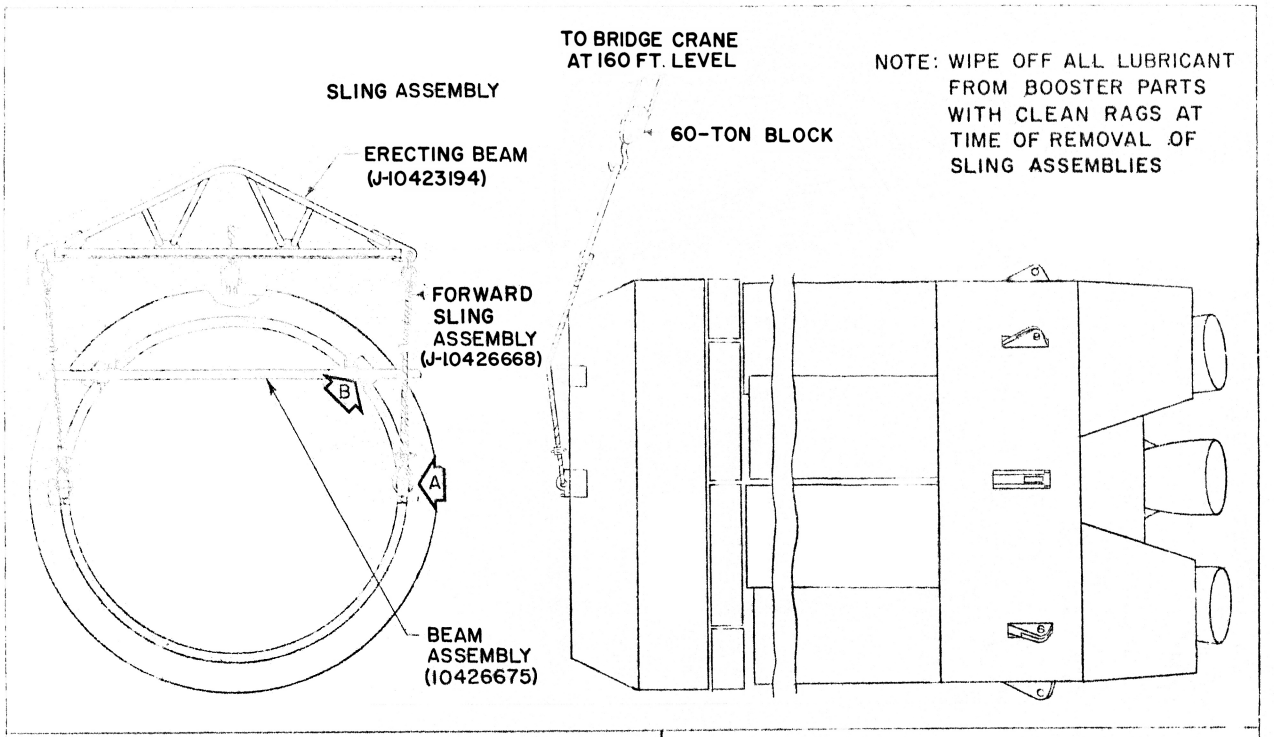


STEP 2
REMOVING FORWARD RING



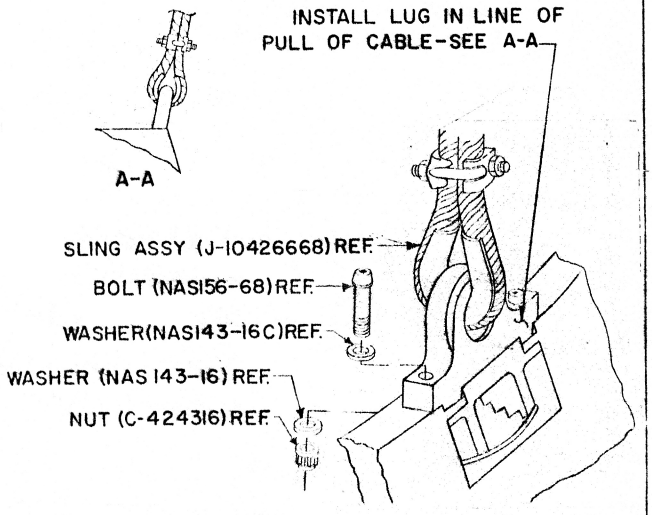
STEP 3
REMOVING REAR RING

FIG. 19 PREPARING BOOSTER FOR ERECTION

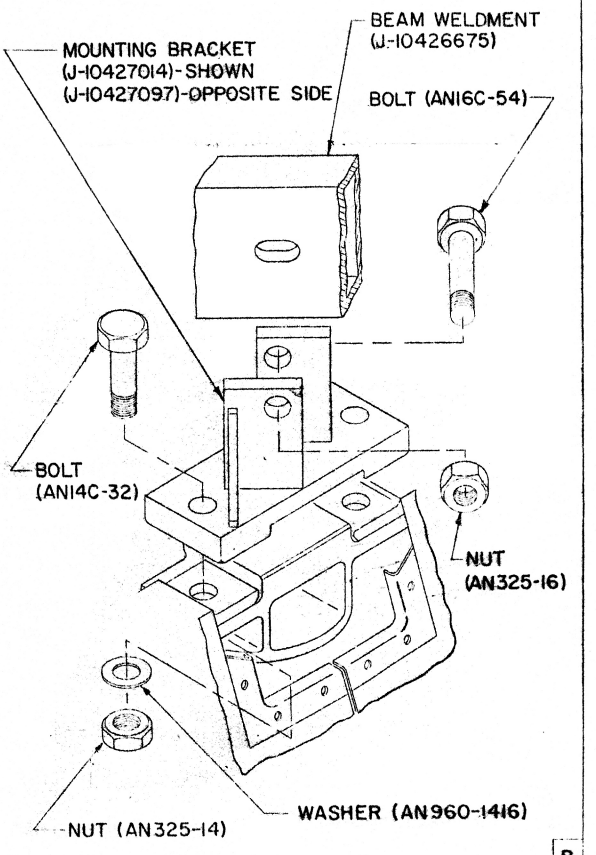


TORQUE HEAD OF BOLT (NAS156-68) TO 6000 INCH LBS (500 FT. LBS). LUBRICATE THREADS, SHANK OF BOLT & EACH SIDE OF WASHER BEFORE INSTALLATION WITH MOLYKOTE TYPE "G".

NOTE: WHENEVER SLING ASSEMBLIES (J-10426668) ARE ATTACHED, NEW BOLTS, WASHERS, AND NUTS SHALL BE INSTALLED. USED HARDWARE TO BE DISCARDED.



A



B

FIG. 20. INSTALLATION OF BEAM WELDMENT AND FOWARD SLING ASSEMBLIES

1.4 Removal Procedure Forward Ring Sections (J-AF-12004-3-0).

1.4.1 Position mobile crane so that the two crane hooks are directly above the forward ring. The mobile crane is now in a position so the boom can be maneuvered for all forward ring disassembly operations.

1.4.2 Using mobile crane, raise and position the horizontal platform and personnel on top of the booster just aft of the forward ring so that the platform is resting firmly on top of two 70-inch tanks. Working from the horizontal platform complete the following procedures: (See figure 19, step 2.)

1.4.2.1 Connect ring handling brackets to forward ring section with Fin III identification with nuts and bolts. (See figure 21.)

1.4.2.2 Lower crane hooks to work area and connect to choker lines.

1.4.2.3 Connect choker lines to ring handling brackets and put slight tension on crane cables. Attach tag line to lower position of ring section. (See figure 21, detail A.)

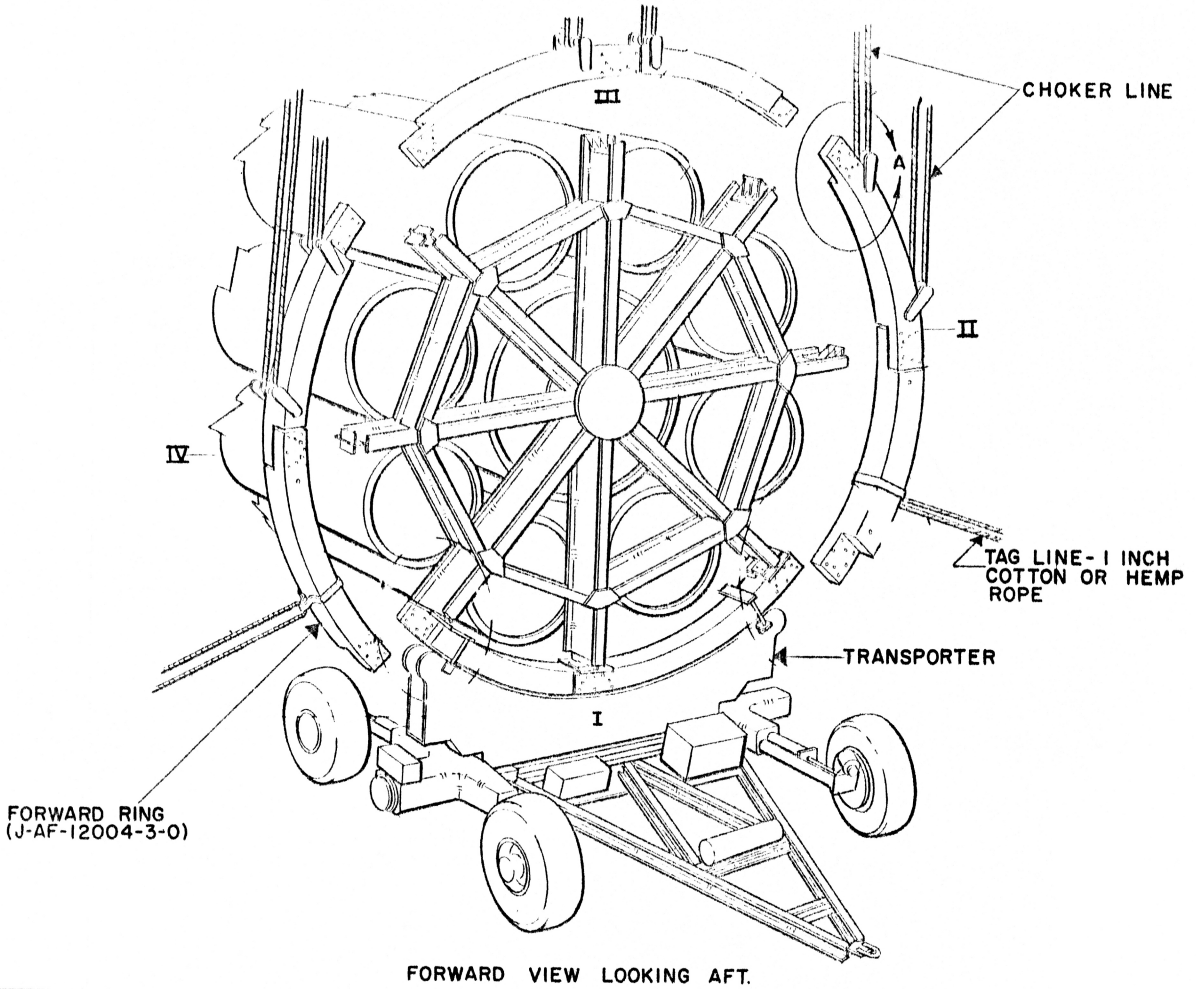
1.4.2.4 Disconnect tee bracket from forward ring section at I-beam No. 5 by removing four bolts, nuts, and washers and key retaining screw and key. (See figure 22.) Leave tee bracket bolted to the I-beam.

1.4.3 Using fork lift, raise and position transportation ring platform and personnel as necessary on each sied of the booster at ring section separation and tee attachment locations at I-beams No. 4 and 6. (See figure 19, Step 2.) (See figure 22 for identification of Fin Lines and I-beams).

1.4.4 Disconnect tee brackets from forward ring at I-beams No. 4 and 6 by removing four bolts, nuts, and washers and key retaining screw and key at each tee bracket. (See figure 22.)

1.4.5 Disconnect and remove forward ring section with Fin III identification as follows: (See figure 23.)

1.4.5.1 Remove two 4 1/2-inch screws (J-AF-12004-3-12) from forward ring sections at I-beams No. 4 and 6. Insert these screws in opposite holes and tighten screws to pull locators to the disconnect position.



FORWARD VIEW LOOKING AFT.

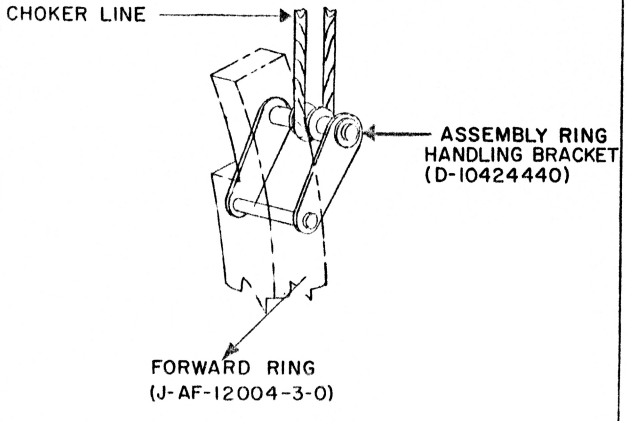
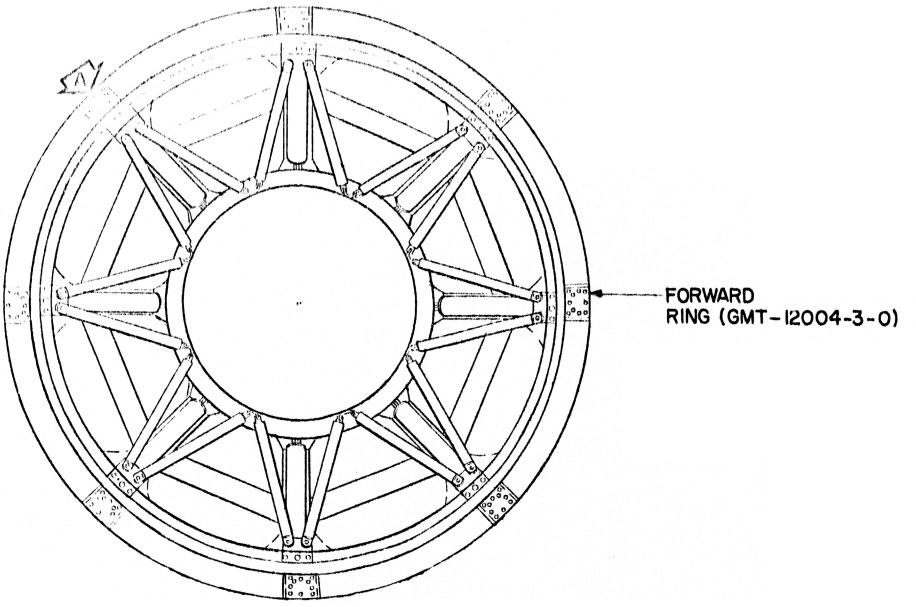


FIG. 21. REMOVING FORWARD RING SECTIONS (J-AF-12004-3-0)



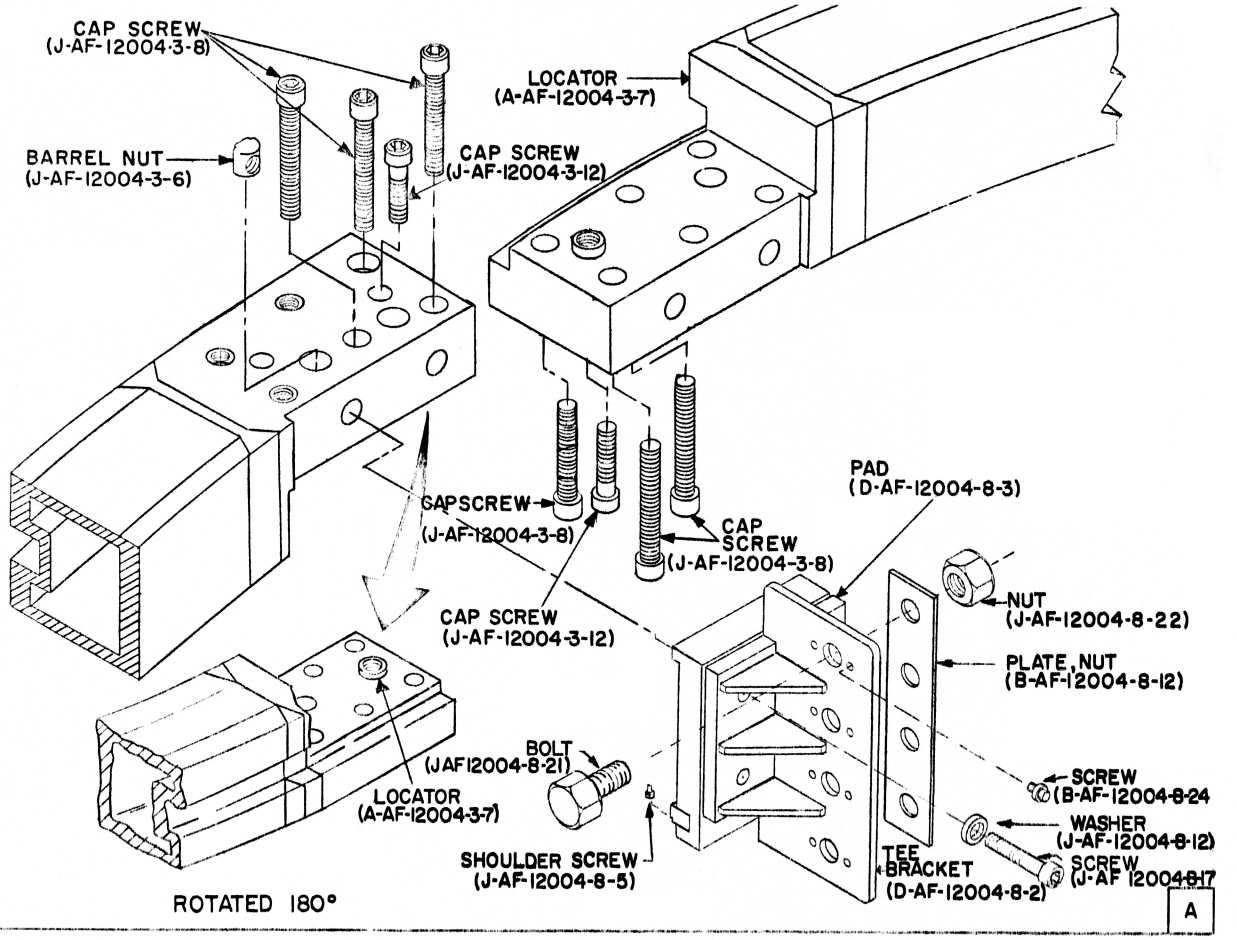


FIG. 22. FORWARD RING SECTION ATTACHING POINTS

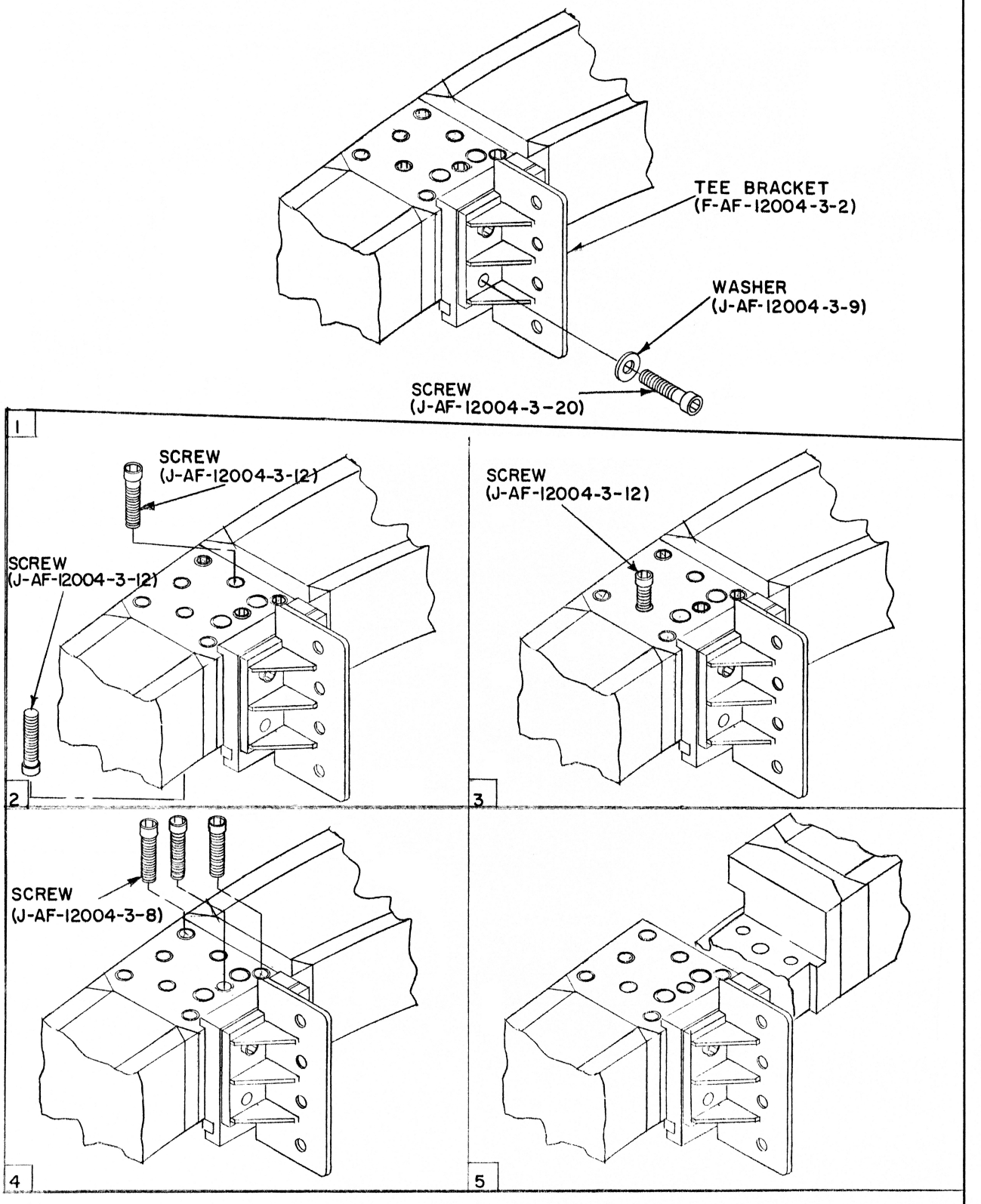


FIG. 23. FORWARD RING SECTION REMOVAL PROCEDURES

NOTE: The 4 1/2-inch screws (J-AF-12004-3-12) and locators (A-AF-12004-3-7) remain with the forward ring sections.

1.4.5.2 Remove six 8-inch screws (J-AF-12004-3-8) from each end of forward ring section with Fin III identification.

1.4.5.3 Using mobile crane, lower forward ring section with Fin III identification to the ground. Use tag line to control swinging motion.

1.4.5.4 Disconnect ring handling brackets from forward ring section with Fin III identification.

1.4.6 Disconnect tee bracket from I-beam No. 5 by removing four bolts, nut plate, and nuts. (See figure 23 detail A.)

1.4.7 Thread rope through 1-inch diameter hole of tee bracket. Attach rope to mobile crane hook and lower bracket to the ground.

1.4.8 Using mobile crane, lower horizontal platform and personnel to the ground.

1.4.9 Using fork lift, lower transportation ring platform and personnel to I-beam No. 7. (See figure 19, step 2.)

1.4.10 Connect ring handling brackets to forward ring section with Fin II identification with nuts and bolts. (See figure 21, detail A.)

1.4.11 Lower crane hooks to work area and connect to choker lines.

1.4.12 Connect choker lines to ring handling brackets and put slight tension on crane cables. Attach tag lines to lower portion of ring section.

1.4.13 Disconnect tee bracket from forward ring section at I-beam No. 7 by removing four bolts, nuts, and washers and key retaining screw and key. (See figure 22, detail A.)

1.4.14 Remove two bolts, nuts, and washers from base of tee bracket at I-beam No. 8.

1.4.15 Disconnect and remove forward ring section with Fin II identification as follows: (See figure 23.)

1.4.15.1 Remove two 4 1/2-inch screws (J-AF-12004-3-12) from forward ring sections at I-beam No. 8. Insert these

1.4.15.1 (Con.)

screws in opposite holes and tighten screws to pull locators to the disconnect position.

NOTE: The 4 1/2-inch screws (J-AF-12004-3-12) and locators (A-AF-12004-3-7) remain with the forward ring sections.

1.4.15.2 Remove six 8-inch screws (J-AF-12004-3-8) from end of forward ring section with Fin II identification at I-beam No. 8.

1.4.15.3 Lower transportation ring platform and personnel to the ground and move fork lift clear of ring area.

1.4.15.4 Using mobile crane, lower forward ring section with Fin II identification to the ground. Use tag line to control swinging motion.

1.4.15.5 Disconnect ring handling brackets and tag line from forward ring section with Fin II identification.

1.4.16 Reposition fork lift, raise transportation ring platform and personnel to I-beams No. 6 and 7.

1.4.17 Thread a rope through the 1-inch diameter holes in base of tee brackets No. 6 and 7.

1.4.18 Disconnect tee bracket from I-Beams No. 6 and 7 by removing four bolts, nut plate, and nuts at each tee bracket and lower tee brackets to the ground. (See figure 21.)

1.4.19 Reposition fork lift; raise transportation ring platform and personnel to I-beam No. 3. (See figure 19, step 2.)

1.4.20 Remove forward ring section with Fin IV identification in accordance with the applicable procedures outlined in paragraphs 1.4.10 through 1.4.18.

1.4.21 Using fork lift, lower transportation ring platform and personnel to the ground.

1.4.22 Clean and preserve forward ring components and attaching hardware in accordance with paragraph 4.2.

NOTE: The forward end of the booster is now resting on three points, tee brackets at I-beams No. 1, 2, and 8, of the forward ring section with Fin I identification. Tee brackets at I-beams

1.4.22 NOTE: (Con.)

No. 2 and 8 are still connected to the I-beams and have two of the four bolts through their base to the ring section still installed. Tee bracket at I-beam No. 1 is intact and will not be disconnected until erection cables are connected and slight lifting forces obtained.

1.4.23 Move ring details to adequate storage area, place on cross ties, or equivalent, and cover with a tarpaulin.

1.5 Removal Procedure Rear Ring Sections (J-AF-12004-2-0).

1.5.1 Position mobile crane so that the two crane hooks are directly above the rear ring. The crane boom can now be maneuvered for removal of all rear ring sections.

1.5.2 Using mobile crane, raise and position the horizontal platform and personnel on top of the booster just forward of the rear ring so that the platform is resting firmly in proper position for removal of the rear ring section with Fin III identification. (See figure 4.) Working from the horizontal platform, complete the following procedures:

1.5.2.1 Connect ring handling brackets to rear ring section with Fin III identification with bolts and nuts. (See figure 5, detail A.)

1.5.2.2 Lower Crane hooks to work area and connect to choker lines. Connect choker lines to ring handling brackets and put slight tension on crane cables. (See figure 5, detail A.)

1.5.2.3 Disconnect tee bracket from outrigger No. 5 by loosening set screws and removing connecting pin. (See figure 6.)

1.5.3 Using fork lift, raise and position the transportation ring platform and personnel as necessary on each side of the booster at outriggers No. 4 and 6. (See figure 4.) Working from the transportation ring platform, complete the following procedures to remove rear ring section with Fin III identification.

1.5.3.1 Disconnect tee brackets at outriggers No. 4 and 6 from rear ring by removing four bolts and washers through each tee bracket to the ring. (See figure 6.)

1.5.3.2 Remove the 4 1/2-inch screws (J-AF-12004-2-18) from end holes of each ring section. Insert these screws

1.5.3.2 (Con.)

in holes on opposite side of ring sections and tighten screws to pull locators (A-AF-12004-2-14) to the disconnect position. (See figure 6.)

NOTE: One 4 1/2-inch screw (J-AF-12004-2-18) and one locator (A-AF-12004-2-14) are located in the end hole of each ring section; therefore, when the ring sections are connected, one screw is on the forward side of the rear ring and one screw is on the aft side of the rear ring at each splice joint. Screws (J-AF-12004-2-18) and locators (A-AF-12004-2-14) remain with the ring sections.

1.5.3.3 Disconnect rear ring section with Fin III identification from rear ring sections at outriggers No. 4 and 6 by removing two barrel nuts (J-AF-12004-2-6) and six screws (J-AF-12004-2-17) at each end. (See figures 5 and 6.) (See figure 8 for identification of finglines and outrigger numbers.)

1.5.3.4 Connect tag line to rear ring section with Fin III identification and hoist off of booster and lower into working area. Use tag line to control swinging movement. (See figure 5.)

1.5.3.5 Disconnect ring handling brackets from rear ring section with Fin III identification and remove choker lines from mobile crane hooks.

1.5.3.6 Using mobile crane, lower horizontal platform and personnel to the ground.

1.5.4 Using fork lift, raise and position transportation ring platform and personnel to a height as necessary for removal of rear ring section with Fin IV identification. (See figure 4.) Working from the transportation ring platform, complete the following procedures:

1.5.4.1 Connect ring handling brackets to rear ring section with Fin IV identification with bolts and nuts. (See figure 5.)

1.5.4.2 Using mobile crane with two hooks, lower crane hooks to work area and connect to choker lines.

1.5.4.3 Connect choker lines to ring handling brackets on rear ring section with Fin IV identification and put slight

1.5.4.3 (Con.)

tension on crane cables. (See figure 5.)

1.5.4.4 Disconnect tee bracket from rear ring section at outrigger No. 7 by removing four bolts from base of tee. Remove two bolts only from base of tee bracket at outrigger No. 8. (See figure 6.)

NOTE: The remaining two bolts through the base of the tee bracket at outrigger No. 8 will remain installed until erection cables are connected and slight lifting forces are obtained from the service structure.

1.5.4.5 Disconnect rear ring section with Fin IV identification by performing the applicable procedures outlined in paragraphs 1.5.3.2 and 1.5.3.3.

1.5.4.6 Connect tag line to lower end of rear ring section with Fin IV identification (See figure 5.)

1.5.4.7 Lower personnel and transportation ring platform with fork lift and clear immediate area preparatory to hoisting rear ring section free of booster.

1.5.4.8 With personnel positioned to maintain a taut tag line, lift rear ring section with Fin IV identification free of booster and lower into working area with mobile crane. (See figure 5.)

1.5.4.9 Disconnect ring handling brackets from rear ring section and remove choker lines from mobile crane hooks.

1.5.4.10 Position fork lift, raise the transportation ring platform and personnel to a height as necessary to disconnect tee brackets from outriggers No. 6 and 7. (See figure 19, step 3.

1.5.4.11 Thread a rope through the 1-inch diameter holes in base of tee brackets at outriggers No. 6 and 7. Attach ropes to mobile crane hooks.

1.5.4.12 Loosen set screws and remove connecting pins at outriggers No. 6 and 7. Lower tee brackets to the ground.

1.5.4.13 Lower transportation ring platform and personnel to the ground with fork lift.

1.5.5 Using fork lift, raise and position transportation ring platform and personnel to a height as necessary for removal of rear ring section with Fin II identification. (See figure 19, step 3.) Working from the transportation ring platform, complete the following procedures:

1.5.5.1 Connect ring handling brackets to rear ring section with Fin II identification with bolts and nuts. (See figure 5.)

1.5.5.2 Using mobile crane with two hooks, lower crane hooks to work area and connect choker lines. (See figure 5.)

1.5.5.3 Connect choker lines to ring handling brackets on rear ring section with Fin II identification and put slight tension on crane cables. (See figure 5.)

1.5.5.4 Disconnect tee brackets from rear ring section at outriggers No. 2 and 3 by removing four bolts at base of each tee bracket. (See figure 6.)

1.5.5.5 Disconnect rear ring section with Fin II identification by performing the applicable procedures outlined in paragraphs 1.5.3.2 and 1.5.3.3. (See figure 7.)

1.5.5.6 Connect tag line to lower end of rear ring section with Fin II identification. (See figure 5.)

1.5.5.7 Insert two barrel nuts (J-AF-12004-2-6) in rear ring section with Fin I identification at outrigger No. 2 and secure tee bracket to rear ring section with two bolts. (See figure 7.)

NOTE: The two bolts through the base of the tee bracket at outrigger No. 2 will remain installed until the erection cables are connected and slight lifting forces are obtained from the service structure.

1.5.5.8 Lower personnel and transportation ring platform with fork lift and clear immediate area preparatory to hoisting rear ring section free of booster.

1.5.5.9 With personnel positioned to maintain a taut tag line, lift rear ring section with Fin II identification free of booster and lower into working area with mobile crane. (See figure 5.)

1.5.5.10 Disconnect ring handling brackets from rear ring section and remove choker lines from mobile crane hooks.

1.5.5.11 Perform applicable procedures outlined in paragraphs 1.5.4.10 through 1.5.4.12 to remove tee brackets from outriggers No. 3 and 4.

1.5.5.12 Lower personnel and transportation ring platform with fork lift and clear the area preparatory to moving transporter.

1.5.5.13 Clean and preserve rear ring components and attaching hardware in accordance with paragraph 4.2.

NOTE: The aft end of the booster is now resting on three points, tee brackets No. 1, 2 and 8, of the rear ring section with Fin I identification. Tee brackets No. 2 and 8 at outriggers No. 2 and 8, respectively, are still connected to their outrigger beams and have two of the four bolts through their base to the ring section still installed. Tee bracket No. 1 is intact and will not be disconnected until erection cables are connected and slight lifting forces are obtained from the service structure. Transporter is now ready to be towed into position.

1.5.5.14 Move ring details to adequate storage area, place on cross ties, or equivalent, and cover with a tarpaulin.

2. ERECTING BOOSTER.

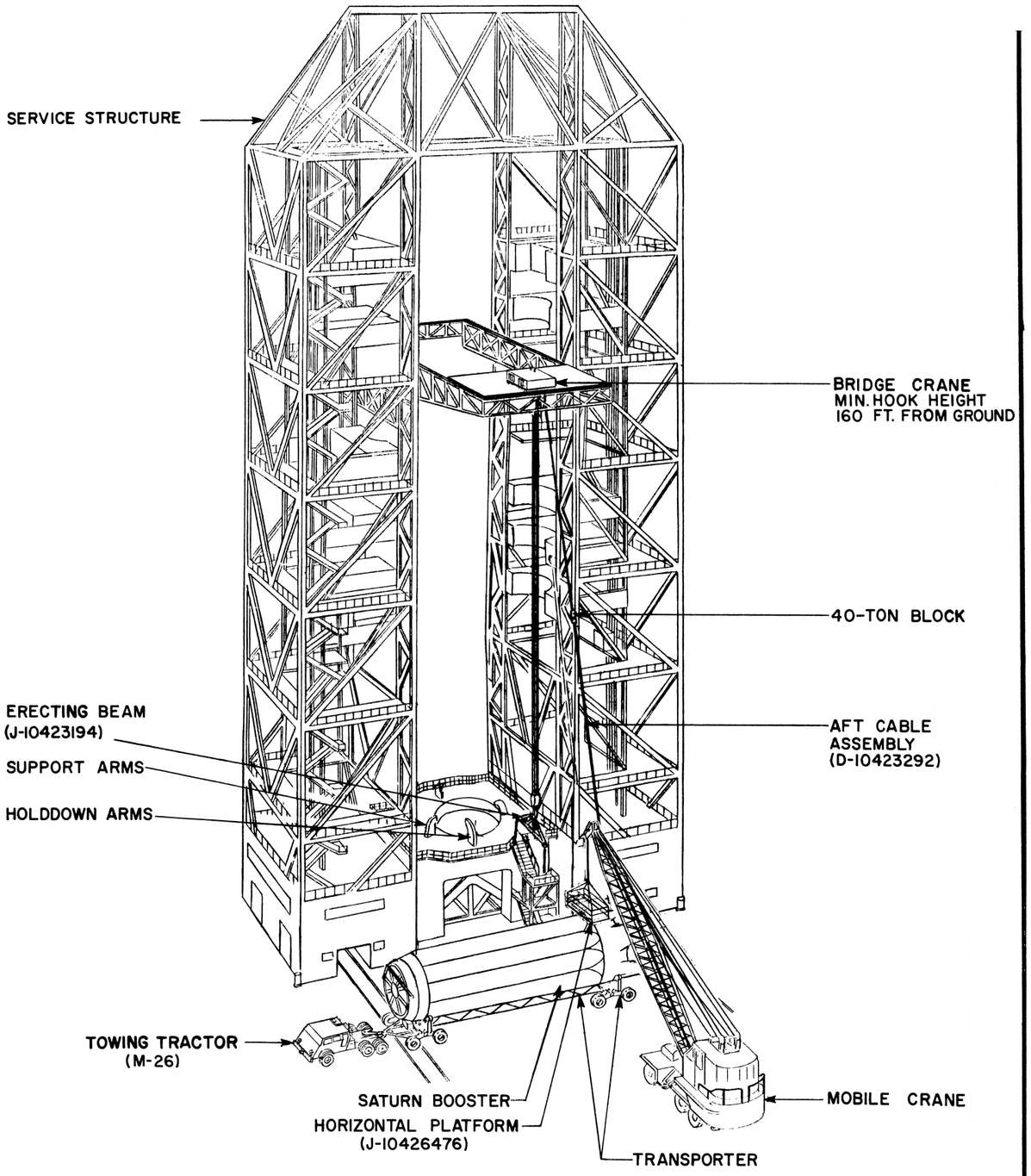
2.1 Positioning Transporter and Attaching Cables.

2.1.1 Using towing tractor, position transporter so that outrigger No. 5 is directly under the bridge crane 40-ton block. (See figure 24, step 1.)

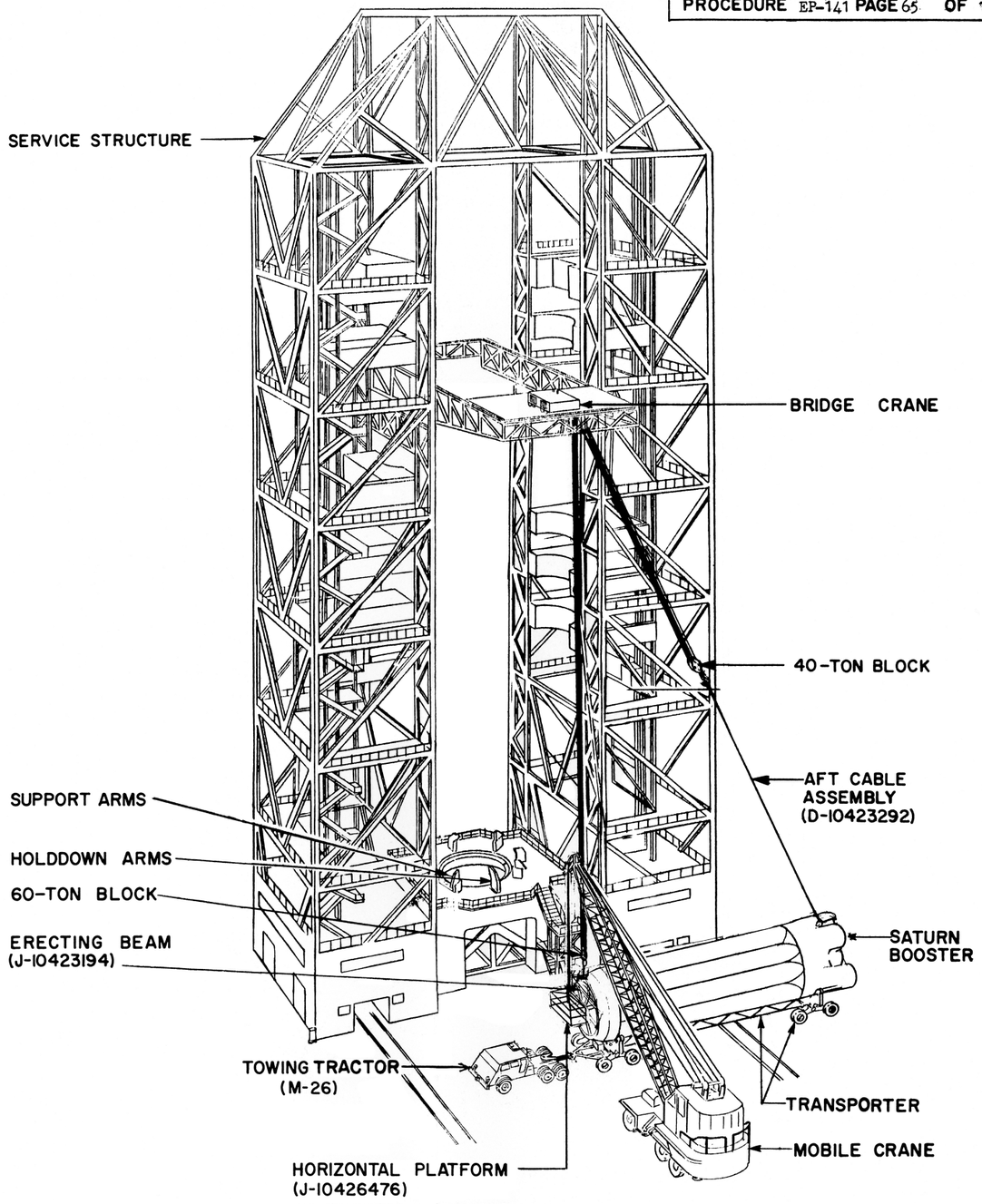
2.1.2 Using mobile crane, place horizontal platform on booster so that platform is stable and outrigger No. 5 is accessible to personnel on platform.

2.1.3 Lower aft cable assembly (D-10423292) with 40-ton block and connect aft cable assembly to outrigger No. 5 as shown in figure 11.

2.1.4 Using mobile crane, remove horizontal platform and personnel from booster.



STEP 1
ATTACHING AFT CABLE ASSEMBLY AT
I-BEAM NO. 5



STEP 2
ATTACHING FORWARD SLING ASSEMBLY TO
ERECTION BEAM

FIG. 24 ATTACHING AFT AND FORWARD SLING ASSEMBLIES

2.1.5 Using towing tractor, back transporter until second stage adapter on booster is directly beneath and in line with 60-ton block of bridge crane. (See figure 24, step 2.)

NOTE: Allow slack to be released by 40-ton block to permit movement of booster with transporter as aft cable assembly has already been connected.

2.1.6 Using mobile crane, position horizontal platform in front of second stage adapter in position to attach forward sling assemblies (J-10426668) as shown in figure 24, step 2.

2.1.7 Attach two lines to horizontal platform and maintain taut lines by men on the ground in order to avoid damage to second stage adapter.

2.1.8 Untie forward sling assembly cables; lower erecting beam (J-10423194) with 60-ton block. Attach forward sling assemblies to erecting beam. (See figure 25.)

2.1.9 Using bridge crane, slowly raise 60-ton block until slight tension is exerted on forward sling assembly and contact is established between beam weldment (J-10426675) and forward sling assemblies (J-10426668).

2.1.10 Remove mobile crane, horizontal platform, and personnel from forward end of transporter.

2.1.11 Using towing tractor, position transporter and booster as shown in figure 26, step 1. (See figure 27 for position of booster in relation to 60 and 40-ton hooks.)

NOTE: During this movement slack will have to be let by the 60-ton block and taken by the 40-ton block from the bridge crane until the booster is in correct lift-off position.

2.1.12 With transporter in correct lift-off position, lock brakes and chock all wheels on transporter.

2.1.13 Using fork lift, raise transportation ring platform and personnel to the necessary height and attach two tag lines to each outrigger No. 3 and 7. (See figure 26, step 1.)

NOTE: Tag lines are to be 1-inch diameter hemp rope, or equal, approximately 75 feet long.

2.1.14 Lower transportation ring platform and personnel to the ground and move fork lift and transportation ring platform clear of the area.

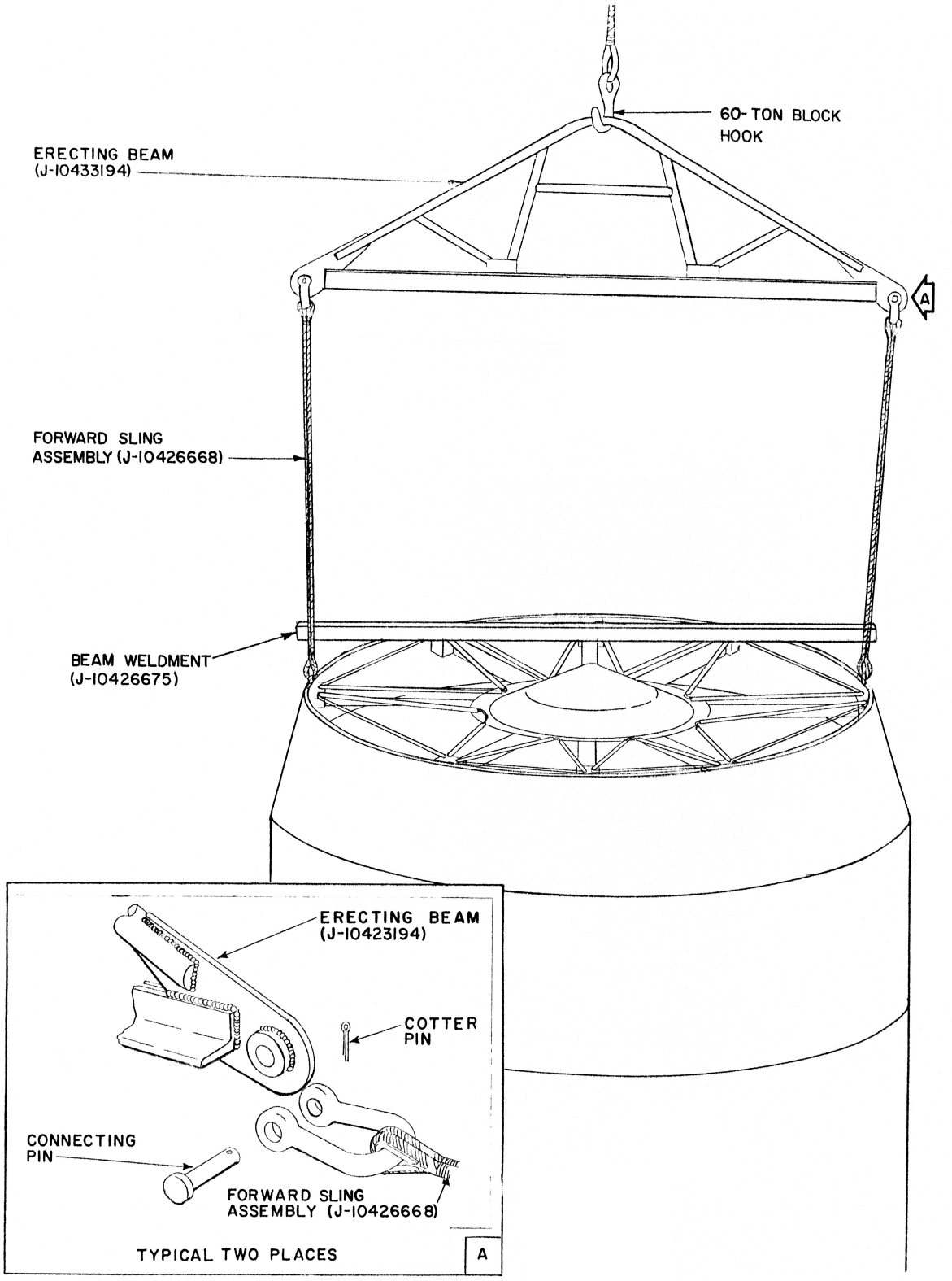
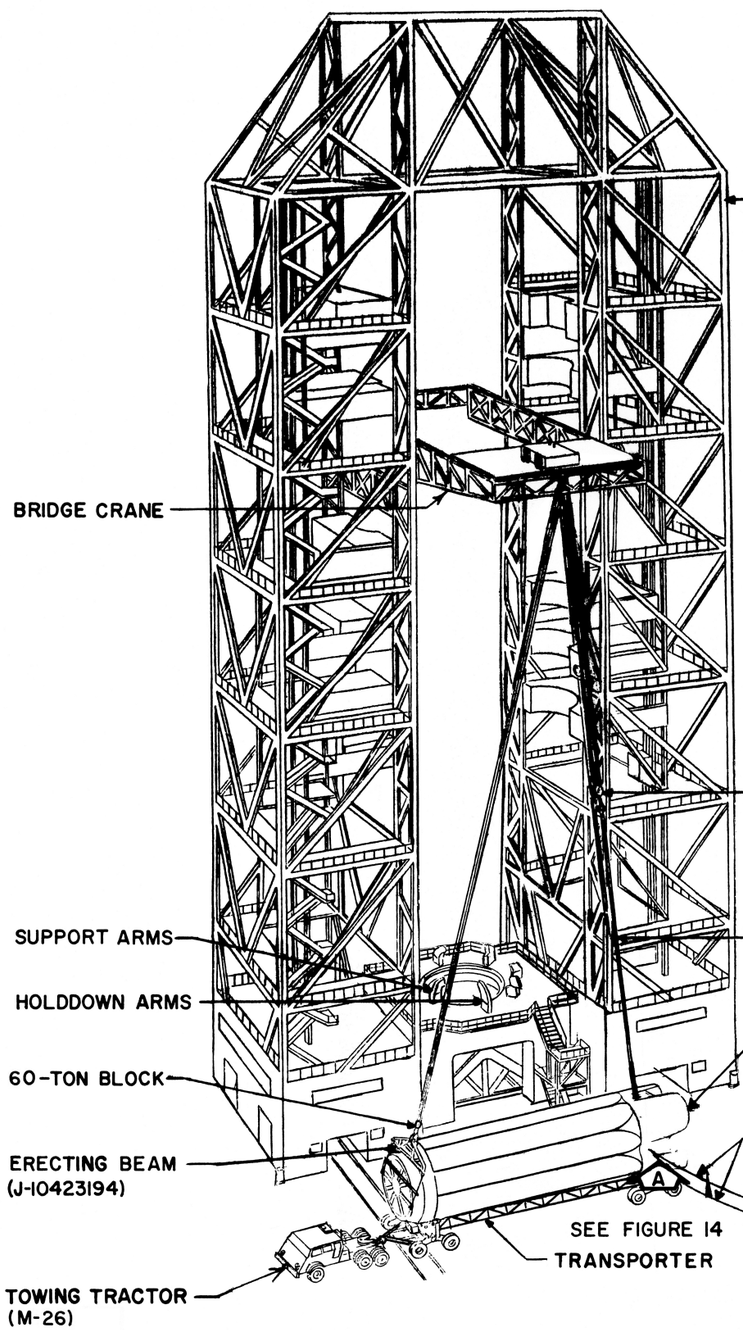
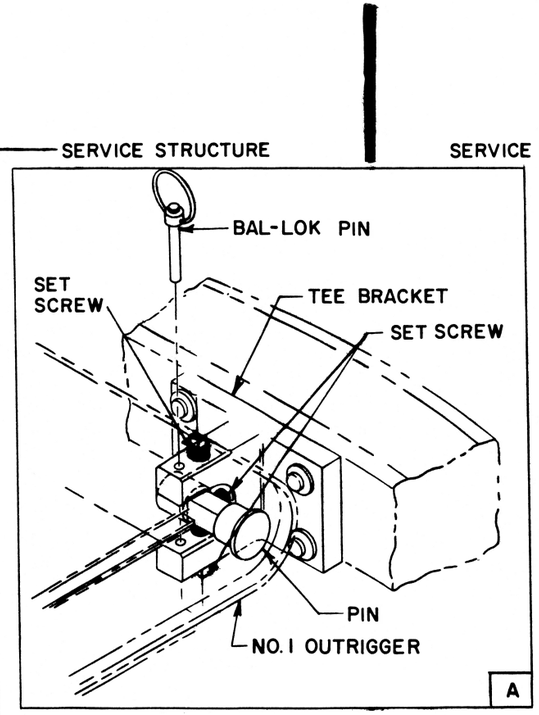


FIG. 25. CONNECTING ERECTING BEAM AND FORWARD SLING ASSEMBLIES

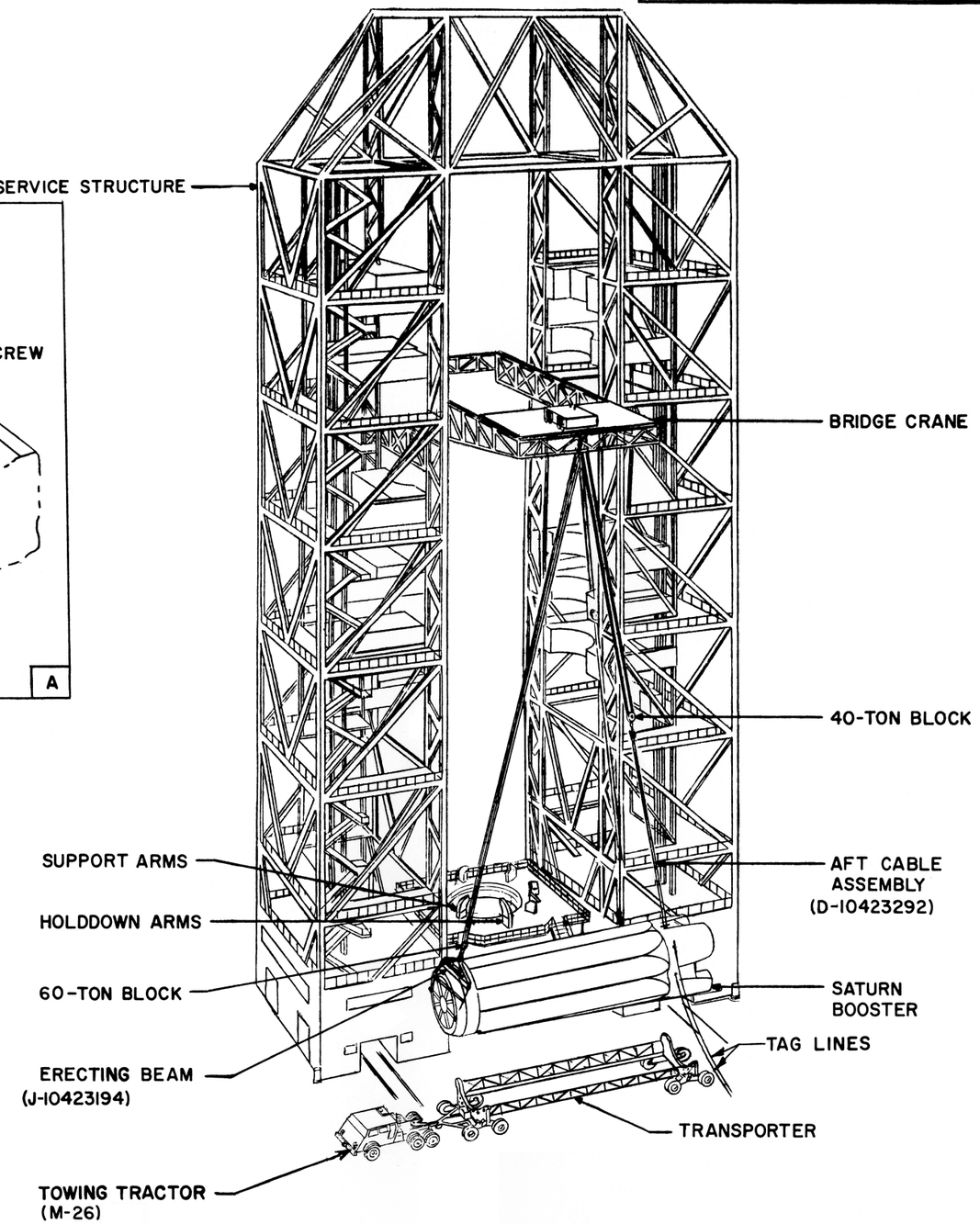




PRIOR TO LIFTING THE BOOSTER FROM THE TRANSPORTER, STABELIZE THE BOOSTER SO THAT THE PIN THROUGH OUTRIGGER NO. 1 IS FLOATING IN THE RECESS OF TEE BRACKET. SEE FIGURE 14.

STEP 1

STABILIZING BOOSTER PREPARATORY TO LIFTING OFF TRANSPORTER



STEP 2

LIFTING BOOSTER OFF TRANSPORTER

FIG.26 LIFTING BOOSTER OFF TRANSPORTER

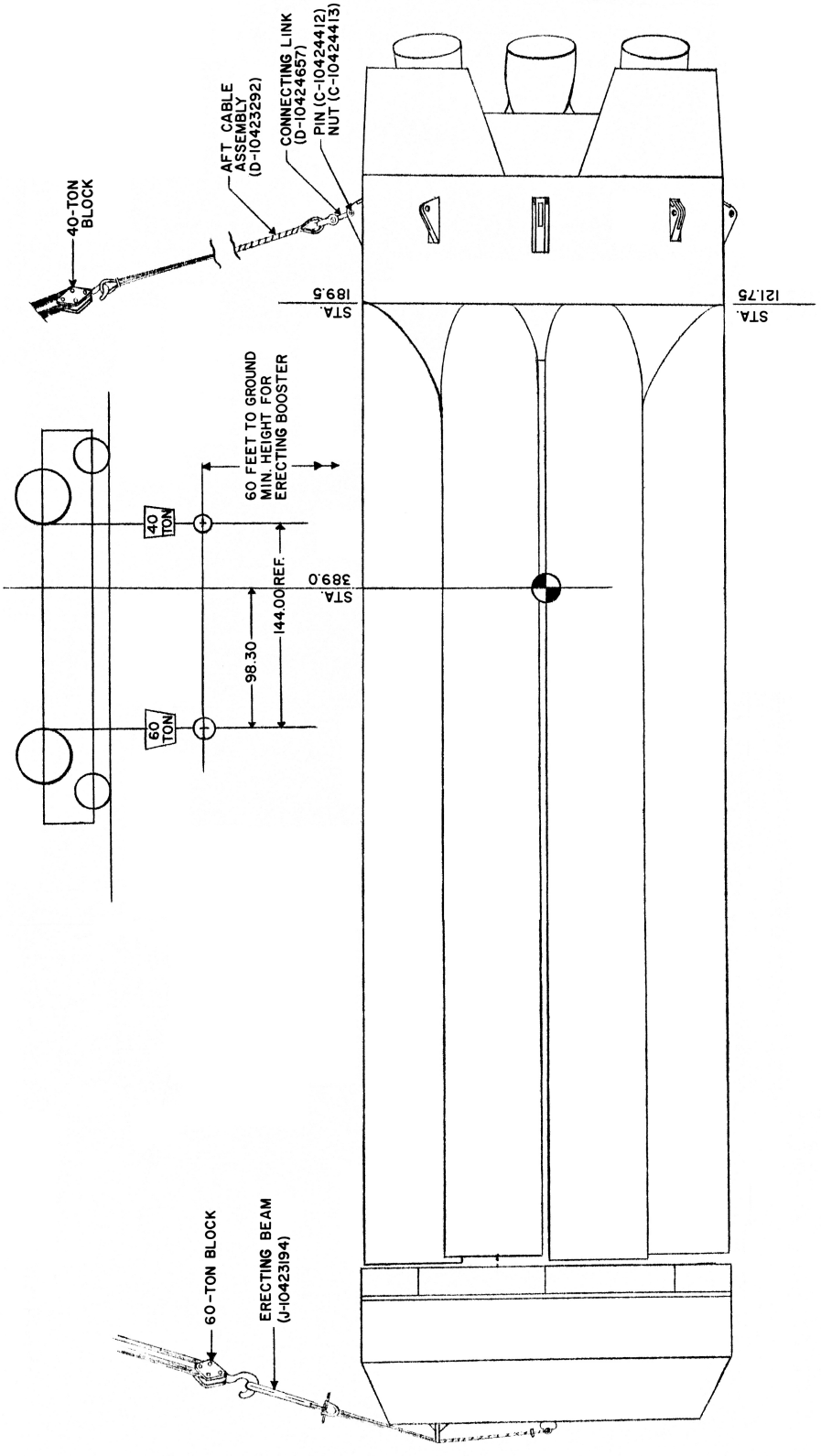


FIG.27 S-I STAGE CENTER OF GRAVITY DIAGRAM

2.2 Removing Booster from Transporter and Positioning on Launch Pedestal.

NOTE: Prior to the following procedures, substantial lifting forces must be obtained from the bridge to support the booster. The lifting forces should not, however, be great enough to lift the booster from the transporter or cause binding of the hardware yet to be removed.

2.2.1 Using fork lift, raise transportation ring platform and personnel to a height necessary to disconnect tee brackets from forward ring at I-beams No. 2 and 8.

2.2.2 Remove two bolts, and key retaining screw and key from base of each tee bracket at I-beams No. 2 and 8.

2.2.3 Remove four bolts, nut plates, and nuts from each I-beam No. 2 and 8. Remove tee brackets and place on transporation ring platform.

2.2.4 Lower transportation ring platform, personnel, and tee brackets. Move fork lift, transportation ring platform, and tee brackets clear of area.

2.2.5 Remove four bolts and key retaining screw and key from base of tee bracket at I-beam No. 1.

2.2.6 Remove four bolts, nut plate, and nuts from I-beam No.1.

2.2.7 Remove tee bracket from forward ring section with Fin I identification and move tee bracket clear of area.

2.2.8 Remove Bal-lok pin and loosen the forward and aft set screws in tee bracket at outrigger No. 1 of rear ring. The set screws through base of tee bracket are to remain fixed.

2.2.9 Using fork lift, raise transportation ring platform and personnel as necessary on each side of the booster at outriggers No. 2 and 8 of rear ring.

2.2.10 Remove two bolts through base of each tee bracket at outriggers No. 2 and 8.

2.2.11 Disconnect tee brackets from outriggers No. 2 and 8 by loosening set screws and removing connecting pins.

2.2.12 Place tee brackets on transportation ring platform. Lower personnel and transportation ring platform with fork lift and clear immediate area near rear ring.

NOTE: The pin through outrigger No. 1 is not removed at this time for the purpose of using it as a guide to stabilize the booster in the transporter before it is hoisted from the transporter. The pin in outrigger No. 1 will be removed after the the booster has been hoisted clear of the transporter.

2.2.13 Have men hold each of the four tag lines to prevent undue movement of booster. (See figure 26, step 1.) Using the pin through outrigger No. 1 as a guide in relationship to the notch in the tee bracket at outrigger No. 1, stabilize the booster in the transporter so the pin is floating in the center of the notch. (See figure 14.)

2.2.14 With bridge crane 60-ton block and 40-ton block lifting simultaneously, hoist booster off transporter in its stabilized condition completely clear of transporter. (See figure 26, step 2.)

NOTE: Booster retains its horizontal position and lower sections of the forward and rear rings remain attached to the transporter.

2.2.15 Using towing tractor, remove transporter from firing site area.

2.2.16 Using fork lift, raise transportation ring platform and personnel to a height necessary for installation of holddown block assemblies.

2.2.17 Remove connecting pin from outrigger No. 1 and attach tag line to outrigger No. 1 if conditions warrant.

2.2.18 Lower transportation ring platform and personnel to the ground. Remove fork lift and transportation ring platform from firing site area.

2.2.19 Using bridge crane 60-ton block, hoist booster into vertical position. Use 40-ton block to stabilize booster and take up slack during maneuver. During this movement, additional stabilization will be maintained by tag lines.

CAUTION: Extreme care must be taken to prevent the rear hoisting cables from slapping the booster as the booster moves to the complete vertical position. A small amount of movement of the erection cable at this point lets the booster swing through several degrees of arc.

2.2.20 Using mobile crane, raise horizontal platform and personnel to outrigger No. 5 and disconnect aft cable assembly. (See figure 28, step 1.) Attach tag line to outrigger No. 5 if conditions warrant.

2.2.21 Lower horizontal platform, personnel, and aft cable assembly to the ground. Remove mobile crane, horizontal platform, and aft cable assembly from firing site area.

2.2.22 Using 60-ton block, hoist booter to a height sufficient to clear launch pedestal and move booster horizontally to a position vertically over opening of launch pedestal.

2.2.23 Transfer tag lines to personnel on launch pedestal and lower booster to a position a few feet above holddown arms. (See figure 28, step 2.)

2.2.24 Using tag lines, orientate booster Fin Line I with launcher Fin Line I as shown in figures 8 and 29.

2.2.25 Remove tag lines.

2.2.26 Install outboard holddown block assemblies (D-10418916) on outriggers No. 2, 4, 6, and 8 and inboard holddown block assemblies (D-10418915) on outriggers No. 1, 3, 5, and 7. (See figure 30.)

2.2.27 Install inboard guide plates (B-10418920) using bolts (MS35298-230) and washers (MS35333-32) at each end of connecting pin on outriggers No. 1, 3, 5, and 7. (See figure 30.)

2.2.28 Retract support arms.

2.2.29 Ascertain that holddown arms are uncocked. (See figure 30, step 1.)

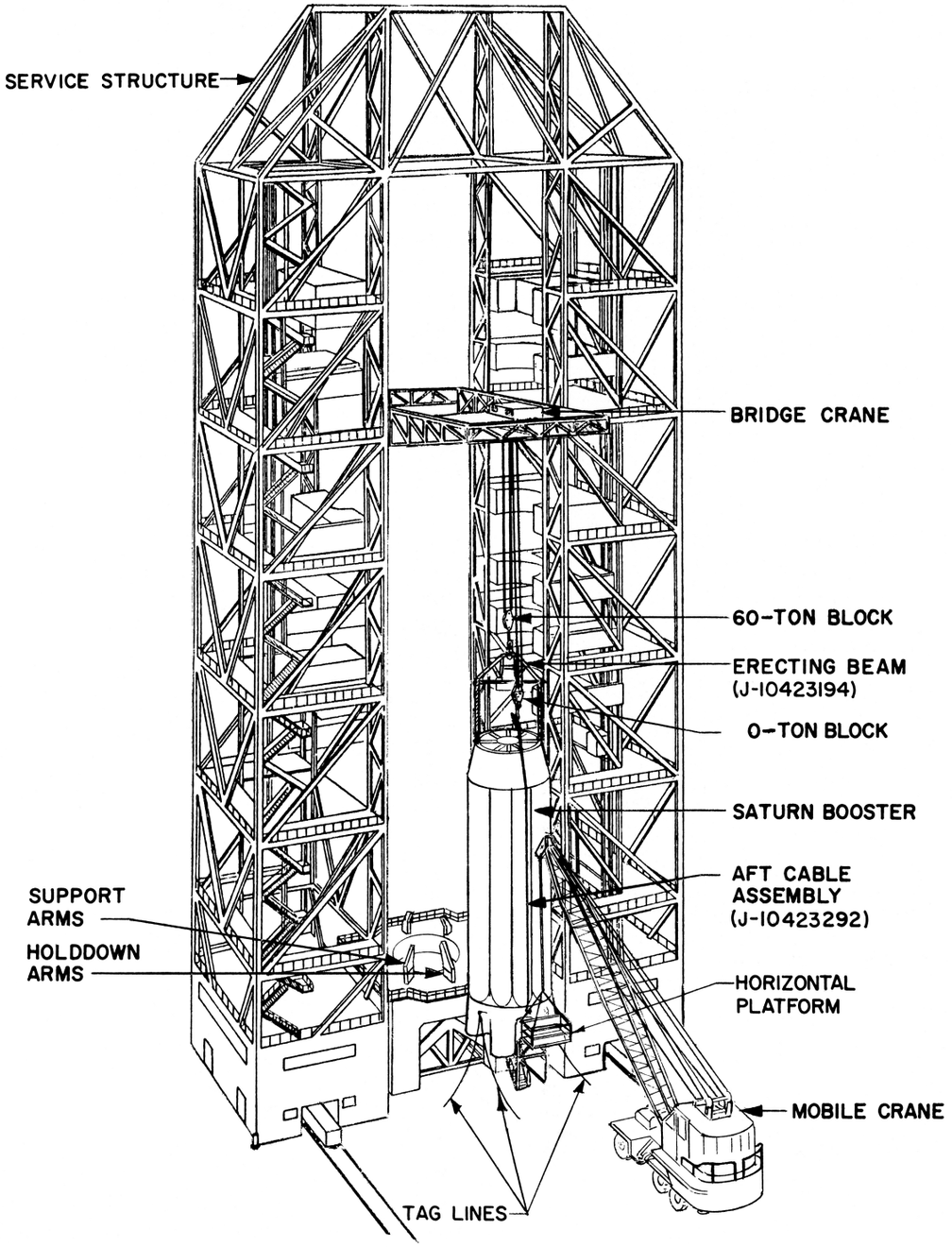
2.2.30 Using bridge crane 60-ton block, lower booster until outriggers, with holddown block assemblies attached, are approximately one-eighth inch above respective retractable support arm and holddown arm billets. Adjust support arms as necessary.

2.2.31 Carefully position each block assembly in exact center of its billet and lower booster until weight rests on holddown arms. Lock the base of each block assembly to its respective billet with four set screws, two through each side of the billet.

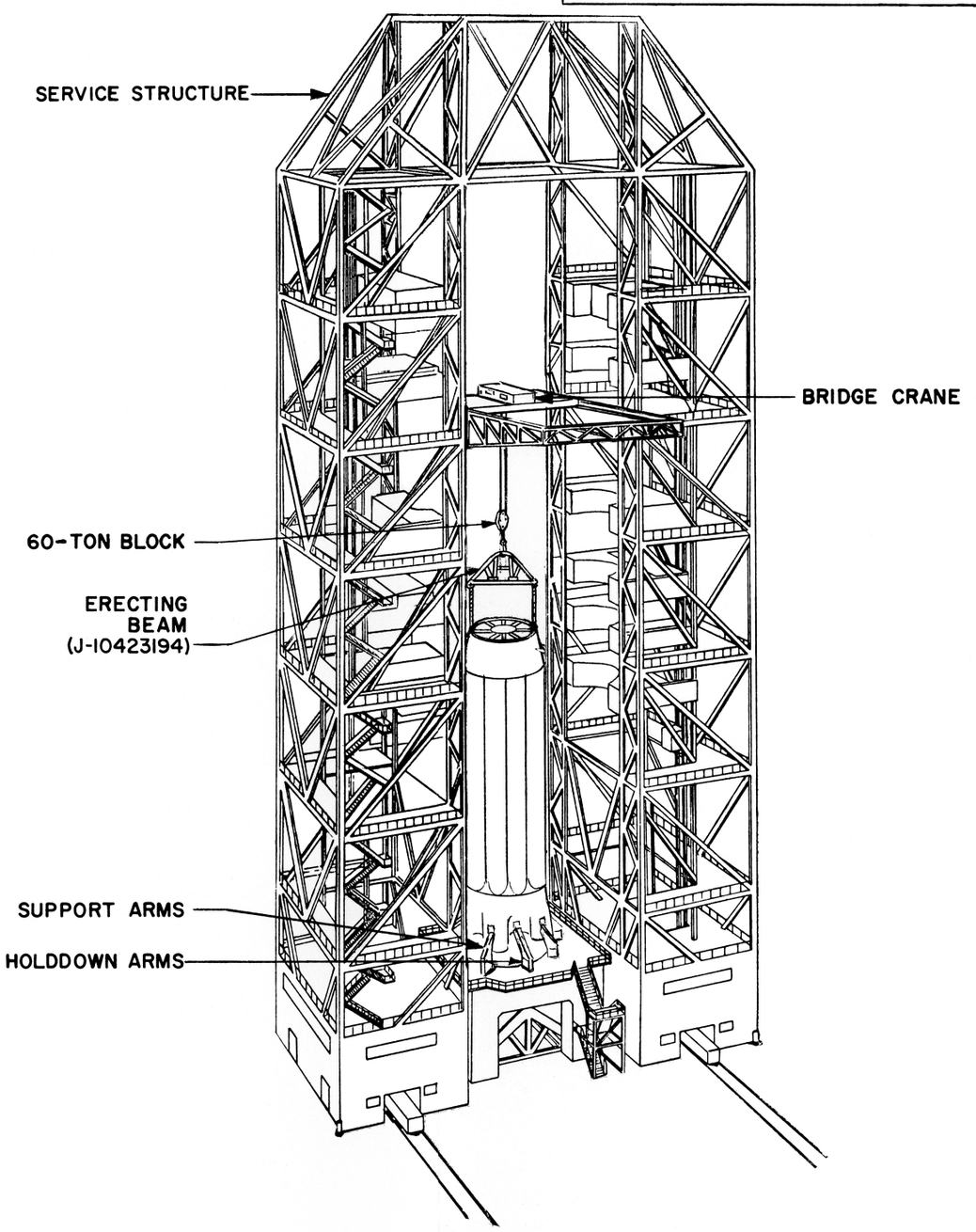
2.2.32 Place retractable support arms in support position and adjust support anvil so that it picks up the block assemblies.

CAUTION: Check to assure that weight is distributed on all support arms and that block assemblies are centered in billet.

2.2.33 Position holddown arms to secure booster to launch pedestal. (See figure 30.)



STEP 1
DETACHING AFT CABLE ASSEMBLY FROM OUTRIGGER NO. 5



STEP 2
POSITIONING BOOSTER ON LAUNCH PEDESTAL

FIG. 28 REMOVING AFT CABLE ASSEMBLY AND POSITIONING BOOSTER ON LAUNCH PEDESTAL

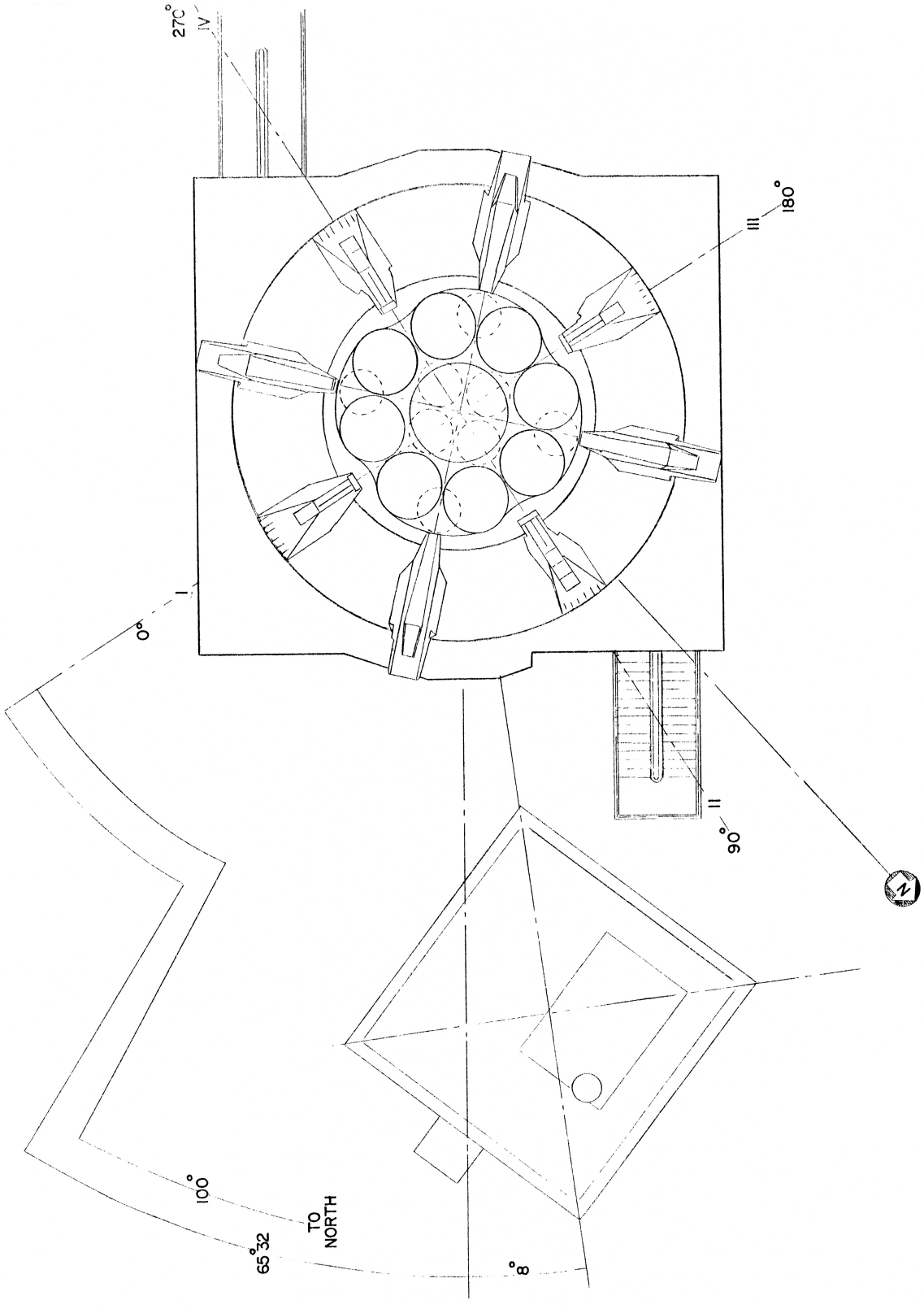
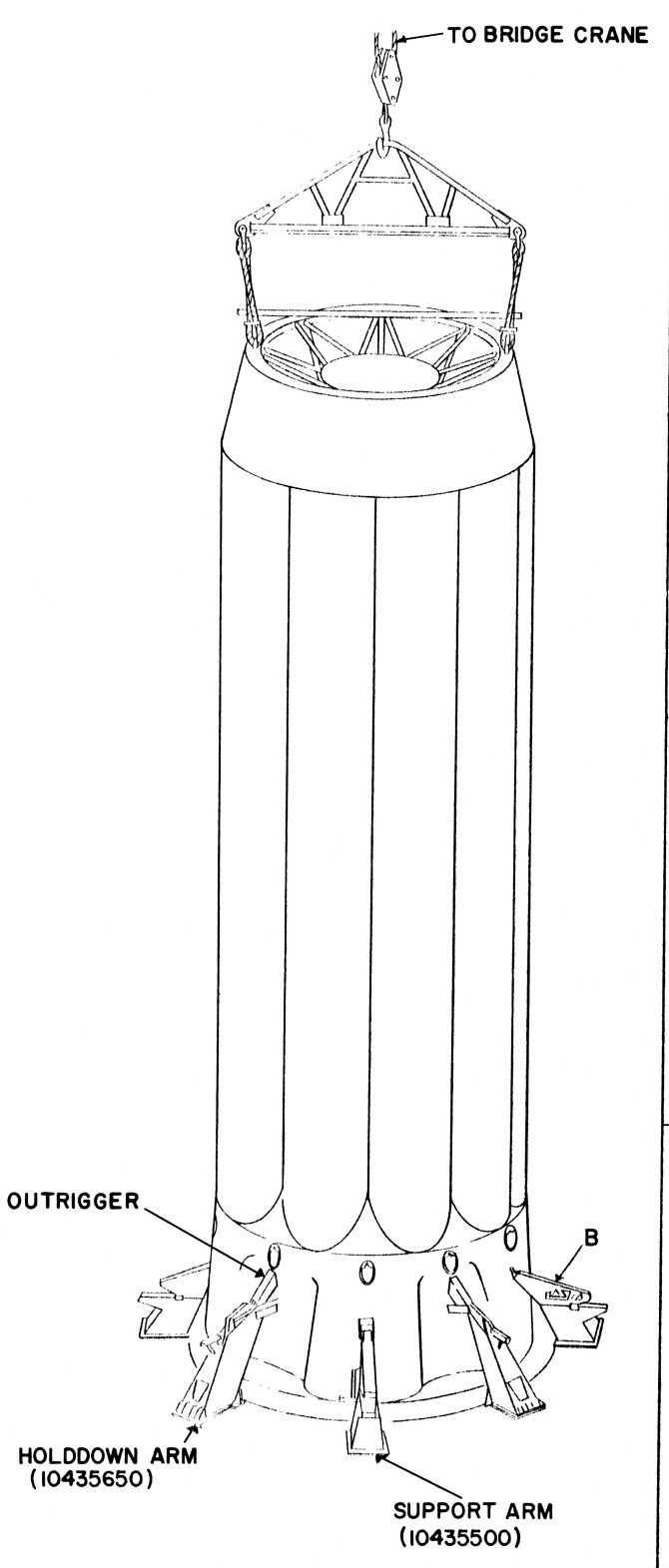
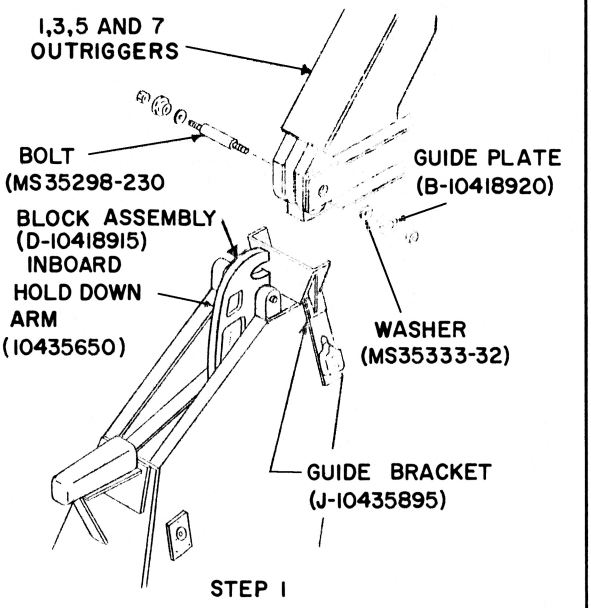
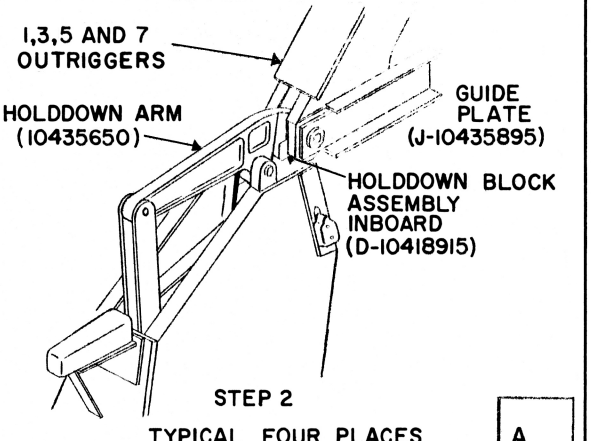


FIG. 29. BOOSTER TO LAUNCH PEDESTAL ORIENTATION DIAGRAM





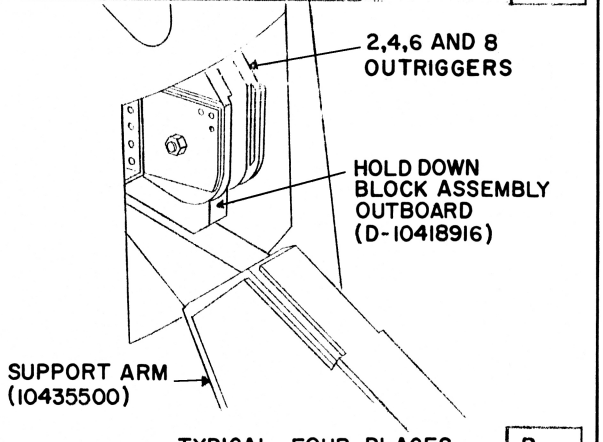
STEP 1



STEP 2

TYPICAL FOUR PLACES

A



TYPICAL FOUR PLACES

B

FIG. 30 POSITIONING BOOSTER ON SUPPORT ARMS AND HOLDDOWN ARMS

2.2.34 Remove guide brackets from holddown arms.

NOTE: Before vehicle is to be launched, remove clips from holddown block assemblies (D-10418915 and D-10418916).

2.2.35 Disconnect forward sling assemblies (J-10426668) by removing nuts and bolts that attach erection lugs to second stage adapter.

2.2.36 Using bridge crane 60-ton block, raise erecting beam (J-10423194) and forward sling assemblies clear of booster and lower components to work area.

2.2.37 Disconnect beam weldment (J-104266675) from mounting brackets (J-10427014 and J-10427097) by removing bolts (AN16C-54) and nuts (AN325-16). (See figure 20, detail B.)

2.2.38 Using bridge crane 40-ton block and two sling assemblies (10427036), raise beam weldment (J-10426675) clear of booster and lower to work area.

2.2.39 Disconnect and remove mounting brackets (J-10427014 and J-10427097) from second stage adapter. (See figure 20, detail B.)

2.2.40 Install the original flight hardware removed for installation of forward sling assemblies (J-10426668) and beam weldment (J-10426675). (See figure 2.)

NOTE: The booster is now erected on the launch pedestal awaiting the installation of the upper stages.

3. REMOVING BOOSTER FROM LAUNCH PEDESTAL.

Removing the booster from the launch pedestal is essentially the reverse of erecting procedures, paragraph 2. Special care must be exercised in installing forward sling assembly on the booster. (See figure 20.)

WARNING: Corect installation of forward sling assembly (J-10426668) is extremely important. Lubricating the shank and threads of the bolts (NAS156-68) and each side of the washers (NAS143-16 and NAS143-16C) and obtaining a torque valve of 6000 inch pounds (500 foot pounds) from the head of the bolts in mandatory to prevent shearing of the attachment hardware during removal of booster from launch pedestal. It should be noted also that upon replacing the booster on the transporter that the forward clamp supports (J-AFA-12053) are to be connected but not tightened so as to restrict the forward end of the booster from rotating during transportation.

4. REMOVING RING SECTION WITH FIN I IDENTIFICATION AND PRESERVING ALL RING DETAILS AND ATTACHING HARDWARE.

4.1 Removing Forward and Rear Ring Sections with Fin I Identification from Transporter.

NOTE: The forward and rear ring sections with Fin I identification are to be removed after firing of the Saturn Booster.

4.1.1 Connect ring handling brackets to forward ring section with Fin I identification with bolts and nuts.

4.1.2 Position mobile crane so that the two crane hooks are directly above the forward ring section.

4.1.3 Lower crane hooks to work area and connect to choker lines. Connect choker lines to ring handling brackets and put slight tension on crane cables.

4.1.4 Remove two forward support clamps, reference J-AF-12004-4-0, from forward cradle by removing one nut (J-AF-12004-4-38) and bolt (J-AF-12004-4-33) from each clamp. Remove eight screws (J-AF-12004-4-32) that attach two brackets (J-AF-12004-4-31) to cradle. (See figure 12.)

4.1.5 Using mobile crane, hoist forward ring section from transporter and lower to the ground.

4.1.6 Disconnect choker lines and remove ring handling brackets from forward ring section with Fin I identification.

4.1.7 Connect ring handling brackets to rear ring section with Fin I identification with bolts and nuts.

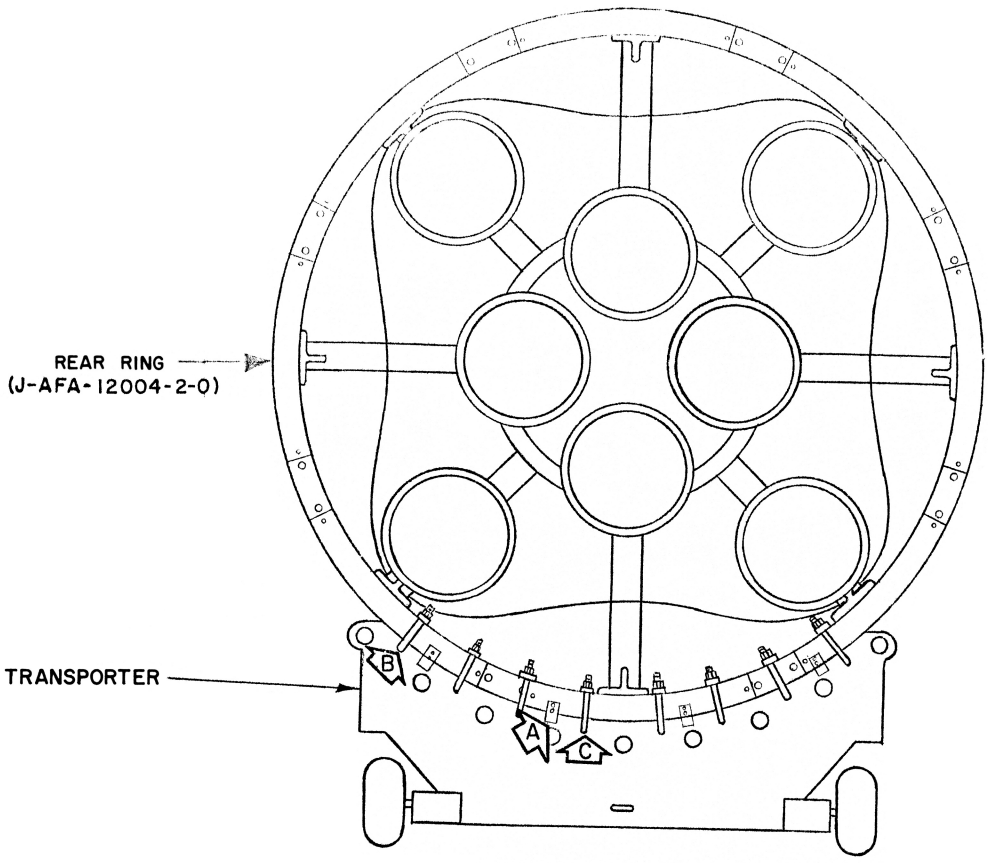
4.1.8 Position mobile crane so that the two crane hooks are directly above the rear ring section.

4.1.9 Lower crane hooks to work area and connect to choker lines. Connect choker lines to ring handling brackets and put slight tension on crane cables.

4.1.10 Remove all clamps that secure rear ring section with Fin I identification to rear cradle. (Reference drawing J-AFA-12053.) (See figure 31.)

4.1.11 Using mobile crane, hoist rear ring section from transporter and lower to the ground.

4.1.12 Disconnect choker lines and remove ring handling brackets from



AFT VIEW LOOKING FORWARD

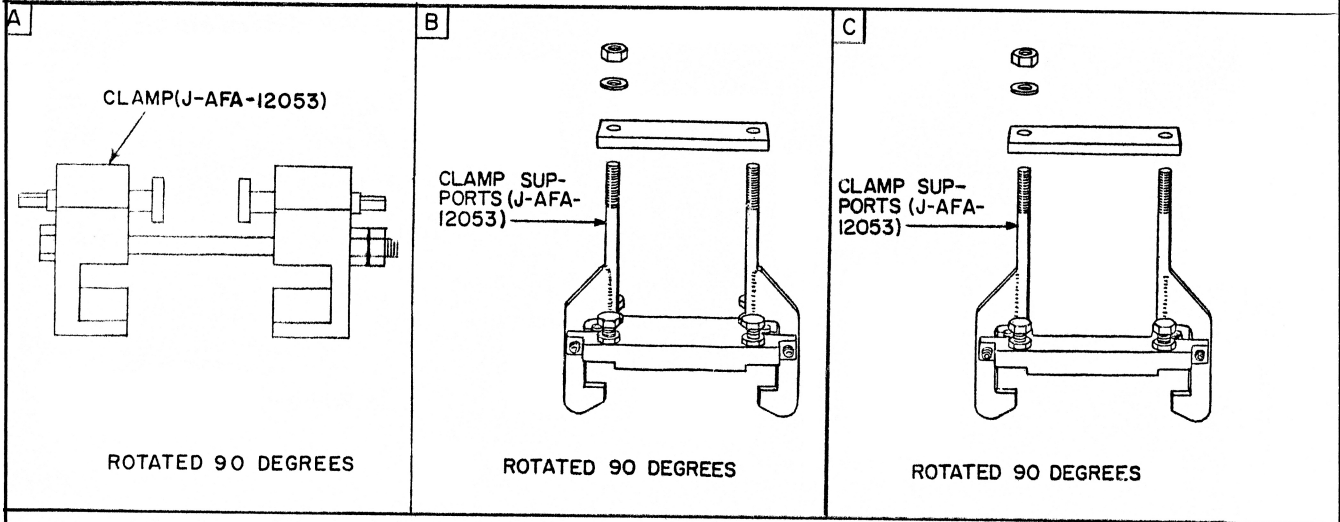


FIG. 31 REAR RING SUPPORT CLAMPS

4.1.12 (Con.)
rear ring section with Fin I identification.

4.2 Preserving Forward and Rear Ring Details and Attaching Hardware.

NOTE: The following procedures should be performed as soon as possible after disassembly and should be repeated at 30-day intervals if necessary.

4.2.1 Clean mating surfaces of forward and rear ring sections, support clamps, and tee brackets with dry-cleaning solvent, Federal Specification P-S-661, in accordance with paragraph 3.2.1 of Military Specification MIL-P-116 and apply P-3 corrosion preventive, Military Specification MIL-C-16173, to mating surfaces.

4.2.2 Clean attaching hardware for forward and rear ring sections, support clamps, and tee brackets with dry-cleaning solvent, Federal Specification P-S-661, in accordance with paragraph 3.2.1 of Military Specification MIL-P-116 and immerse parts in P-9 preservative lubricating oil, Military Specification MIL-L-644.

CHAPTER III

GENERAL INSTRUCTIONS FOR THE SATURN S-I TRANSPORTER

TABLE OF CONTENTS

Paragraph		Page
LIST OF ILLUSTRATIONS		87
INTRODUCTION		89
1.	DESCRIPTION AND LEADING PARTICULARS	91
1.1	Description	91
1.2	Leading Particulars	103
2.	OPERATING PROCEDURES	107
2.1	General	107
2.2	Preoperational Check	107
2.3	Starting and Stopping Power Unit and Lamp Test	111
2.4	Locking and Unlocking Wheels	111
2.5	Steering the Dolly	112
2.6	Operating the Brakes	113
2.7	Tire Change Procedure	113
3.	INSTALLATION AND REMOVAL PROCEDURES	116
3.1	Installation	116
3.2	Removal	118
4.	SHIPMENT BY BARGE	118
4.1	Description	118
4.2	Loading at MSFC	120
4.3	Tie-Down Arrangement	120
4.4	Unloading at AMR	123
5.	SATURN S-I PORTABLE JACKS	124
5.1	Description	124
5.2	Work Area Requirements	124

TABLE OF CONTENTS (Con.)

Paragraph Page

5.3 Power Requirements 124

5.4 Positioning Booster 124

5.5 Electrical and Mechanical Checkout 128

5.6 Positioning Jacks under Jack Pad 128

5.7 Lifting 131

5.8 Storage 131

5.9 To Replace Cradles on Transporter 131

5.10 Emergency Use: Dolly Repairs, Tire Change, Etc. 131

5.11 Lubrication Instructions 133

6. PREPARATION OF DOLLIES FOR SHIPMENT BY COMMERCIAL CARRIER 133

6.1 General 133

6.2 Loading and Tie-Down Procedures for Operator's Seat, Detachable Drawbar, and Dolly 133

7. PREPARATION OF FIXTURE FOR SHIPMENT BY COMMERCIAL CARRIER 139

7.1 General 139

7.2 Preservation of Assembly Fixture 139

LIST OF ILLUSTRATIONS

Figure	Title	Page
32	Saturn Transporter	92
33	Saturn Transporter Dimensions	93
34	Transporter Dolly	95
35	Drawbar Extension	96
36	Dolly Electrical System	97
37	Front Dolly Steering System	99
38	Rear Dolly Steering System	101
39	Air over Hydraulic Brake System	105
40	Operator's Control Assembly	108
41	Lubrication Chart	109
42	Jacking for Wheel Removal	114
43	Wheel Removal and Installation	115
44	Removing and Installing Dolly to Assembly Fixture	117
45	Attaching Fixture to Dolly	119
46	Tie Down Arrangement S-1 to Barge	121
47	Portable Jack Assembly	125
48	Jack Positioning and Cable Inter-Connect Diagram	126
49	Attaching Jack Pad Assembly	127
50	Positioning Jack Assembly	129
51	Jack Assembly under Jack Pad	130
52	Fixture Assembly Supported by Jack Assemblies	132
53	Tie-Down Procedures	134
54	Installing Operator's Seat on Drawbar	137

LIST OF ILLUSTRATIONS (Con.)

Figure	Title	Page
55	Assembly Fixture AF-12004 Breakdown	140
56	Packaging Truss Weldments and Miscellaneous Hardware	141
57	Packaging Aft and Forward Cradles	143
58	Packaging Ring Sections	145

INTRODUCTION

The primary purpose of this chapter is to provide the necessary information for operation of the Saturn S-I transporter. This chapter is presented in seven main paragraphs. Paragraph 1. contains a description of the transporter and leading particulars of its major components. Paragraph 2. presents operating procedures necessary for complete operation and control of the transporter. Paragraph 3. contains installation and removal procedures for installing the dollies to or removing the dollies from the assembly fixture. Paragraph 4. gives instructions for shipment of entire transporter with cargo by barge. Paragraph 5. contains information for operation of portable storage jacks used to support fixtures and cargo if stored on a hardstand area. Paragraph 6. contains information pertaining to the preparation for shipment of a complete dolly by either motor freight or railroad, and paragraph 7. contains instructions for shipping the fixture assembly by commercial means.

The transporter is specifically designed to transport the Saturn booster from one location to another and provide complete maneuverability at each location. The transporter consists of three major assemblies and is towed by a prime mover. Steering of the transporter is accomplished by two operators, one seated on each dolly. Unless otherwise stated, the terms left-hand and right-hand appearing in this chapter refer to the left and right of a person seated in the prime mover facing forward.

1. DESCRIPTION AND LEADING PARTICULARS.

1.1 Description.

1.1.1 The Saturn S-I transporter utilized to transport the Saturn Booster consists essentially of an assembly fixture supported by two dollies which is towed by a prime mover. (See figure 32.) Because the Saturn Booster is assembled on the assembly fixture, the only mention of the assembly fixture will be during the removal and installation of the dollies and during preparation for shipment by commercial carrier. For dimensions of the transporter when completely assembled and loaded, see figure 33.

1.1.2 Each of the dollies is composed of a frame and running gear assembly, drawbar, an operator's seat, a steering system, and a hydraulic system. (See figure 34.) Braking action is provided by an air over hydraulic braking system.

1.1.3 The frame and running gear assembly is an all steel structure consisting of a left-hand walking beam and a right-hand walking beam. Each walking beam has two wheels. The drawbar is equipped with a caster wheel to support it. The drawbar extension is used to connect the transporter to the prime mover for towing. (See figure 35.)

1.1.4 The 24-volt DC electrical system (figure 36) provides power to operate an electric motor which drives the hydraulic pumps. Power is supplied by a power unit, Model No. 06AK-224RV/1658E, which utilizes a gasoline engine to drive a generator. The generator is a series-shunt wound unit, acting as a motor to start the gasoline engine and as a generator when the gasoline engine is operating. Power to start the gasoline engine is obtained from two 12-volt storage batteries connected in series. The power unit may be started and stopped from the electrical control panel, located on the operator's control assembly (figure 34), or from the generator control panel, located on the power unit. A reverse current relay enables the generator to charge the batteries as necessary. The batteries can be disconnected from the system when the dolly is not in use. A DC voltmeter located on the electrical control panel indicates battery voltage when the batteries are connected. Pump motor limit switches, located on the operator's control assembly, prevent the hydraulic pump motor from operating when the steering controls are in the HOLD position.

1.1.5 The front dolly and rear dolly hydraulic steering systems (figures 37 and 38) provide each operator with a means of steering the dollies independently. The system is connected in such a manner to allow the rear wheels and front wheels of each dolly to be steered or locked independently; however, steering or locking of one wheel, independently, is not possible. Normally, all four wheels are steered simultaneously. Normal operating pressure for each system is 1500 psi. This pressure

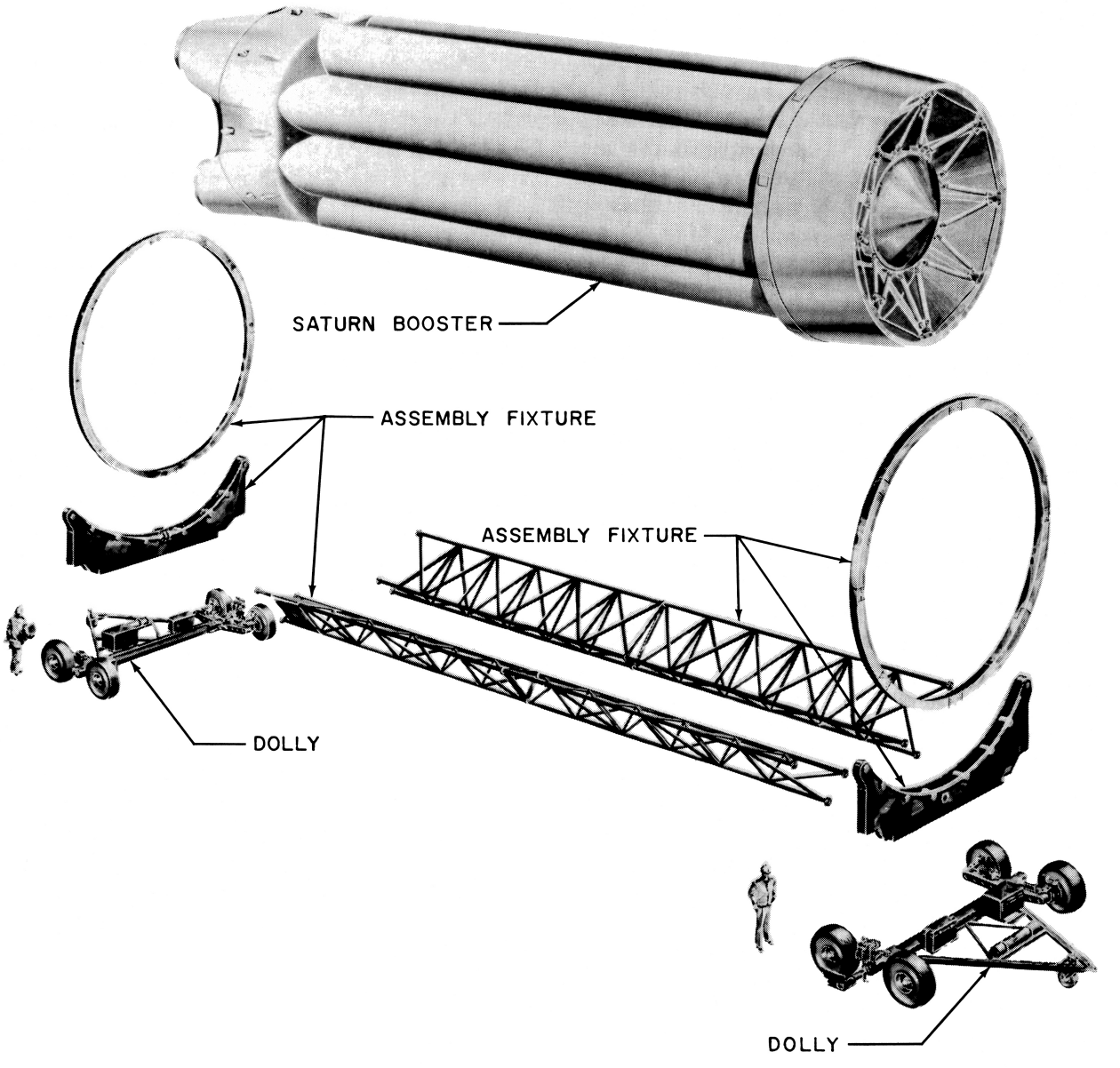


FIG. 32. SATURN TRANSPORTER

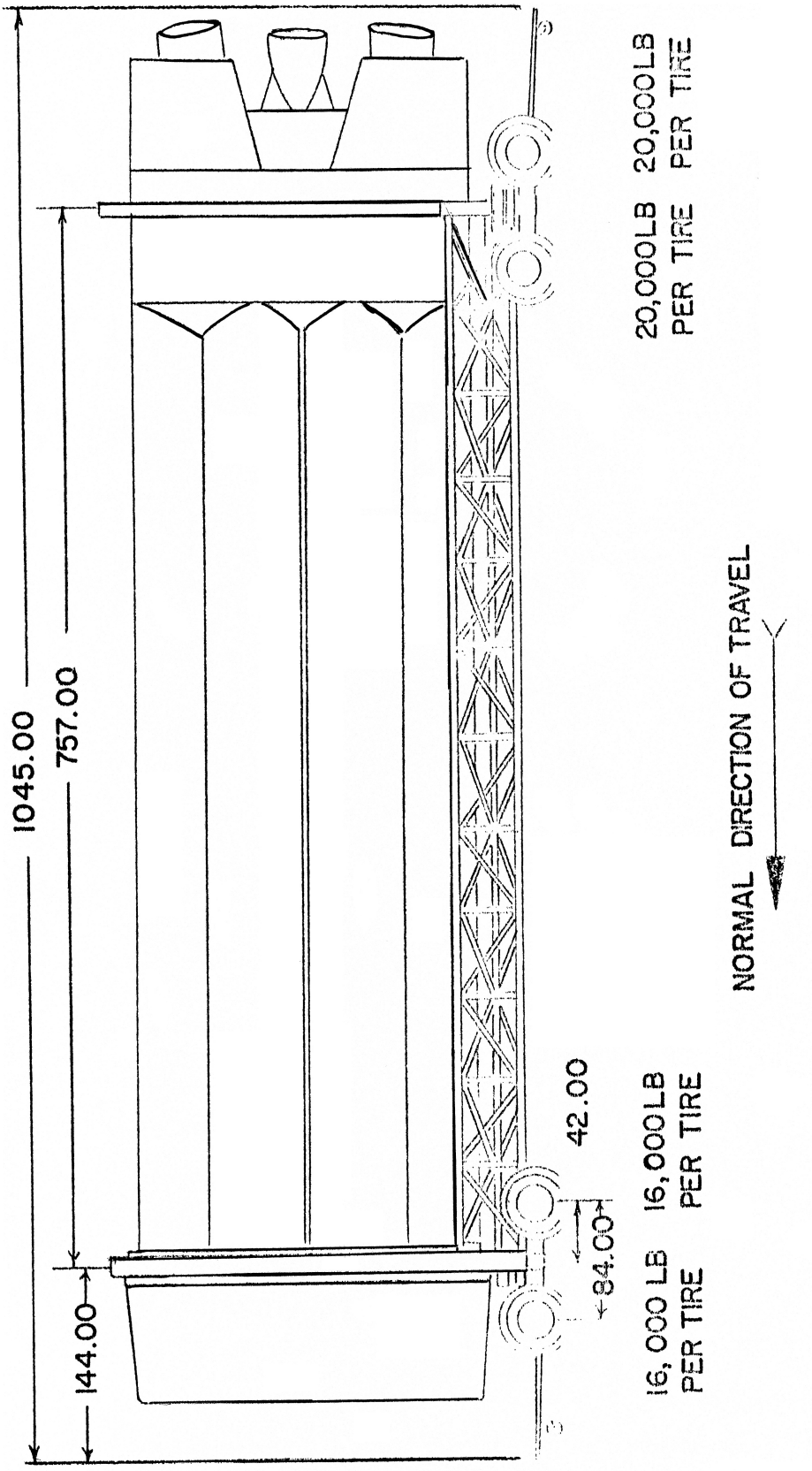


FIG 33. SATURN TRANSPORTER DIMENSIONS (SHEET 1 OF 2)

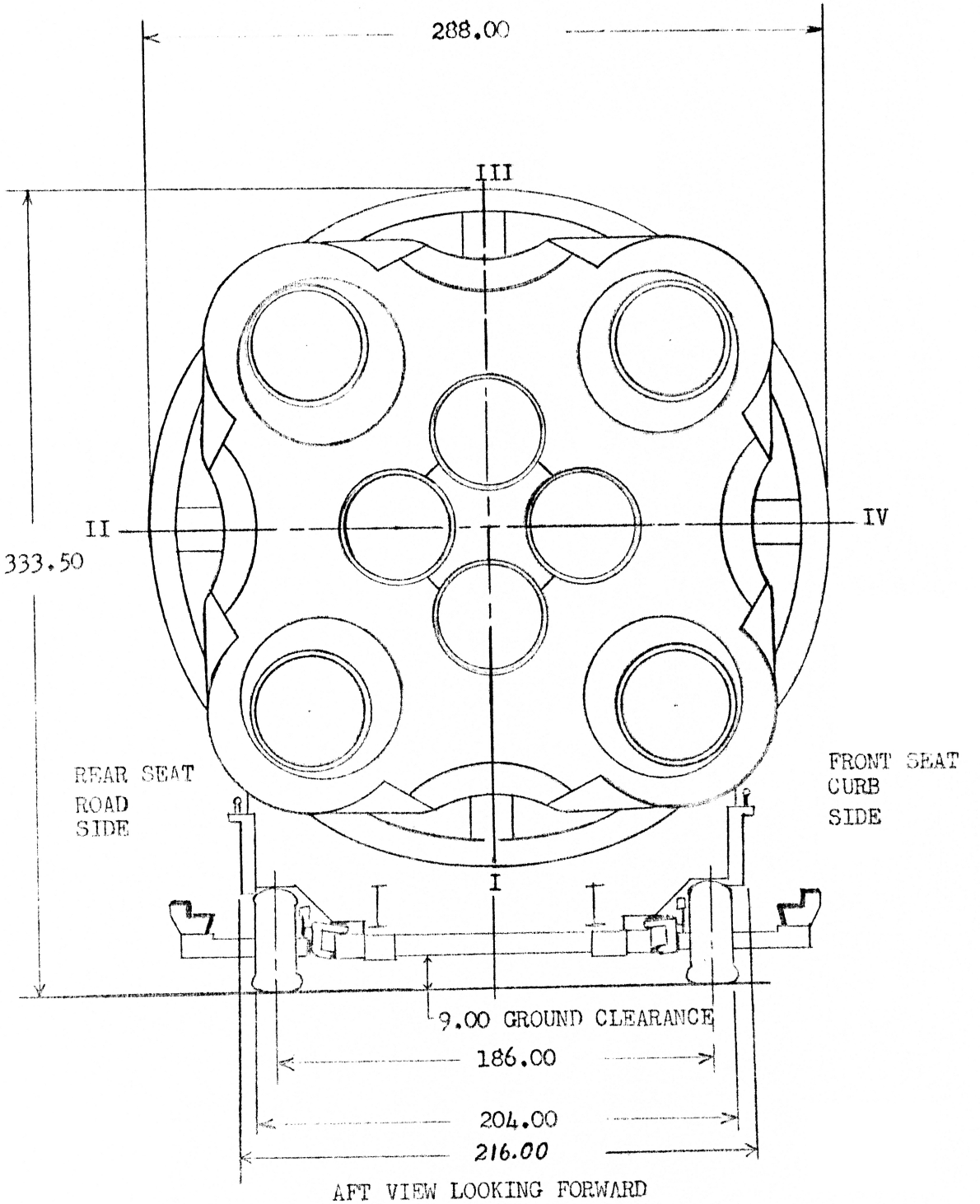


FIG. 33. SATURN TRANSPORTER DEMENSIONS (SHEET 2 OF 2)

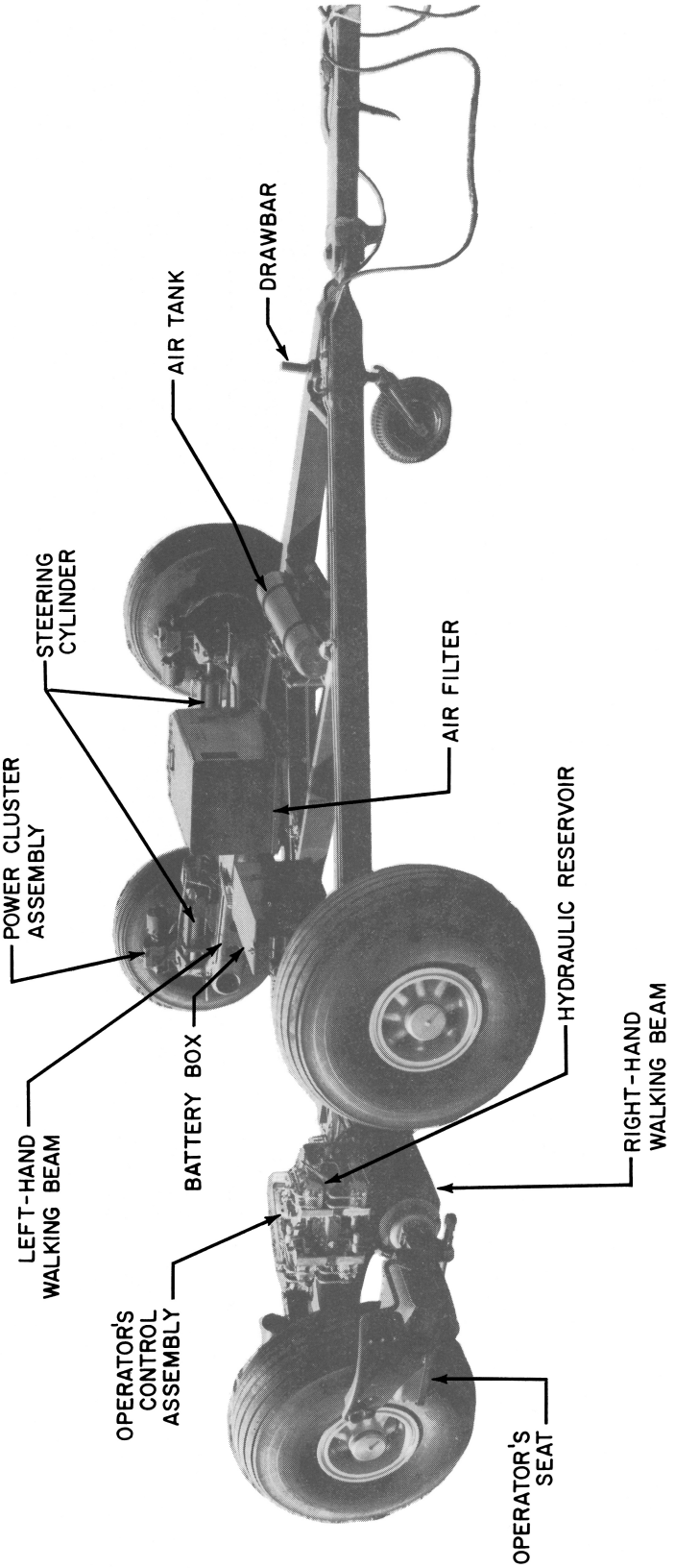


FIG. 34. TRANSPORTER DOLLY

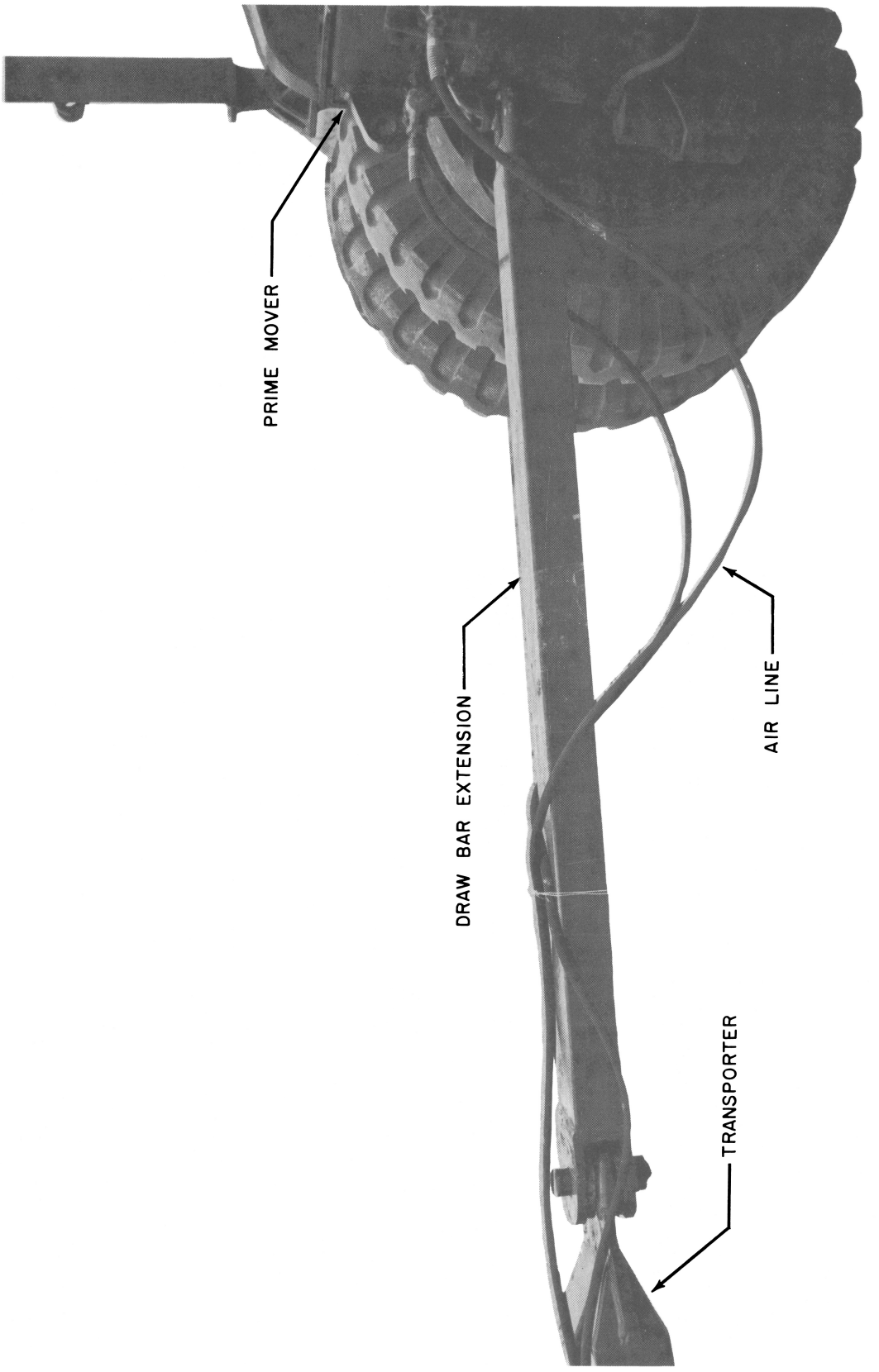


FIG. 35. DRAWBAR EXTENSION

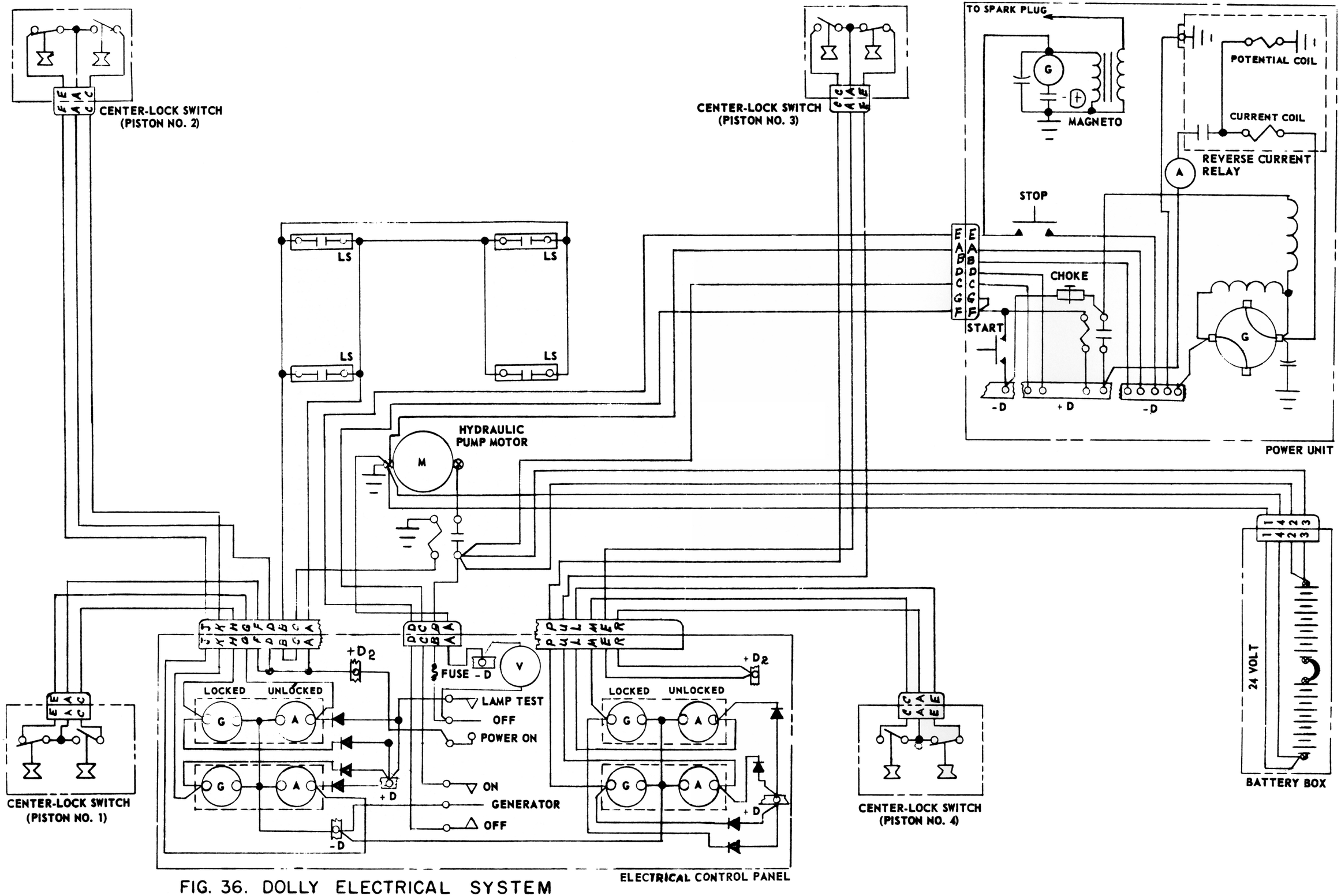


FIG. 36. DOLLY ELECTRICAL SYSTEM

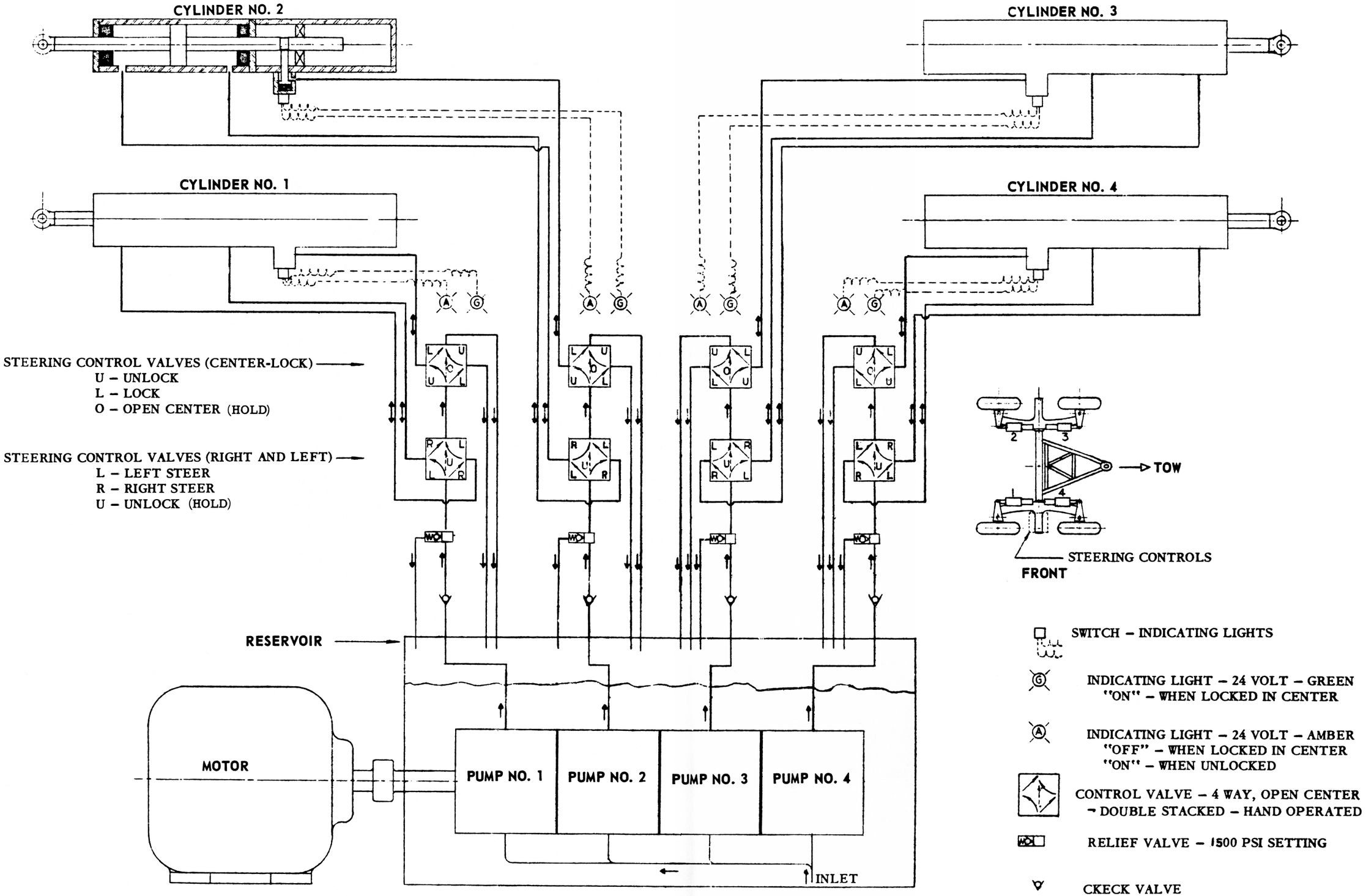


FIG. 37 FRONT DOLLY STEERING SYSTEM

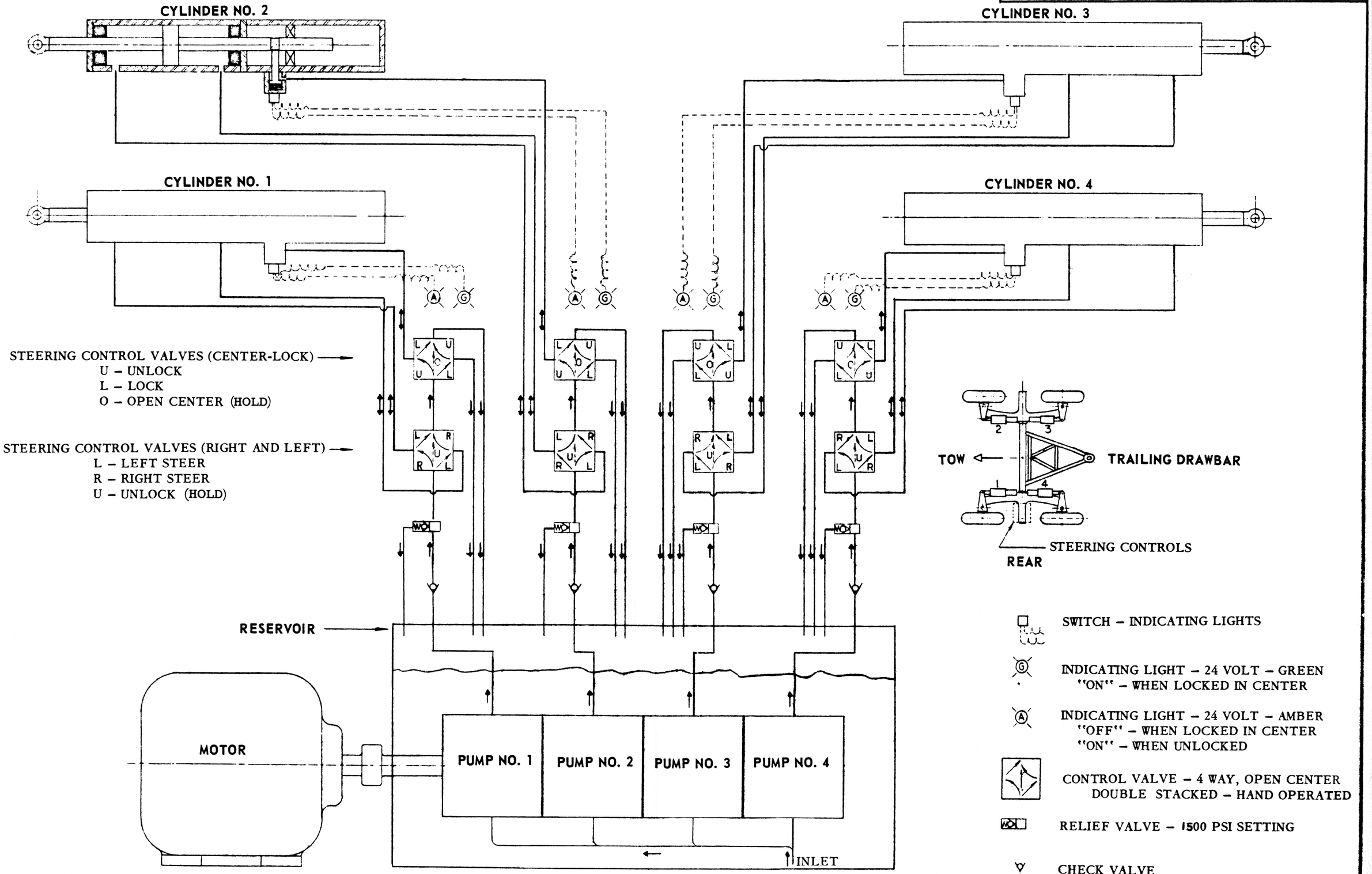


FIG. 38 REAR DOLLY STEERING SYSTEM

1.1.5 (Con.)

is obtained from four hydraulic pumps, driven by one electric motor. These pumps operate only when the steering controls or center-lock controls are rotated out of their HOLD position. Rotation of the steering controls allows pressure to be applied to the steering cylinders (figure 34), causing movement of the wheels. Rotation of the center-lock controls allows pressure to be applied to or released from the center-lock piston. Application of pressure unlocks the steering cylinders and release of pressure allows the cylinders to mechanically lock only in the center position when the wheels are straight.

1.1.6 The brake system (figure 39) is an air over hydraulic system. Normal air pressure for the system is from 90 to 100 psi. The air supply for the system is furnished by the prime mover or an auxiliary source when loading on barge with winch. Each dolly has an individual braking system which can be operated independently of the other; however, both may be operated from the prime mover.

1.2 Leading Particulars.

1.2.1 The leading particulars for the major components of the transporter are contained in Table II.

TABLE II. LEADING PARTICULARS

TRANSPORTER	
LENGTH (Overall)	1045.00 IN.
(Between Supports)	757.00 IN.
HEIGHT (Loaded)	333.50 IN.
WIDTH (Loaded)	288.00 IN.
WEIGHT EMPTY (Less Transportation Rings)	50,000 LB.
MAXIMUM TOWING SPEED	5 MPH
SINGLE DOLLY	
LENGTH	207 IN.
HEIGHT (Tire Diameter)	45.00 IN.
WIDTH (Without Seats)	17.00 FT.
WEIGHT	12,000 LB.

TABLE II. LEADING PARTICULARS (Con.)

TREAD	186.00 IN.
WHEELBASE	84.00 IN.
TIRES	Size 17:00 x 16, Type III, 12 Ply Nylon
TIRE PRESSURE (Loaded)	
Front Tires	60 Plus 30 Minus 10 PSI
Rear Tires	80 ± PSI
ELECTRICAL SYSTEM	
OUTPUT VOLTAGE	24 Volts
POWER UNIT	Gasoline Driven
GASOLINE	Regular grade, automotive
OIL	API, MS OR DG, Winter SAE/10, Summer SAE/30
BATTERY	2 each, 12 Volt
PUMP MOTOR	24 Volt DC
HYDRAULIC SYSTEM	
OPERATING PRESSURE	1500 PSI
TESTING PRESSURE	2250 PSI
HYDRAULIC FLUID	Military Spec, MIL-O-5606
HYDRAULIC FLUID LEVEL	Should be visilbe in reservoir system.
AIR OVER HYDRAULIC BRAKE SYSTEM	
NORMAL AIR PRESSURE	90/100 PSI
MINIMUM PRESSURE	70 PSI
BRAKE FLUID	Heavy duty, automotive
BRAKE FLUID LEVEL	Within ½-inch of top of filler hole
DOLLY AIR TANK	2020 CU. IN.
PRIME MOVER	M-26A1

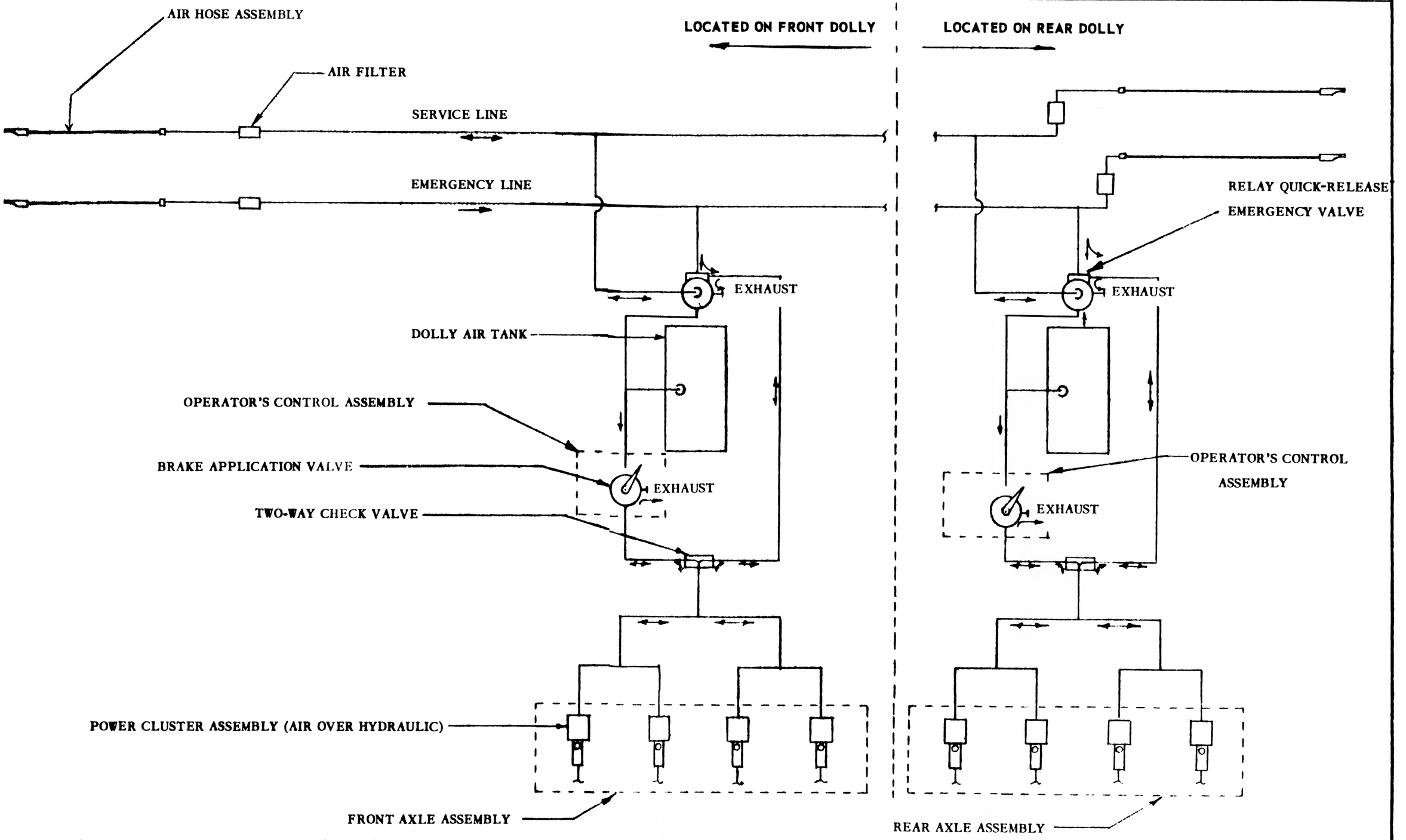


FIG. 39. AIR OVER HYDRAULIC BRAKE SYSTEM

2. OPERATING PROCEDURES.

2.1 General.

2.1.1 Operation of the transporter is performed by two operators, one operator seated on each dolly at the operator's control assembly (figure 40). Each dolly is operated separately and independently of the other.

2.2 Preoperational Check.

2.2.1 Before operating either of the dollies, the following checks should be accomplished:

2.2.1.1 Check electrical wiring for damage and security.

2.2.1.2 Check battery for proper water level.

2.2.1.3 Check to see that battery output cables are connected to battery box connections.

2.2.1.4 Check battery voltage reading on DC voltmeter located on electrical control panel. (See figure 40.) Voltage reading should be at least 22 volts DC.

2.2.1.5 Check hydraulic reservoir (figure 34) for proper level of hydraulic fluid. For proper level, refer to Table II.

2.2.1.6 Check gasoline and oil level in power unit.

2.2.1.7 Check tires for proper air pressure. Refer to Table II for correct tire pressure.

2.2.1.8 Drain all condensation from air tank and air filters.

2.2.1.9 Check master cylinder of power cluster assembly for proper level of brake fluid. For proper level see Table II.

2.2.1.10 Using prime mover as source of air pressure, check air lines (figure 35) for leakage. Visually check air lines for damage and security.

2.2.1.11 Check brakes for proper operation by applying and releasing.

2.2.1.12 Check dolly for proper lubrication. (See figure 41.)

CAUTION: Because of the loads the transporter is to carry, damage to the equipment and improper operation may result if proper lubrication is not observed.

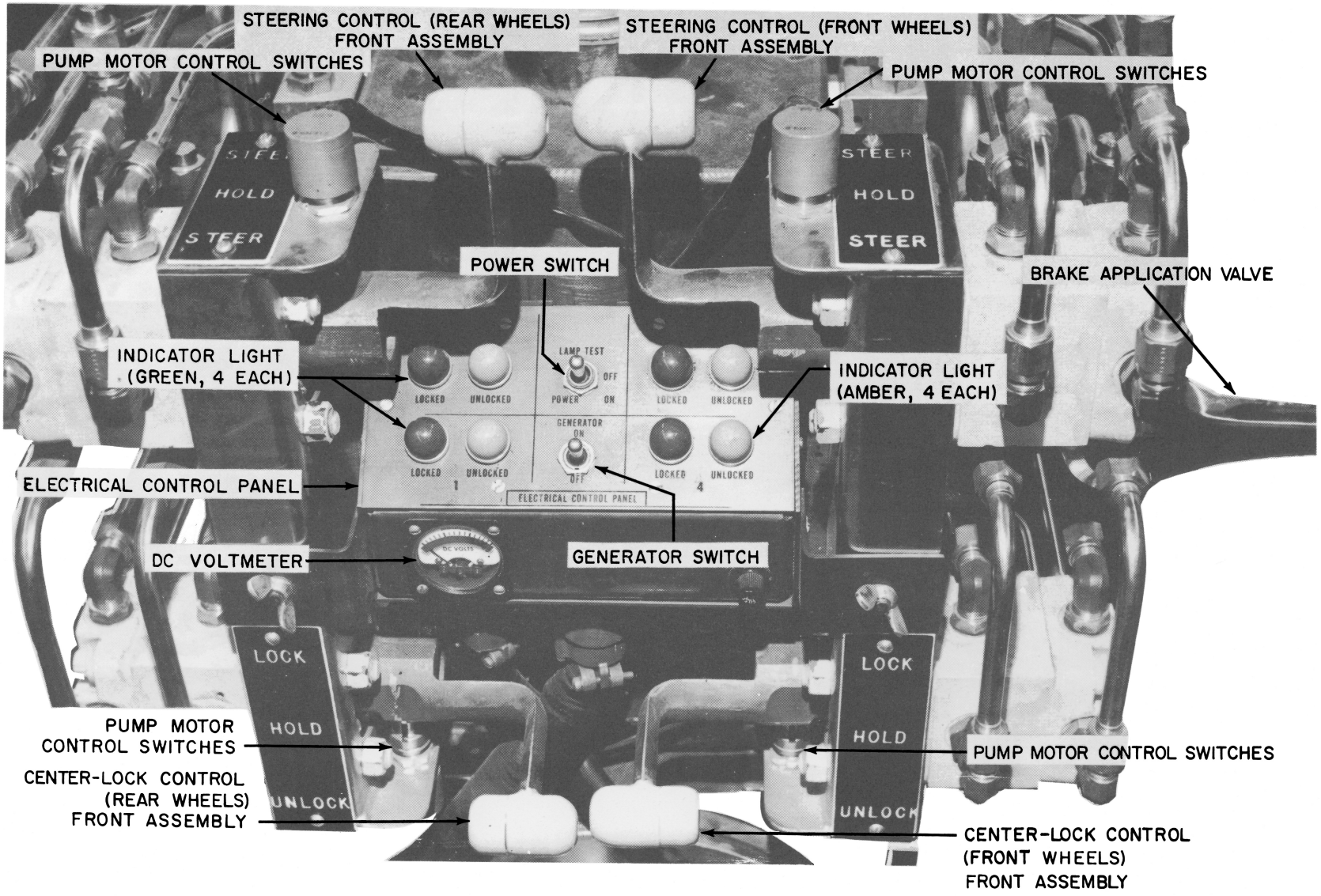


FIG. 40. OPERATOR'S CONTROL ASSEMBLY

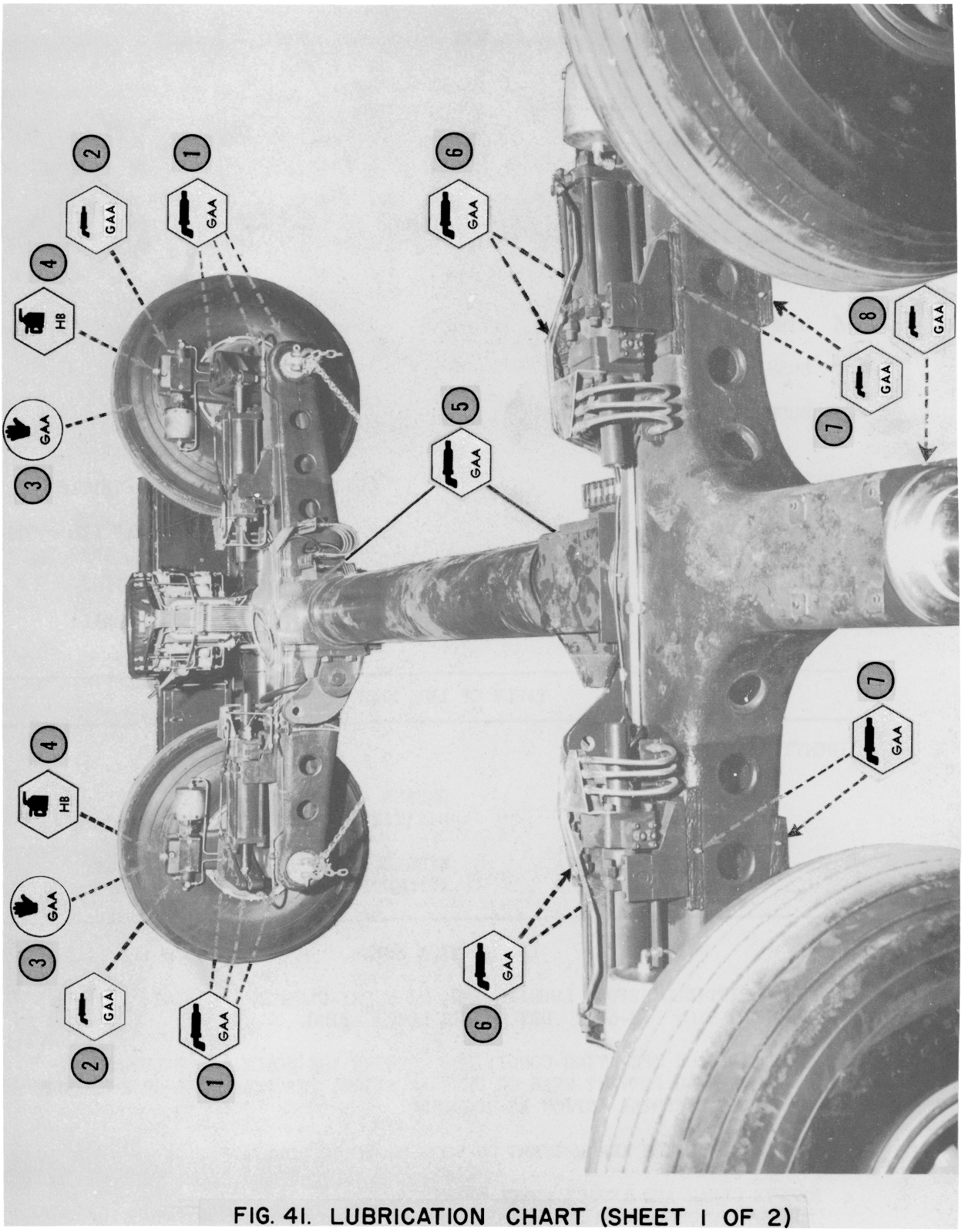


FIG. 41. LUBRICATION CHART (SHEET 1 OF 2)

KEY

1 KINGPIN AND THRUST BEARING

2 BRAKING MECHANISM

3 WHEEL BEARING (SEE NOTE 4)

4 BRAKE CYLINDER

5 BUSHING

6 STEERING CYLINDER PIN

7 BUSHING

8 BUSHING

APPLICATION SYMBOLS

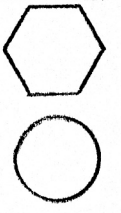


OIL CAN

ZERK GUN

HAND

LUBRICATION FREQUENCY SYMBOLS



MONTHLY AND AFTER EACH TRIP

SEMIANNUALLY

TABLE OF LUBRICANTS

IDENTIFICATION LETTER	TYPE OF LUBRICANT
GAA	GREASE AUTOMOTIVE AND ARTILLERY MILITARY SPECIFICATION MIL-G-10924
HB	HYDRAULIC BRAKE FLUID, HEAVY DUTY AUTOMOTIVE

LUBRICATION NOTES

1 CLEAN FITTINGS BEFORE LUBRICATING, WITH DRY-CLEANING SOLVENT, FEDERAL SPECIFICATION P-S-661. DRY BEFORE LUBRICATING.

2 IF CLIMATE OR OPERATING CONDITIONS REQUIRE THE DOLLY TO BE LUBRICATED MORE OFTEN TO PREVENT WEAR OR DETERIORATION, THE PERSONNEL RESPONSIBLE WILL TAKE REMEDIAL ACTION AS REQUIRED.

3 LUBRICATE BROKEN ARROW ITEMS ON BOTH SIDES OF DOLLY.

4 REMOVE CLEAN AND REPACK WHEEL BEARINGS.

FIG. 41. LUBRICATION INSTRUCTIONS (SHEET 2 OF 2)

2.2.1.13 If dolly is not to be used immediately, disconnect battery output cables from battery box.

2.3 Starting and Stopping Power Unit and Lamp Test.

2.3.1 Starting power unit from operator's electrical control panel. (See figure 40.)

2.3.1.1 Position GENERATOR switch to ON.

2.3.1.2 Release GENERATOR switch when gasoline engine starts.

2.3.2 Stopping power unit from operator's electrical control panel. (See figure 40.)

2.3.2.1 Position GENERATOR switch to OFF.

2.3.2.2 Release GENERATOR switch when gasoline engine stops.

2.3.3 Starting power unit from generator control panel.

2.3.3.1 Depress and hold GENERATOR START switch.

2.3.3.2 Release GENERATOR START switch when gasoline engine starts.

2.3.4 Stopping power unit from generator control panel.

2.3.4.1 Depress and hold GENERATOR STOP switch.

2.3.4.2 Release GENERATOR STOP switch when gasoline engine stops.

2.3.5 Lamp test. (See figure 40.)

2.3.5.1 Position POWER switch to LAMP TEST. All indicator lights should illuminate.

2.3.5.2 Position POWER switch to OFF.

2.4 Locking and Unlocking Wheels.

2.4.1 Locking wheels. (See figure 40.) Locking of the wheels can be accomplished in center position only. To lock wheels proceed as follows:

2.4.1.1 Start generator.

2.4.1.2 Position power switch to ON.

2.4.1.3 Pull center-lock controls upward to LOCK position.

2.4.1.4 Steer wheels toward center position as necessary until LOCKED indicator lights illuminate, indicating wheels

2.4.1.4 (Con.)

are locked. Position steering controls to HOLD immediately.

2.4.1.5 Return center-lock controls to their normal center position marked HOLD.

2.4.1.6 Turn power switch OFF and cycle steering control valves to relieve pressure on the lock mechanism.

2.4.2 Unlocking wheels. (See figure 40.)

CAUTION: Prior to unlocking wheels, always cycle the steering controls with the POWER switch in OFF position to prevent damage to the locking device.

2.4.2.1 Position POWER switch to OFF.

2.4.2.2 Cycle steering controls through their full cycle and return to HOLD position.

2.4.2.3 Position power switch to ON.

2.4.2.4 Position center-lock controls to UNLOCK. When UNLOCKED indicator lights illuminate the wheels are unlocked.

2.4.2.5 Position center-lock controls to HOLD.

2.5 Steering the Dolly. (See figure 40.)

2.5.1 To steer either the front dolly or the rear dolly when traveling forward, perform the following steps:

NOTE: Steering controls must be in the extreme position, either toward or away from the operator in STEER, before the steering control valve will open. When operating the control levers between the positions, use firm, quick action.

2.5.1.1 Unlock wheels as outlined in Paragraph 2.4.2.

2.5.1.2 To move either end of transporter away from operator, position steering controls away from operator to STEER position. Retain steering controls in STEER until desired degree of turn is obtained, then return to HOLD position.

2.5.1.3 To move either end of transporter toward operator, position steering controls toward operator to STEER position. Retain steering controls in STEER until desired degree of turn is obtained and then return to HOLD position.

NOTE: The front or rear wheels of a dolly may be operated independently by following procedures outlined in paragraphs 2.4.1, 2.4.2, and 2.5.1, using only steering control and center-lock control. This is necessary "only" during attachment of the dolly to the assembly fixture or when locking wheels in the center position.

2.6 Operating the Brakes.

2.6.1 The brakes of the dolly may be applied by either the prime mover operator or the dolly operator. The dolly operator may apply the brakes by pressing down on the hand-operated brake application valve (figure 40), located on the right-hand side of the operator's control assembly. Releasing the hand-operated brake application valve will release the brakes. The prime mover operator can operate the brakes on both dollies by rotating a hand valve mounted on the steering column of the prime mover.

2.6.2 The brakes of the dolly will automatically lock when the source of air pressure is removed or drops below 50 psi. In order for the brakes to be released, the operator must open the petcock, located on the bottom of the dolly air tank, and bleed the pressure from the system or allow the pressure to be increased above 50 psi.

2.7 Tire Change Procedure.

2.7.1 Jacking. (See figure 42.) Place 50-ton hydraulic toe jack on a bearing plate, 3/4-inch thick with a minimum area of 250 square inches. This plate may be aluminum with a 70 durometer rubber pad of the same size between plate and floor if used on barge deck. The rubber will tend to distribute the load evenly over the plate area. Plywood can be substituted for the rubber. Position jack under jack pad. Operate jack until correct height is obtained. If jack lift is insufficient for clearing tire from ground, raise to maximum height and place wooden blocks under walking beam. Lower jack and block with suitable bearing plates of sufficient height under jack and raise walking beam again.

2.7.2 Wheel removal. (See figure 43.) Use a 9/16-inch wrench to remove hex bolt and lock washer at center of hub cap. Remove hub cap. Bend tabs on lock washer away from slots in axle nut. Use "spanner" wrench to remove axle nut. Remove washer and spacer. Pull wheel from axle being careful not to damage seals, wheel bearings, or axle threads.

2.7.3 Wheel breakdown. (See figure 43.) After wheel has been removed, place it on a flat surface and with the aid of a "Big Bear" bead breaker or similar device, break bead on both sides. Using a 3/8-inch Allen wrench and a 5/8-inch socket or box wrench, remove the eight bolts securing the two halves of the rim. Tire and tube repairs can now be made.

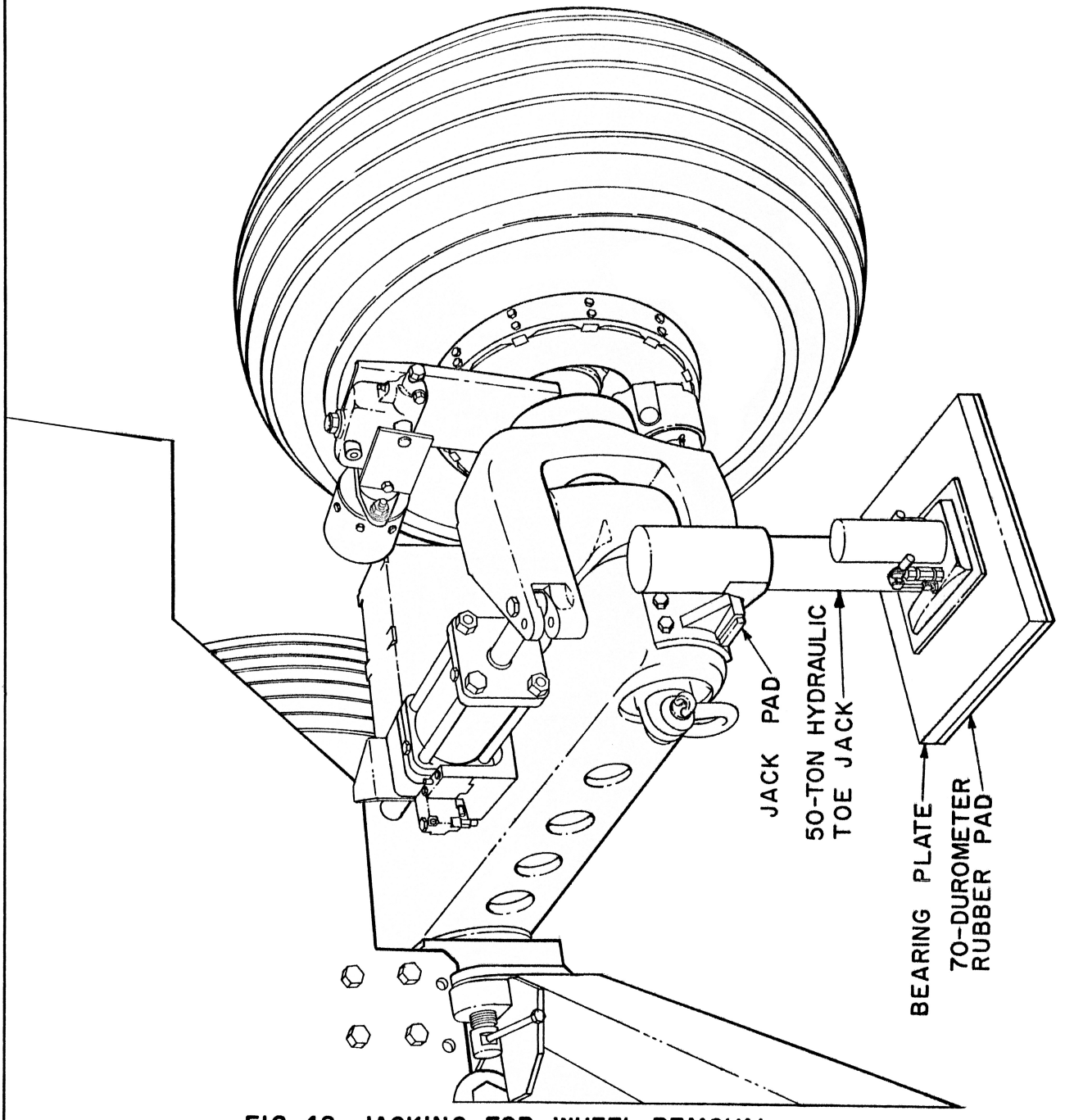


FIG. 42 JACKING FOR WHEEL REMOVAL

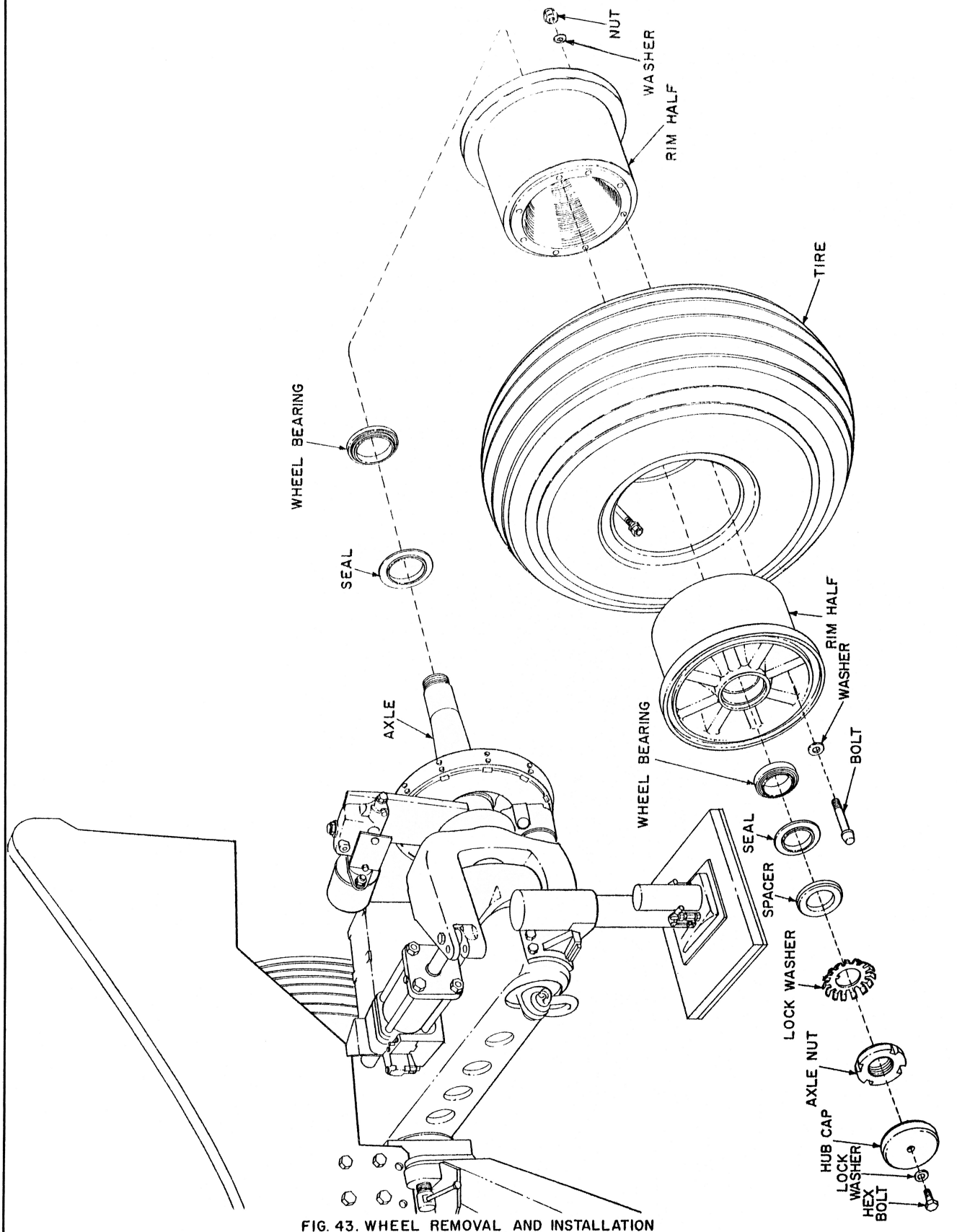


FIG. 43. WHEEL REMOVAL AND INSTALLATION

2.7.4 Wheel assembly. (See figure 43.) Position tube in tire. Position rim halves on tire, taking precautions to correctly position tube valve in correct hole in rim half. Insert eight bolts with washers under heads into rim. Place washer on opposite side and attach nuts. Torque to 50 foot pounds. Inflate to specified air pressure.

2.7.5 Wheel replacement. (See figure 43.) Insert lubricated bearings and seals in rims. Place wheel on spindle, being careful not to damage bearings, seals, or axle threads. Insert spacer and position lock washer adjacent to it. Thread axle nut onto shaft. Pull nut tight with spanner wrench (approximately 100 foot pounds of torque) to pull assembly tight against shoulder. Loosen axle nut to snug fit. Bend lock washer tabs into slots in axle nut. Replace hub cap with bolt and lock washer under head. Tighten snugly.

3. INSTALLATION AND REMOVAL PROCEDURES.

3.1 Installation.

3.1.1 Installation of dolly to assembly fixture. (See figure 44.)

3.1.1.1 Position dolly directly in rear of and alined with assembly fixture.

NOTE: Proper alinement of the dolly and assembly fixture at this point will eliminate unnecessary movement of the dolly during installation.

3.1.1.2 Remove operator's seat as outlined in paragraph 6.2.1.1.

3.1.1.3 Using fixture jacks, raise assembly fixture to height necessary for dolly clearance.

NOTE: Procedures outlined for raising and lowering the assembly fixture should be used to accomplish paragraphs 3.1.1.3 and 3.1.1.7.

3.1.1.4 Move dolly under assembly fixture until lower corners of cradle aline with trunnion grooves on dolly.

3.1.1.5 Raise or lower caster wheel until top surface of trunnion grooves are parallel with bottom surface of cradle.

3.1.1.6 Check horizontal and vertical alinement of dolly trunnion grooves with corners of cradle.

3.1.1.7 Lower assembly fixture onto dolly until attaching bolt holes of dolly and assembly fixture aline.

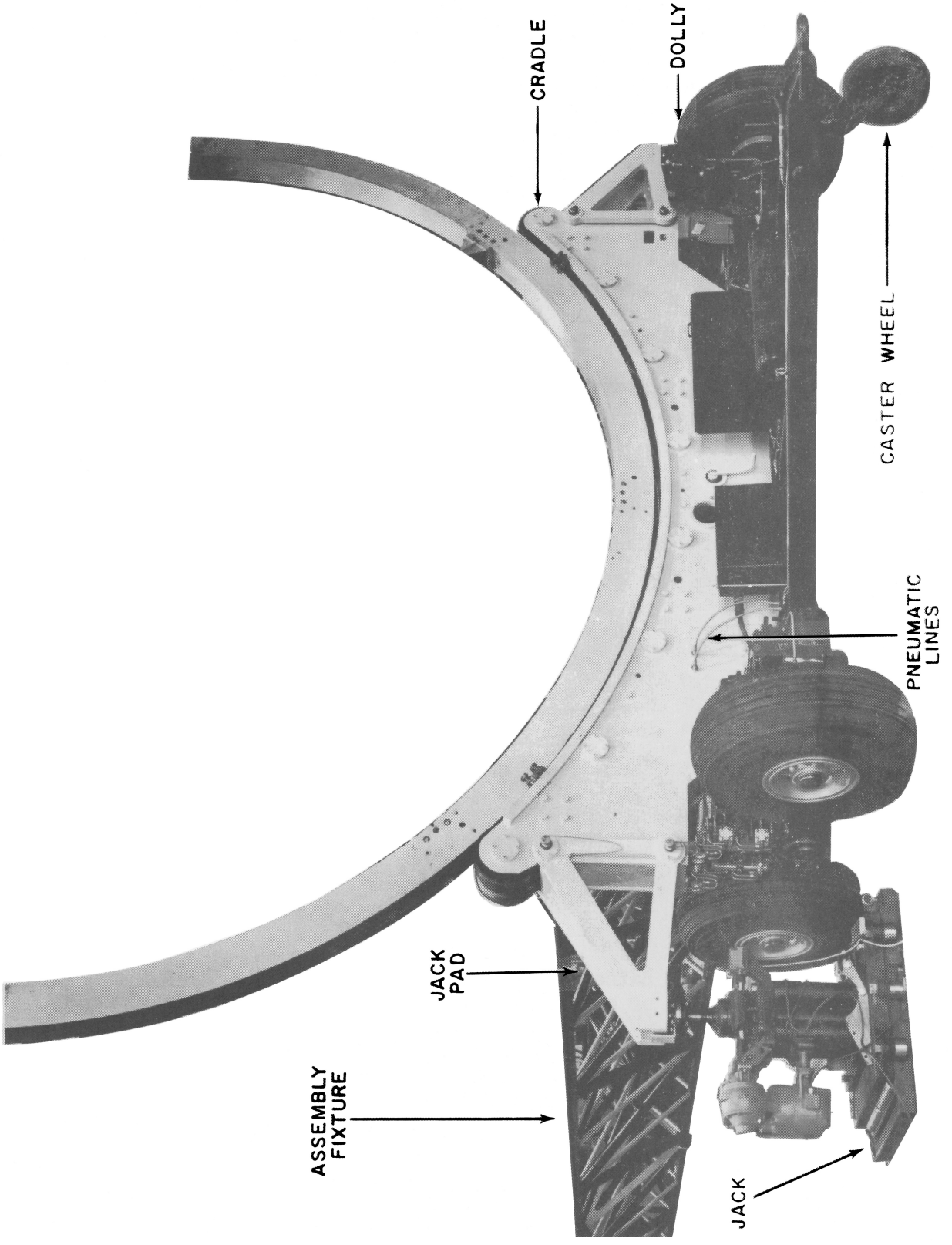


FIG. 44. REMOVING AND INSTALLING DOLLY TO ASSEMBLY FIXTURE

CAUTION: Do not allow full weight of assembly fixture on dolly as damage to caster wheel will result.

3.1.1.8 Secure cradle to dolly trunnion using clamps provided with fixture; two clamps provided for each dolly. (See figure 45.)

3.1.1.9 Extend caster wheel. (See figure 44.)

3.1.1.10 Unlock drawbar by loosening drawbar locking screws.

3.1.1.11 Lower assembly fixture onto dolly.

3.1.1.12 Remove jacks.

3.1.1.13 Remove jack pads.

3.1.1.14 Replace operator's seat.

3.1.1.15 Connect pneumatic lines as required.

3.2 Removal.

3.2.1 Removal of dolly from assembly fixture. (See figure 44.)

NOTE: Procedures outlined for lowering and raising an assembly fixture should be used to accomplish paragraphs 3.2.1.5 and 3.2.1.7.

3.2.1.1 Remove clamps located on fixture which secure cradle to dollies. (See figure 45.)

3.2.1.2 Disconnect pneumatic lines.

3.2.1.3 Extend caster wheel.

3.2.1.4 Lock drawbar to trunnion by tightening drawbar locking screws.

3.2.1.5 Raise assembly fixture until dolly can be moved clear of assembly fixture.

3.2.1.6 Move dolly clear of assembly fixture.

3.2.1.7 Lower assembly fixture.

4. SHIPMENT BY BARGE.

4.1 Description.

4.1.1 The S-I transporter and its booster cargo will be shipped aboard the Saturn barge, "Palaemon".

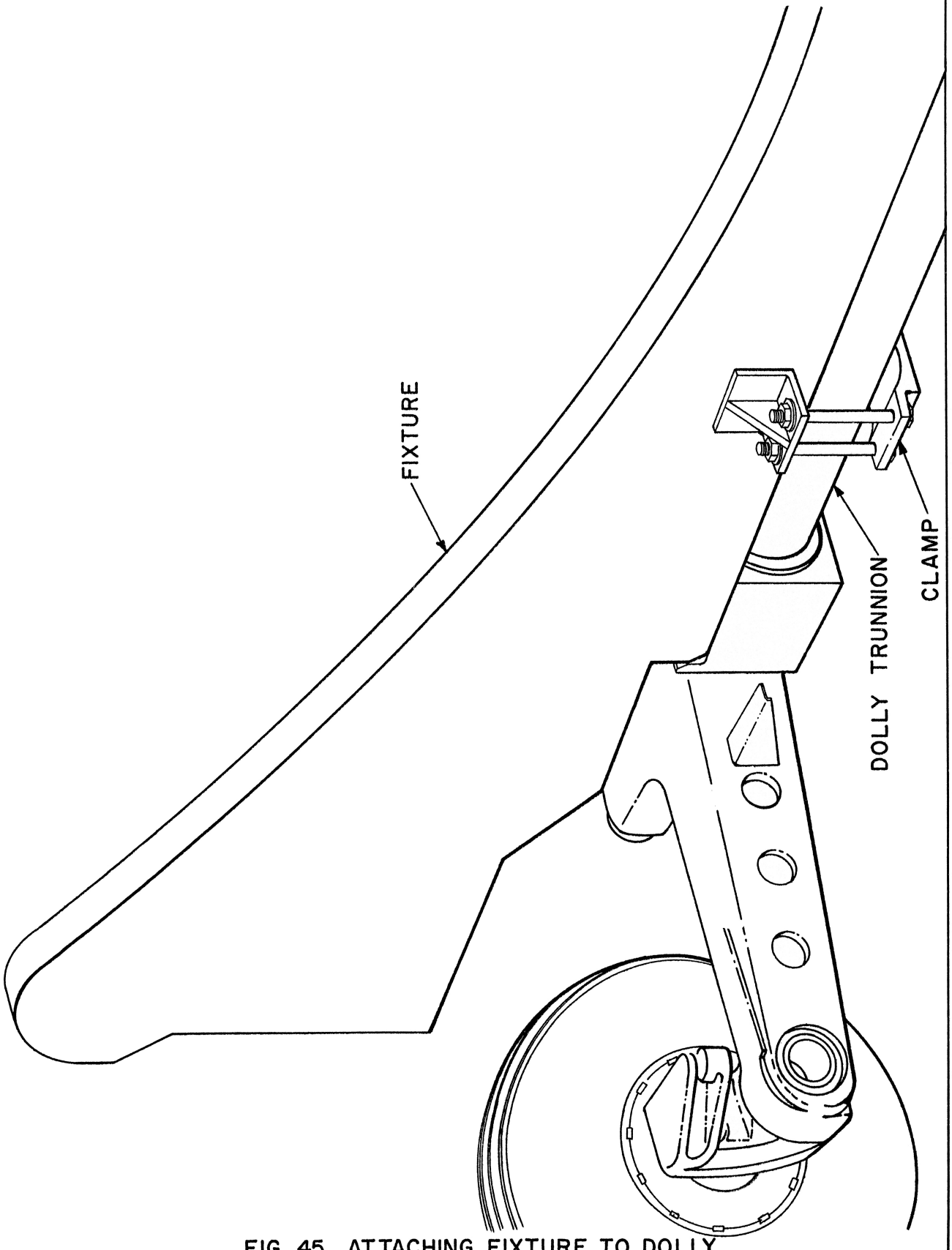


FIG. 45. ATTACHING FIXTURE TO DOLLY

4.2 Loading at MSFC.

4.2.1 The barge will be secured in its slip, the bridges positioned, and the barge correctly ballasted before attempting to load. With the aid of the dock winch facility, the S-I transporter will be loaded on the barge with the rear dolly entering first. Position the transporter as shown in figure 46. The white lines on the deck of the barge are guide lines for the outside edge of the transporter wheels. Red lines on the deck of the barge indicate lanes in which the wheels of the transporter must stay.

4.2.2 It is possible, if necessary, to back the S-I transporter aboard the barge using the prime mover, M-26 tractor.

4.3 Tie-Down Arrangement.

4.3.1 The arrangement of the chain tie-down of the Saturn S-I stage transporter to the deck of the barge is shown in figure 46. Table III lists the termination points for each numbered chain shown in figure 46. Chains used are 25,000 pound cargo tie-down chains. Cargo tie-down rings are screwed into the deck plates to receive the chains. All 25,000 pound chains are to have 1000 pound pre-load and all hooks and chains safety wind.

4.3.2 The chocks are chained together as shown in figure 46, using 10,000 pound cargo tie-down chains. Twelve by twelve by twenty-four inch timbers are placed under each drawbar and the support wheel retracted before tieing it down.

4.3.3 Twelve inch wide by seven feet long timbers should be placed under each walking beam as shown. It should provide 1/2-inch clearance between the timber and walking beam after applying pre-tension load in the chains.

4.3.4 The tie-down arrangement also includes a cable backup system. Eight, 3/4 inch, 6 x 19 steel cable and one inch by 18 inch jaw and eye turnbuckle assemblies are used with each transporter dolly. Its termination points are shown in figure 46. Each cable assembly requires a pre-load of approximately 500 pounds.

TABLE III. TIE-DOWN CHAINS TERMINATION (25,000 POUND CAPACITY)

CHAIN NO.	FROM - DECK DESIGNATION REAR DOLLY	FROM - DECK DESIGNATION FRONT DOLLY	TO - TRANSPORTER STRUCTURE
1	D-3	A-10	Upper Bracket on Cradle
2	D-3	A-10	Lower Bracket on Cradle
3	D-2	A-11	Upper Bracket on Cradle
4	D-2	A-11	Lower Bracket on Cradle

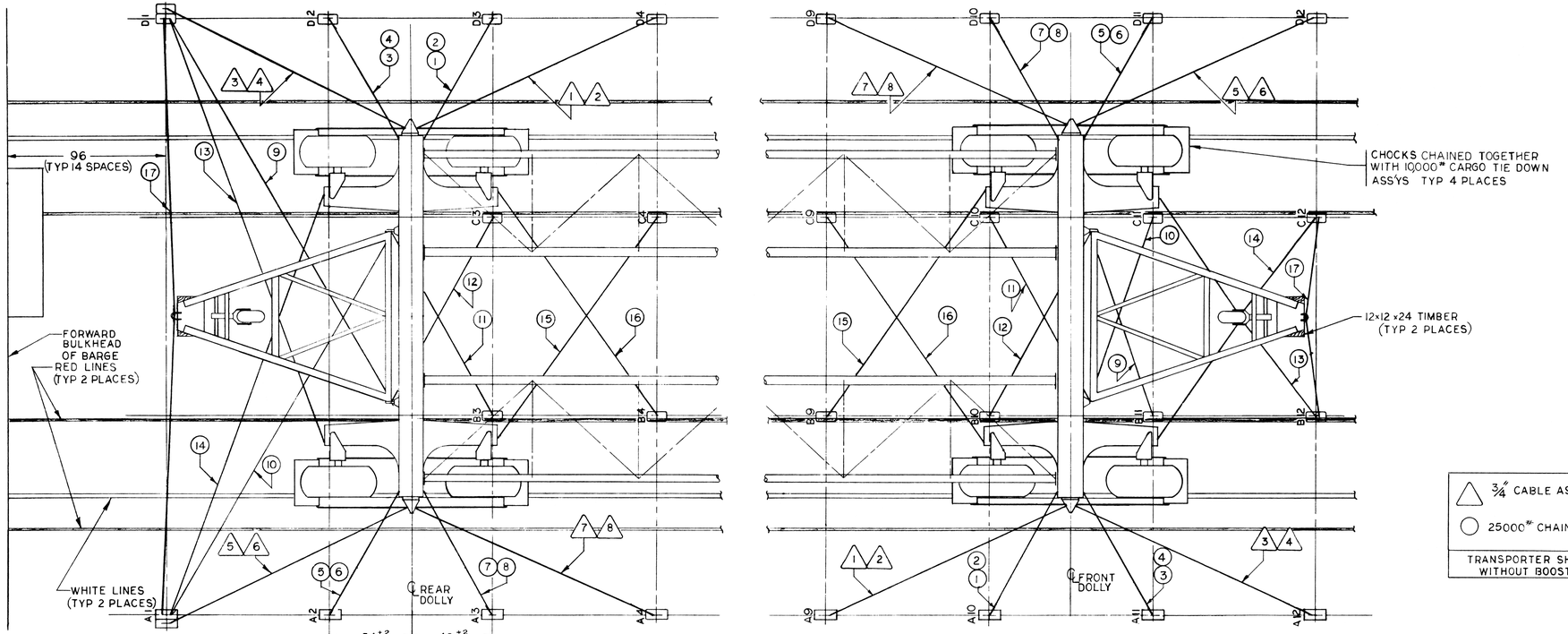


FIG. 46. TIE-DOWN ARRANGEMENT S-1 TO BARGE

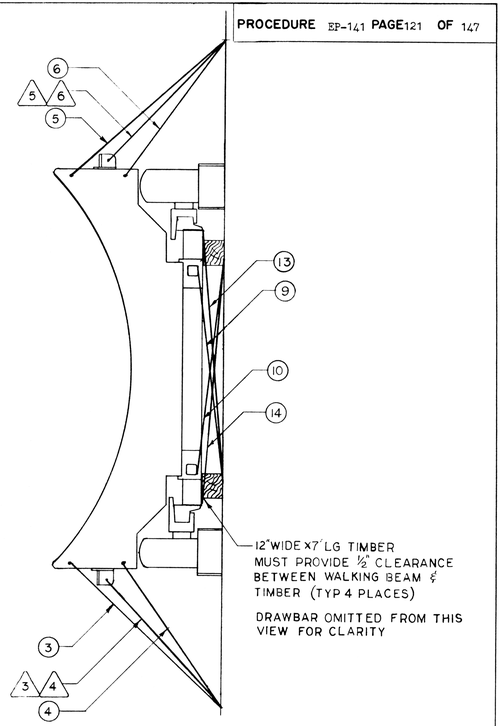


TABLE III. TIE-DOWN CHAINS TERMINATION (25,000 POUND CAPACITY) (Con.)

CHAIN NO.	FROM - DECK DESIGNATION REAR DOLLY	FRONT DOLLY	TO - TRANSPORTER STRUCTURE
5	A-2	D-11	Upper Bracket on Cradle
6	A-2	D-11	Lower Bracket on Cradle
7	A-3	D-10	Upper Bracket on Cradle
8	A-3	D-10	Lower Bracket on Cradle
9	D-1	B-11	Drawbar Attaching Bracket
10	A-1	C-11	Drawbar Attaching Bracket
11	B-3	C-10	Drawbar Attaching Bracket
12	C-3	B-10	Drawbar Attaching Bracket
13	D-1	B-12	Walking Beam Stub Axle
14	A-1	C-12	Walking Beam Stub Axle
15	C-4	B-9	Walking Beam Stub Axle
16	B-4	C-9	Walking Beam Stub Axle
17	D-1		Through Eye of Drawbar to A-1
17		B-12	Through Eye of Drawbar to C-12

4.4 Unloading at AMR.

4.4.1 The barge will be secured at the Saturn unloading facility, the unloading bridges installed, and the barge correctly ballasted before the unloading operation. All tie-down chain and cable assemblies will be removed and secured aboard the barge, including the brackets and attaching hardware on the cradles where chains number 1 through 8 terminate. The M-26 tractor, prime mover for S-I transporter, is backed aboard the barge and connected to the front dolly of the transporter. The S-I stage is then moved to the launch site.

5. SATURN S-I PORTABLE JACKS.

5.1 Description.

5.1.1 A system consisting of four electrically-operated screw jacks has been designed for lifting Saturn S-I stage on assembly fixture, (J-AF-12004) off the dollies. This allows dollies to be removed for other use or repairs.

5.1.2 Each of the four identical portable jack assemblies (J-10426625) consists of a 25-ton screw jack mounted on a pyramidal base and driven by a 1-horsepower, 220-volt, 3 phase gear motor, with a maximum lift of 18 inches. (See figure 47.) A reversing motor starter with push button controls is used in conjunction with a limit switch to control raising and lowering of each jack.

5.1.3 A set of four cables consisting of one 100-foot power supply cable, one 75-foot cable, and two 30-foot cables, is used to connect power supply with the four jacks as shown in figure 48.

5.1.4 A circular level is mounted on the base with the screw jack to facilitate leveling. Jacks must be level to prevent damage when lifting assembly fixture and booster.

5.2 Work Area Requirements.

5.2.1 A level or near level rectangular area 30-feet by 80-feet.

5.2.2 A hard-surfaced area of concrete or asphalt.

5.3 Power Requirements.

5.3.1 Power supply or electrical generator.

5.3.2 220-240 volt, 60-cycle, AC 3-phase, 60-amp, 4-wire system.

5.3.3 A 100-foot long power supply cable, (C-10426926) is furnished with Crouse-Hinds connector, Type APJ, Model M-54, or equivalent, which mates with Crouse-Hinds AR 646 or ARE 6465 receptacles, or equivalent.

5.4 Positioning Booster.

5.4.1 Tow transporter into desired position and remove outrigger seat assemblies

5.4.2 Attach two jack pad assemblies to both forward and rear cradles, using leveling stands (J-MiT-12012-4-0) and (J-MiT-12012-3-0) respectively. Secure each jack pad assembly with two pins. (See figure 49.)

5.4.3 Remove eight bolts which secure dolly to each cradle.

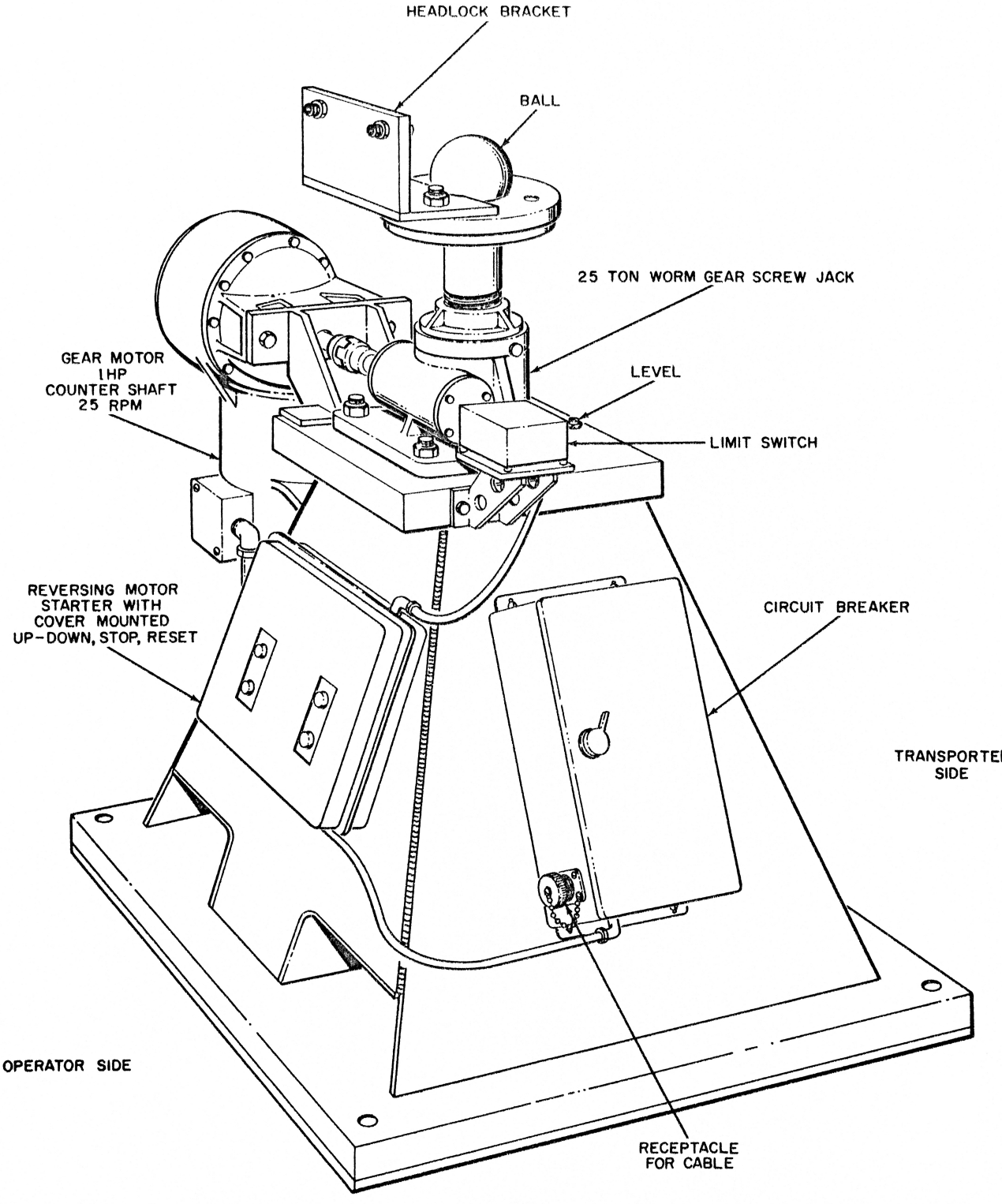


FIG. 47. PORTABLE JACK ASSEMBLY

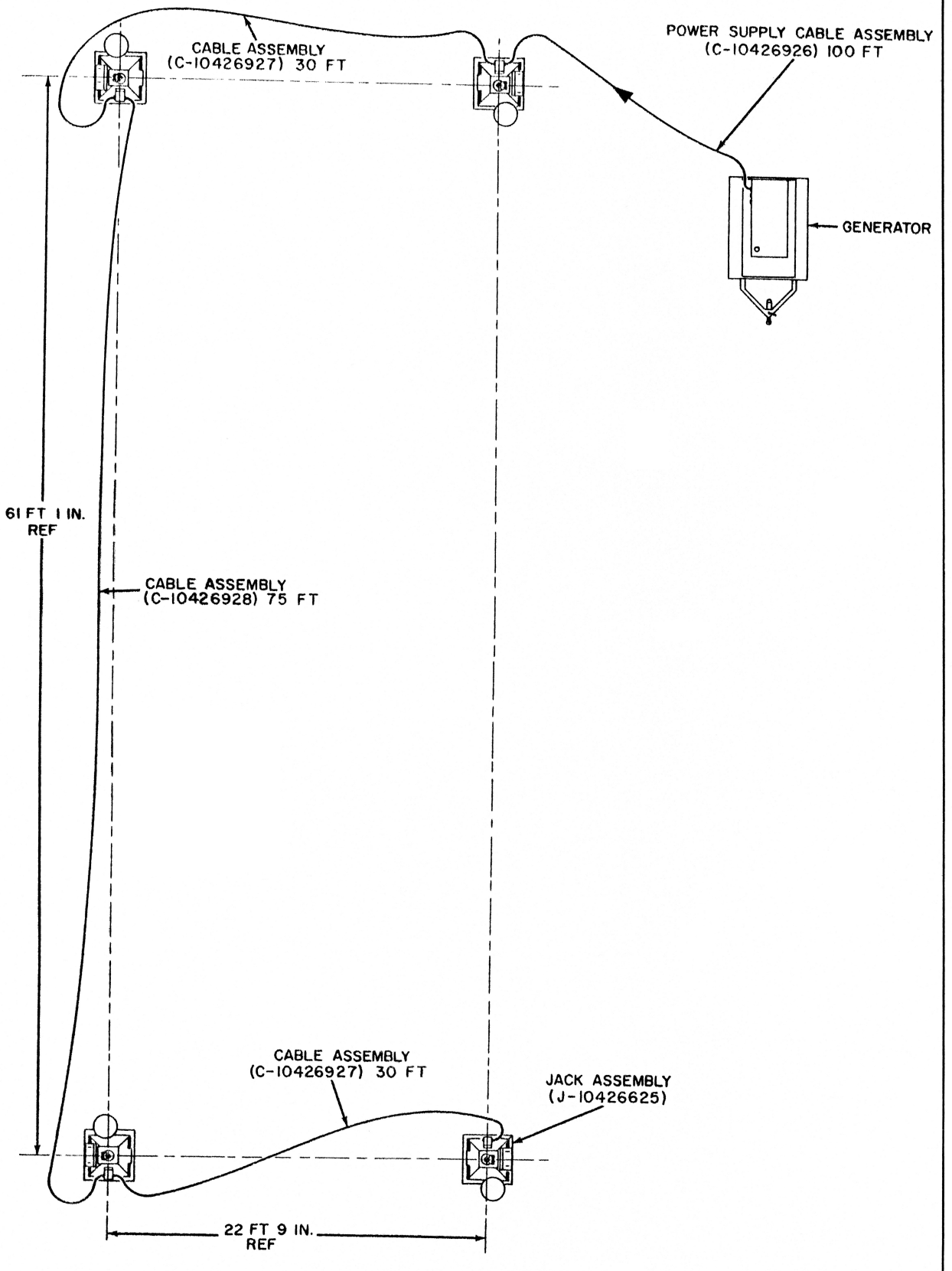


FIG. 48 JACK POSITIONING AND CABLE INTER-CONNECT DIAGRAM

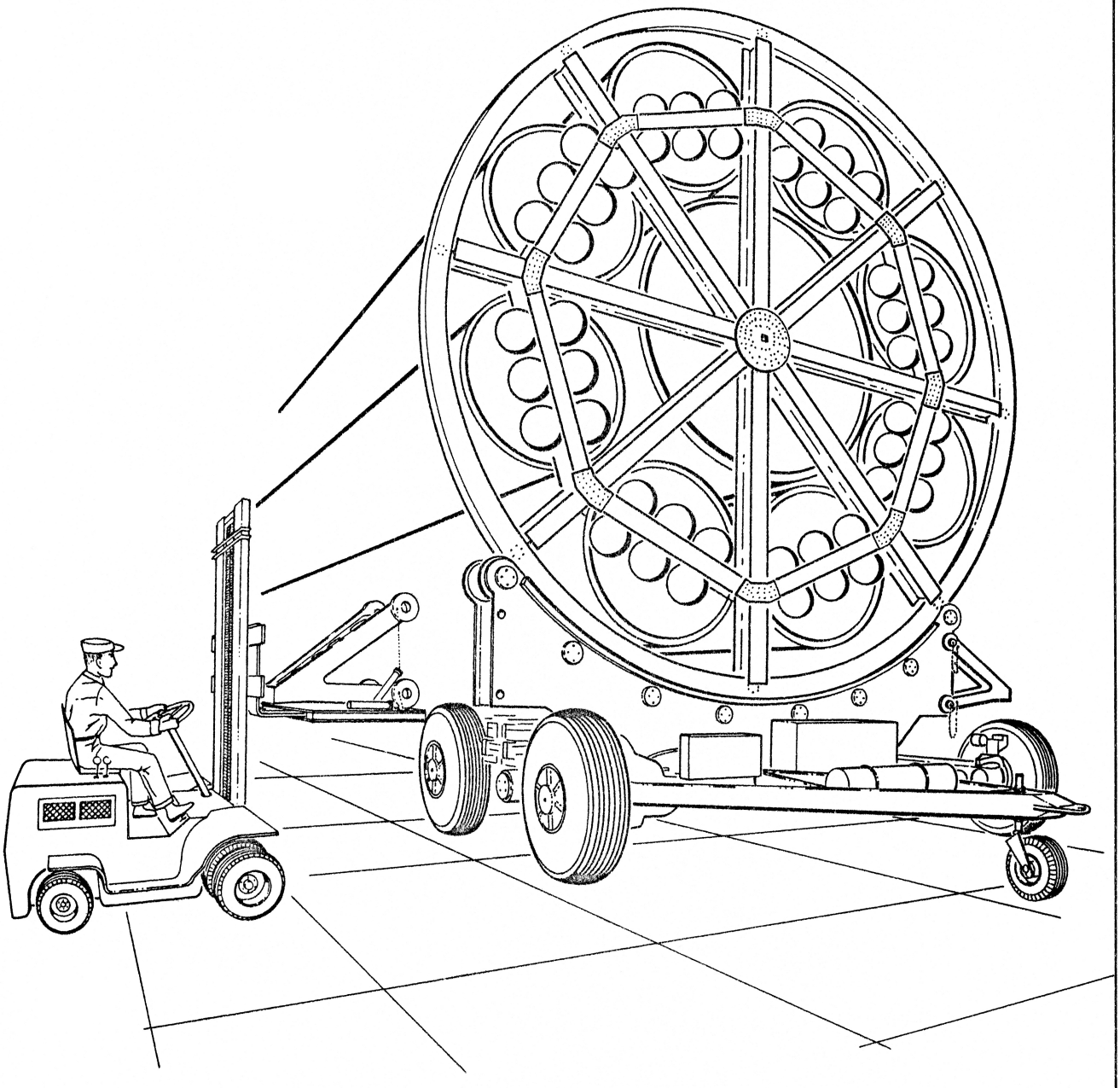


FIG. 49. ATTACHING JACK PAD ASSEMBLY

5.5 Electrical and Mechanical Checkout.

5.5.1 Connect jacks to power supply and operate for functioning test before placing under jack pads for lifting.

5.5.2 Connect three cable assemblies between jacks as shown on Drawing D-10426929 or figure 48. Any jack may be used to connect to power supply with cable assembly (C-10426926) as all jacks are identical.

5.5.3 Check all connections and insure power supply is compatible with requirements (220-240 volts, AC, 60 cycles, 3-phase, 4-wire, 60 amps).

5.5.4 Turn the power on.

5.5.5 Check each jack individually for correct functioning by operating up and down for a short distance. Jack screw must not be allowed to rotate while motor is running. Jack screw will not raise or lower if allowed to rotate. Rotation of screw will cause incorrect functioning of limit switch with possible damage resulting. Correct operating speed of jack screw is about 1/2 inch per minute.

5.5.6 When jacks do not operate in correct response to control buttons or cannot be raised from lowered position, the phase connections in power supply cable may be improperly installed. Corrective action for this condition is to have a qualified electrician change two of the three-phase connections in the Crouse-Hinds, or equivalent, connector of power supply cable assembly (C-10426926). Do not change ground connection.

5.5.7 Check limit switch operation by raising jack screw to upper limits. Normal limit switch settings are 1/2-inch raise for lower limit and $16\frac{1}{2}$ inches for upper limit. If limit switch is correctly set, jack should stop at $16\frac{1}{2}$-inch raise.

5.5.8 Lower jacks to lower limit and check switch operation. If limit switch operation is faulty, it must be corrected before using jacks.

5.6 Positioning Jacks Under Jack Pad.

5.6.1 Place jacks under jack pads with fork lift truck. (See figure 50.) Jacks should be positioned with operator's side away from transporter as shown in figure 48.

5.6.2 Level all jacks. Level bubble must be entirely within circle when jacks are under load.

5.6.3 Center all jacks directly under sockets of respective jack pads. (See figure 51.)

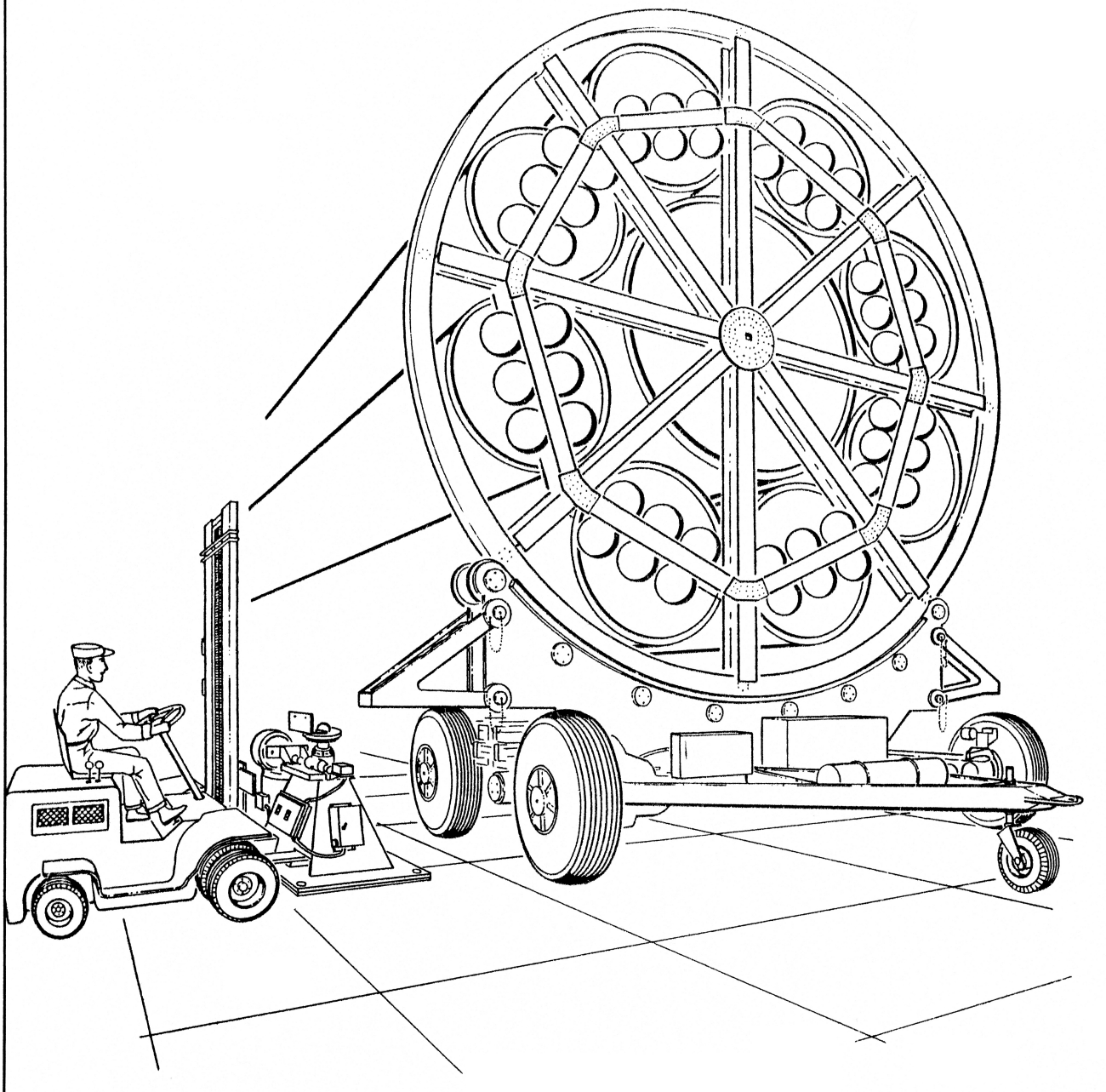


FIG. 50. POSITIONING JACK ASSEMBLY

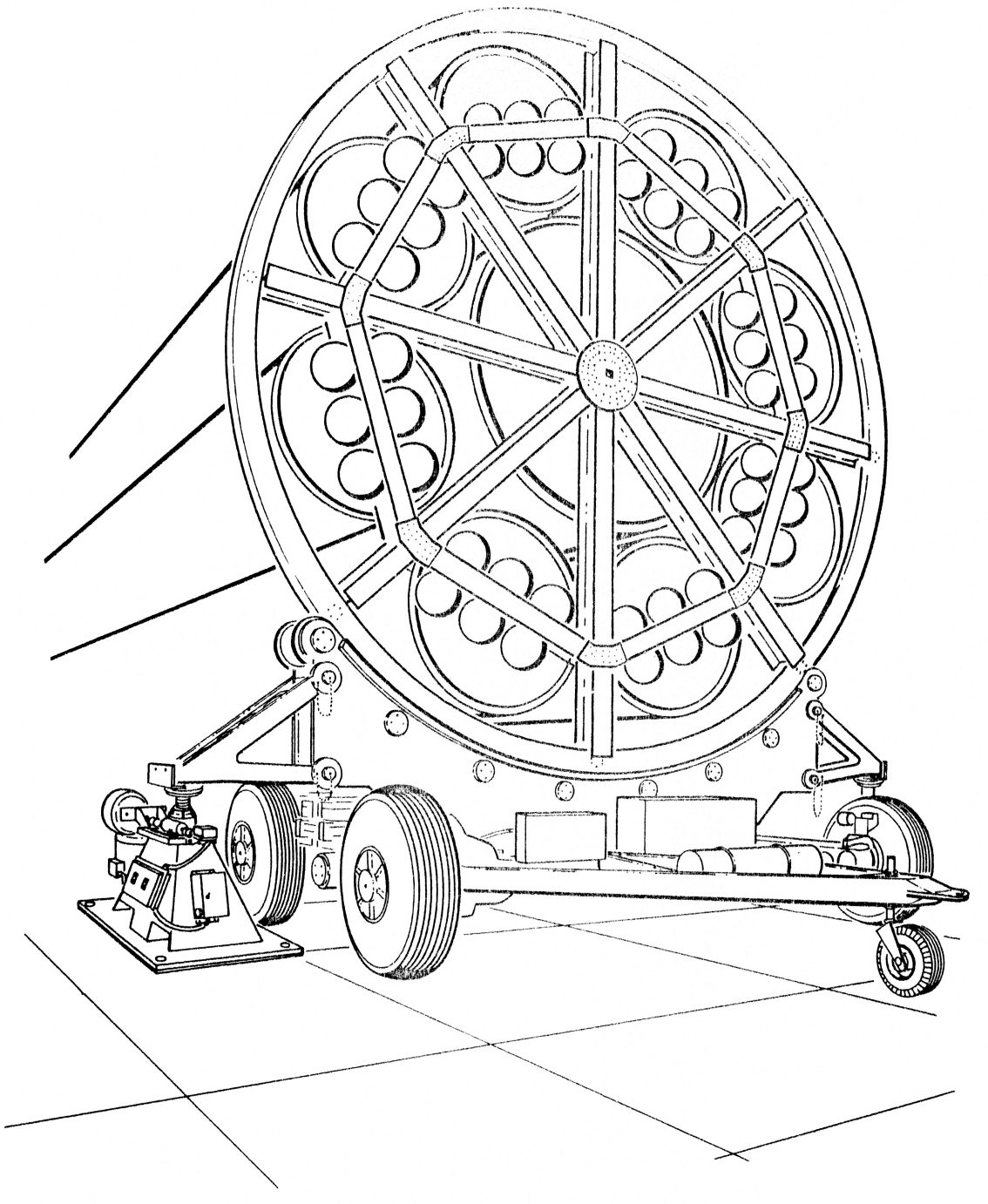


FIG. 51. JACK ASSEMBLY UNDER JACK PAD

5.6.4 Raise each jack within 1/4 inch of socket. If jack is not centered under socket, jack must be moved to proper position. Re-check levels and level jacks if necessary. The operation of jacks under load and not level may damage jacks, cradles, and booster.

5.7 Lifting.

5.7.1 Raise each jack individually to solid contact but do not lift load. Adjust two 1/2-inch set screws in headlock bracket to contact end of jack pad and secure with lock nuts. The headlock bracket prevents rotation of jackscrew while lifting load.

5.7.2 Jacks are now ready for lifting cradles of dollies. All jacks must be raised or lowered simultaneously during lifting operation. If one or more jacks are not level during lifting operation, all jacks must be stopped, lowered, and re-leveled before proceeding.

5.7.3 Start all jacks together and raise to height required to remove dollies. Dollies may now be removed. (See figure 52.) Jacks may be left extended or may be lowered. When lowering, all jacks should be lowered simultaneously to desired height or until first jack reaches lower limit, then all must be stopped.

5.8 Storage.

5.8.1 Storage for considerable periods of time should be accomplished by positioning jack with major portion of weight supported by rigid jacks or blocking under cradles.

5.9 To Replace Cradles on Transporter.

5.9.1 Raise jacks to required height simultaneously.

5.9.2 Back dollies under cradle.

5.9.3 Lower jacks simultaneously until cradles are supported by dollies.

5.9.4 Lower jacks to lower limit, then raise 1/2 inch.

5.9.5 Remove jacks and jack pad.

5.9.6 Secure each cradle to dolly with eight bolts .

5.10 Emergency Use: Dolly Repairs, Tire Change, Etc.

5.10.1 A level area must be used.

5.10.2 Use two jacks to raise forward or rear cradle. This allows removal of a dolly or parts of a dolly for tire change or repair.

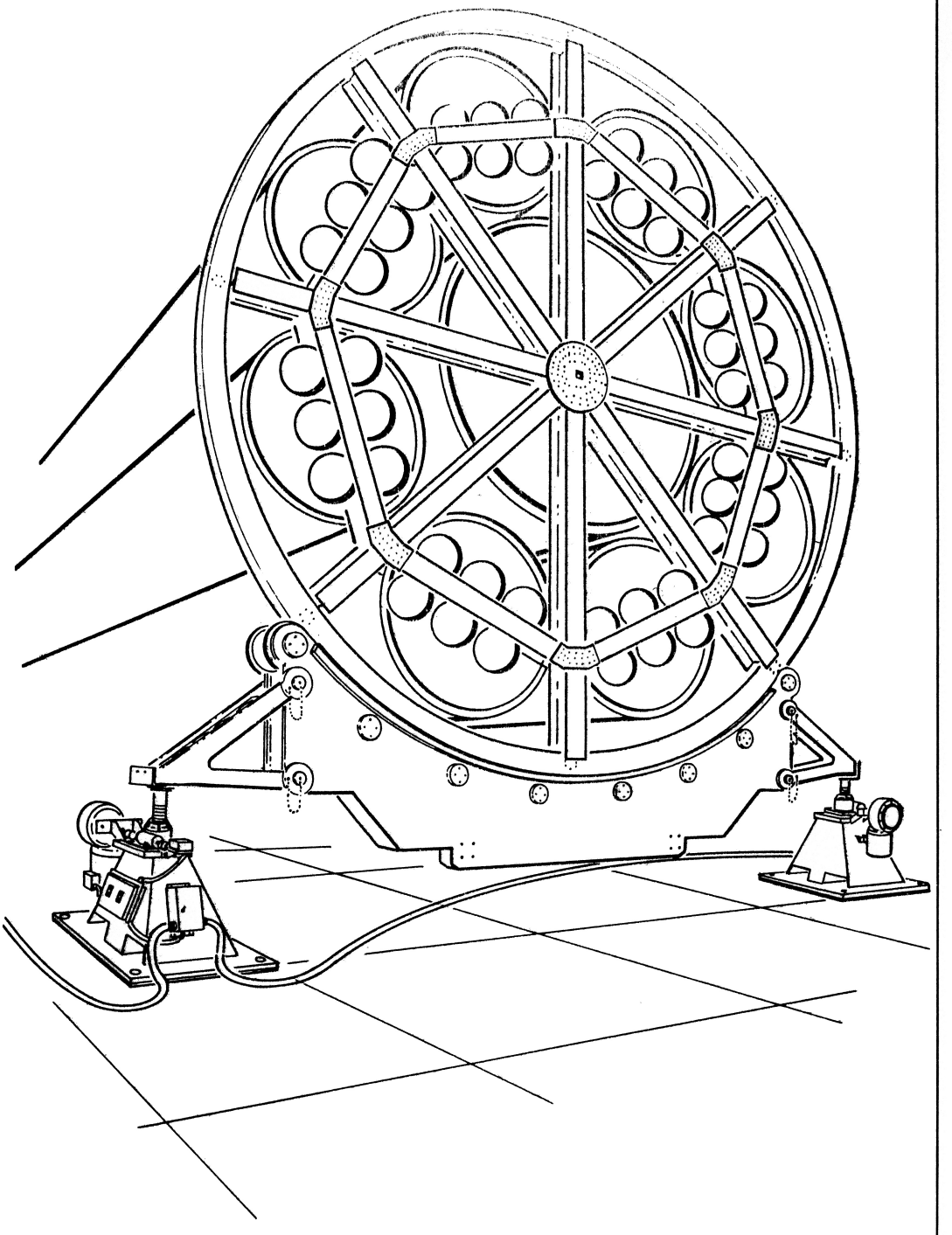


FIG. 52 FIXTURE ASSEMBLY SUPPORTED BY JACK ASSEMBLIES

5.10.3 Two jacks will be used on the same cradle in all cases.

5.10.4 Chocks must be used for dolly on opposite end and brakes applied.

5.10.5 Raise cradle to clear dolly by using two jacks with power supply cable and 30-foot connecting cable. Dolly can be removed, repaired, and/or replaced with operable dolly.

5.11 Lubrication Instructions.

5.11.1 Jack. Lubricate once per month of normal operation with extreme pressure grease or molydenum disulfide type grease. Recommended greases are Mobilplex E.P. #1, Texaco E.P. #1, Molykote Type G or Molytex Grade #2.

5.11.2 Motor Ball Bearings. Relubricate each 3 to 5 years. Recommended lubricants are, Socony Mobil BRB, lifetime grease or Shell Alvania No. 2.

5.11.3 Gear Head. Check oil level with dipstick before each operation. Add oil and change oil as recommended by tag attached to gear head.

6. PREPARATION OF DOLLIES FOR SHIPMENT BY COMMERCIAL CARRIER.

6.1 General.

6.1.1 The dolly may be shipped by either motor freight or by railroad. When shipping the dolly by motor freight, special permits will be required because the dolly, as loaded, is 10 feet 8 inches wide. When shipping the dolly by railroad, special routing will be required. The minimum U.S. rail profile is 10 feet 8 inches. If the dolly is to be shipped by railroad, the power unit and battery box should be removed and shipped by motor freight. Tie-down procedures (figure 53) are essentially the same when shipping by motor freight or by railroad except, when shipping by railroad, additional support should be applied by providing tie-downs through the core support holes in the walking beams.

6.2 Loading and Tie-Down Procedures for Operator's Seat, Detachable Drawbar, and Dolly.

6.2.1 To remove operator's seat and drawbar and prepare dolly for shipment, perform the following steps:

6.2.1.1 Raise operator's seat (back first) permitting attaching end of operator's seat to unlock and slide out of operator's seat bracket.

6.2.1.2 Place operator's seat in bracket provided on drawbar. (See figure 54.)

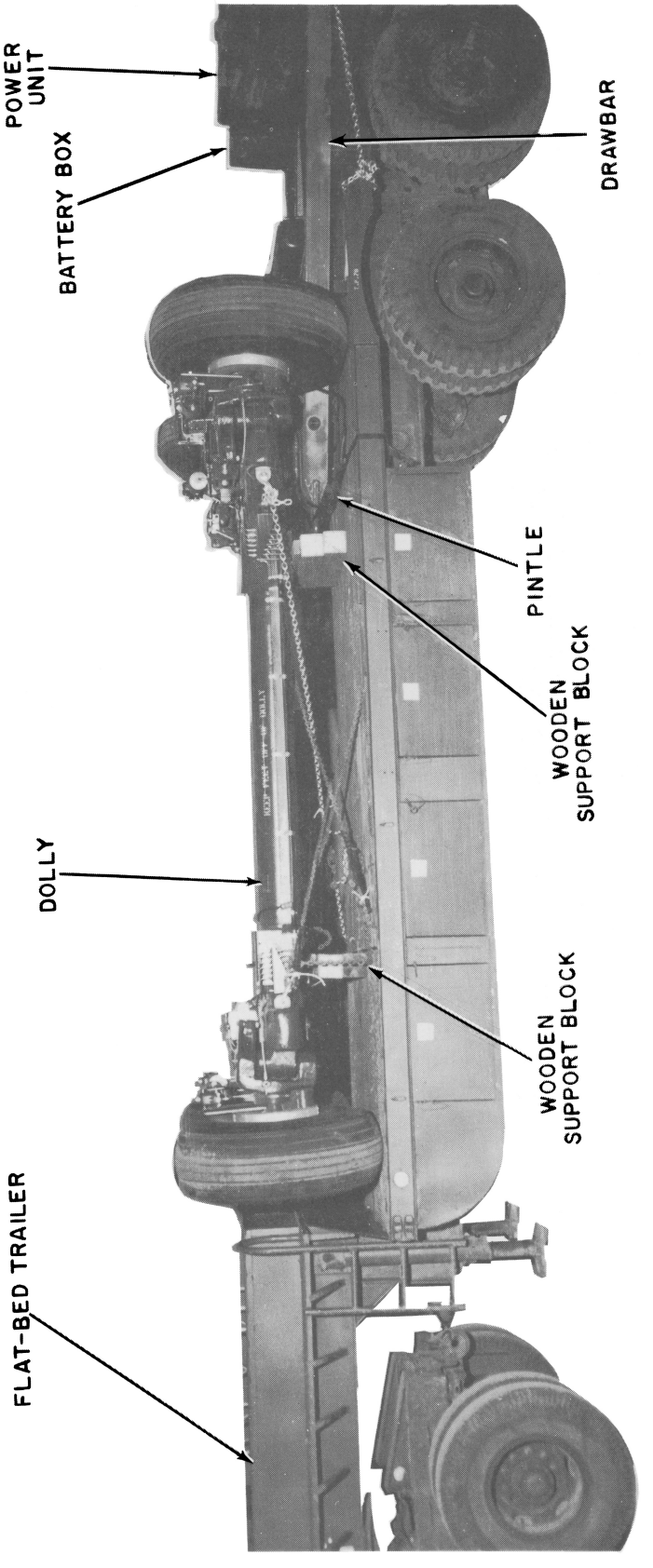


FIG. 53. TIE DOWN PROCEDURES (SHEET 1 OF 3)

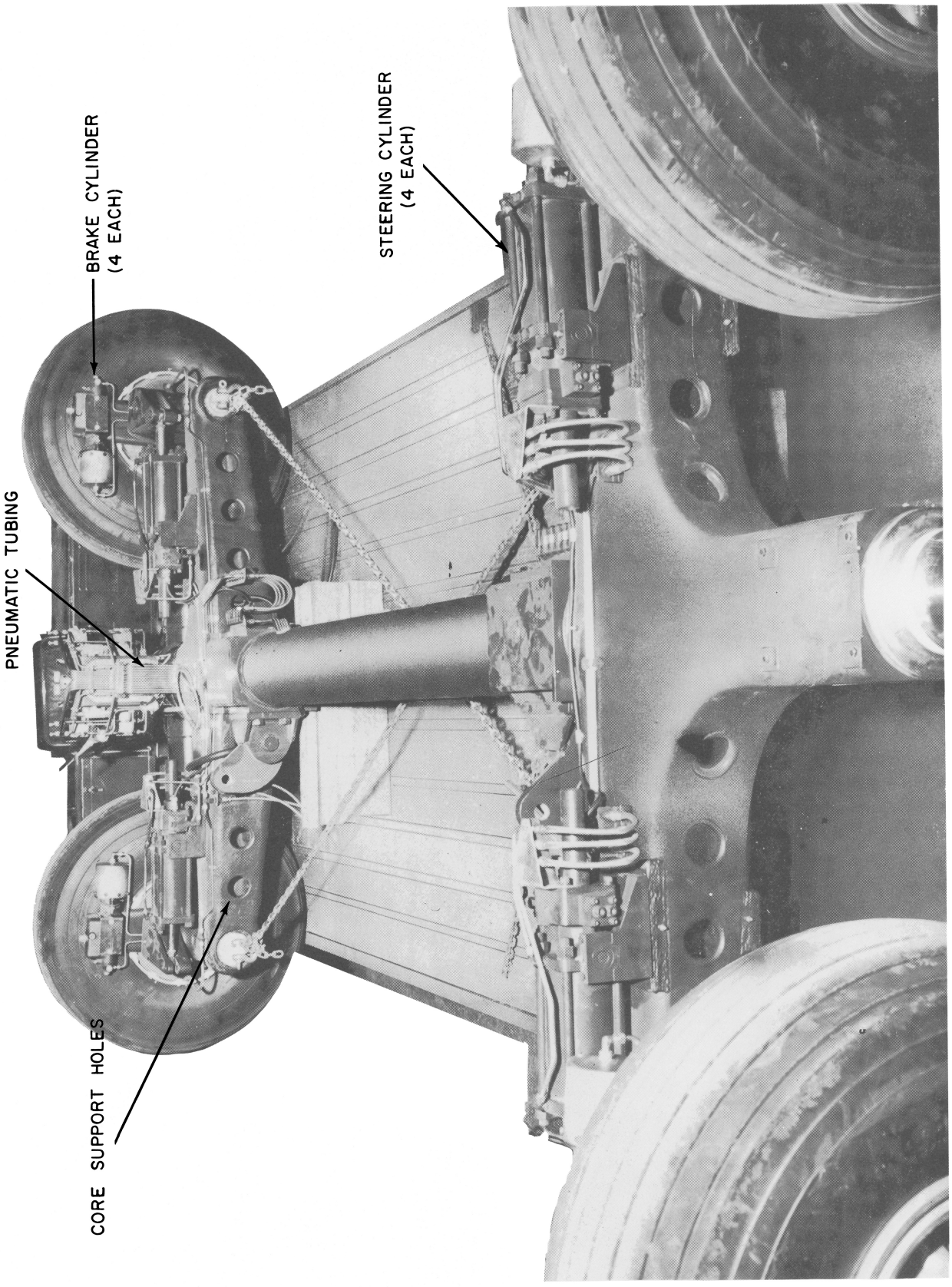


FIG. 53. TIE DOWN PROCEDURES (SHEET 2 OF 3)

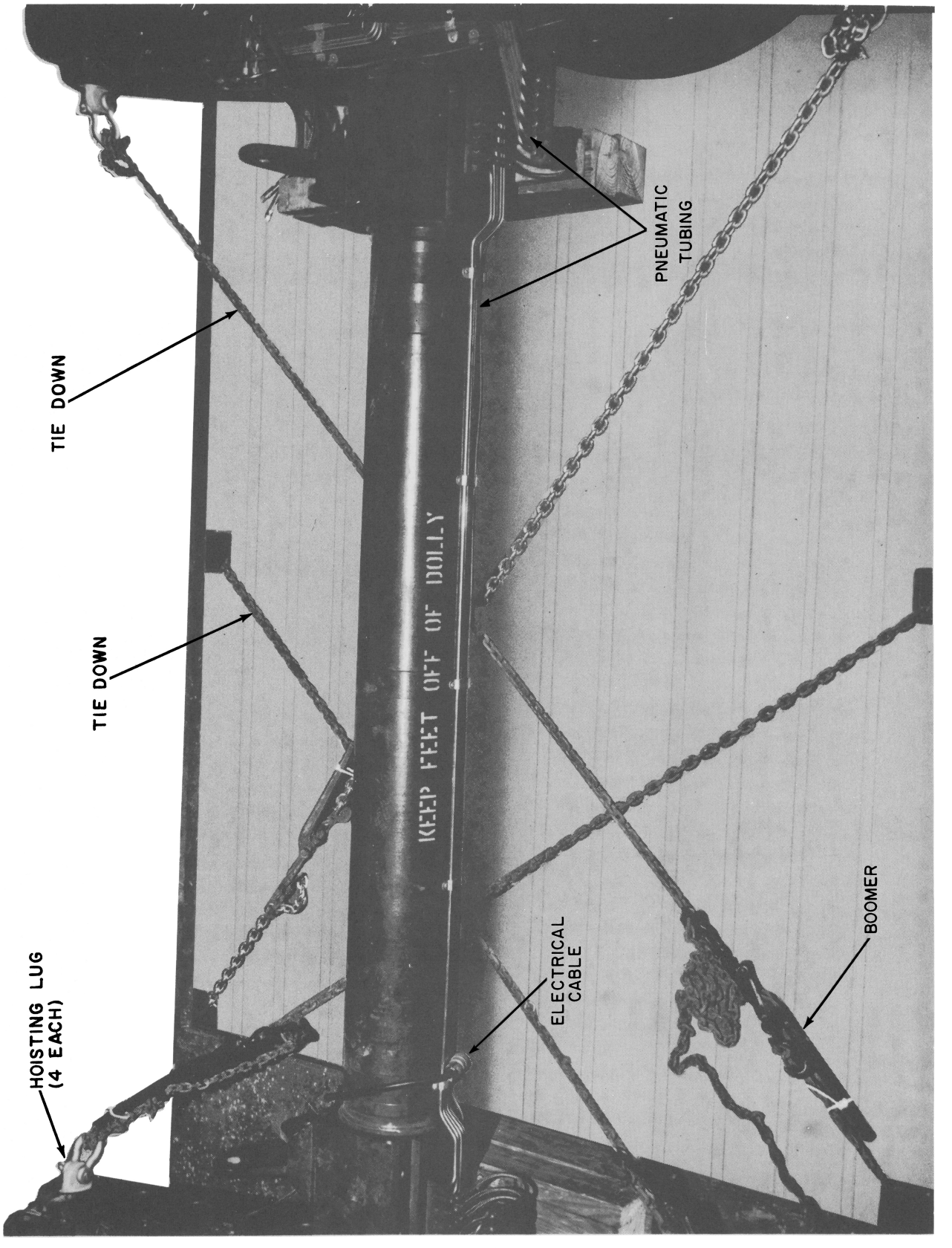


FIG. 53. TIE DOWN PROCEDURES (SHEET 3 OF 3)



FIG. 54. INSTALLING OPERATOR'S SEAT ON DRAWBAR

6.2.1.3 Disconnect all electrical cables and pneumatic tubing between drawbar and dolly. (See figure 53.)

6.2.1.4 Cap all free ends of pneumatic tubing and electrical cables.

6.2.1.5 Secure three hoisting slings of equal length to drawbar, one near each corner, and then attach to crane.

NOTE: A lifting device other than a crane may be used to load the drawbar and dolly providing it does not contact any electrical cables or pneumatic tubing, steering cylinders, brake cylinders, or other parts that may be damaged by the lifting device.

6.2.1.6 Using crane, remove slack in hoisting slings and retain in this position.

6.2.1.7 Retract caster wheel.

NOTE: The drawbar must be supported at each of the three corners as outlined in paragraphs 6.2.1.5 and 6.2.1.6 prior to loosening the drawbar locking screws.

6.2.1.8 Unlock drawbar by loosening drawbar locking screws.

6.2.1.9 Remove drawbar pivot pins to free drawbar.

6.2.1.10 Using crane, place drawbar on flat-bed trailer or rail car. Remove hoisting slings.

NOTE: The drawbar should be positioned so that the air tank, valves, air filters, and tubing are on the top side of the drawbar and clear of tie-downs and other equipment.

6.2.1.11 Secure drawbar in position with tie-downs at pintle and two connecting points.

6.2.1.12 Secure four hoisting slings of equal length to dolly hoisting lugs.

6.2.1.13 Using crane, place dolly on flat-bed trailer or rail car. Remove hoisting slings.

NOTE: The dolly should rest on wooden support blocks placed at each end of trunnion.

6.2.1.14 Secure dolly in position with tie-downs through four hoisting lugs. Ensure that boomers have been tightened sufficiently. (See figure 54.)

6.2.1.15 If dolly is being shipped by rail car, provide additional tie-downs through core support holes in walking beams.

CAUTION: Tie-downs should NOT contact any steering cylinders, brake cylinders, pneumatic tubing, electrical cables, or other equipment that may be damaged.

7. PREPARATION OF FIXTURE FOR SHIPMENT BY COMMERCIAL CARRIER.

7.1 General.

7.1.1 If it becomes necessary to ship the assembly fixture from AMR to MSFC by commercial carrier rather than on the Saturn Barge, the following procedure will apply.

7.1.2 Dolly removal. Remove dollies using portable jacks operating instructions as per paragraph 5., or by using hoisting equipment capable of lifting 25 tons.

7.1.3 Fixture disassembly. After dolly removal, lower the assembly fixture onto supports placed under both cradles. Support the truss weldments (J-AF-12004-1) with blocks at the center flanges. Remove the 24 bolts, nuts, and washers from the flanges of the truss weldment and the spacer plate. (See figure 55.) While supporting the forward cradle assembly (J-AF-12004-4-0) with cranes, disassemble the two forward truss weldments by removing 24 nuts, bolts, and washers. Either place the cradle on its side or place on trailer for shipment. Repeat the procedure for the aft cradle (J-AF-12004-1-0).

7.1.4 Loading on commercial carrier. With all of the fixture disassembled, it may now be loaded on 40-foot long flat bed trailers in the arrangements shown in figures 56, 57, and 58.

7.1.5 Loose hardware. All loose hardware is to be placed in containers provided and loaded on the trailers as shown in figure 55.

7.2 Preservation of Assembly Fixture.

NOTE: The following procedures should be performed as soon as possible after disassembly and should be repeated at 30-day intervals if necessary.

7.2.1 Clean mating surfaces of forward cradle assembly, truss weldments, aft cradle assembly, and spacer plates and rollers in forward and aft cradle assemblies with dry-cleaning solvent, Federal Specification P-S-661, in accordance with paragraph 3.2.1 of Military Specification MIL-P-116 and apply P-3 corrosion preventive, Military Specification MIL-C-16173, to mating surfaces and rollers.

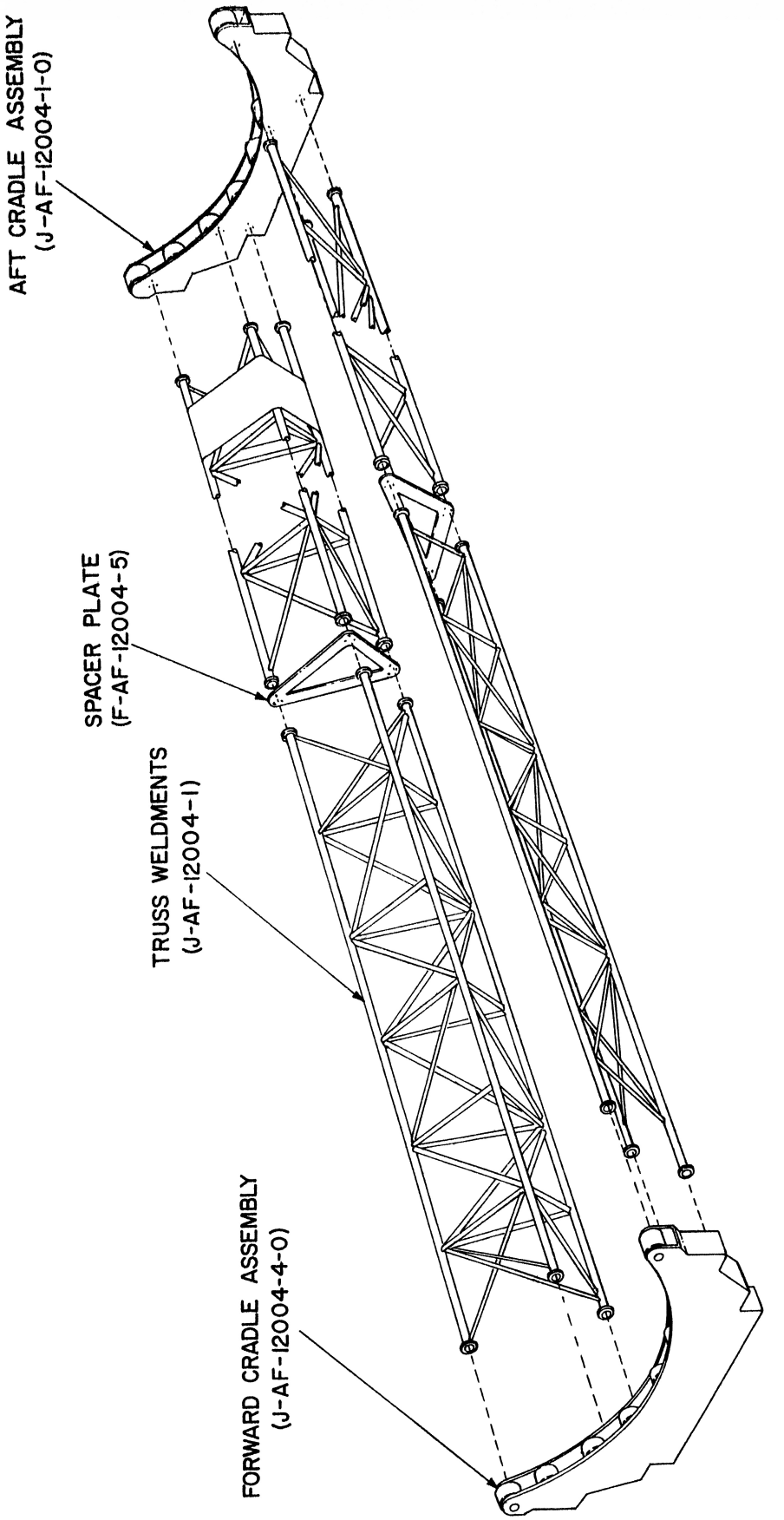


FIG. 55. ASSEMBLY FIXTURE (J-AF-12004) BREAKDOWN

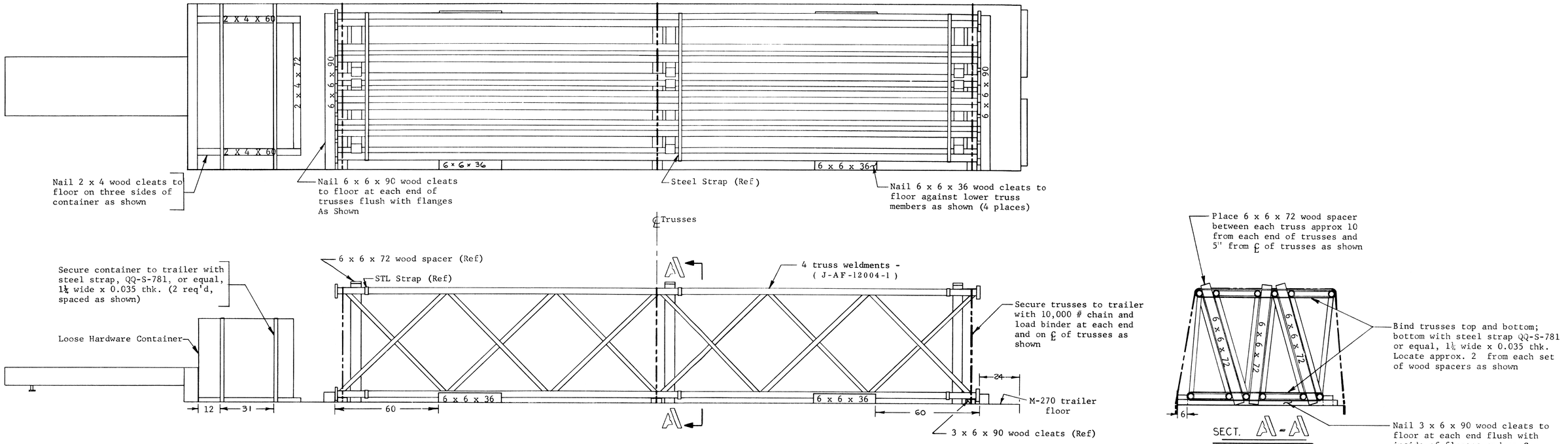


FIG. 56. PACKING TRUSS WELDMENTS AND MISCELLANEOUS HARDWARE

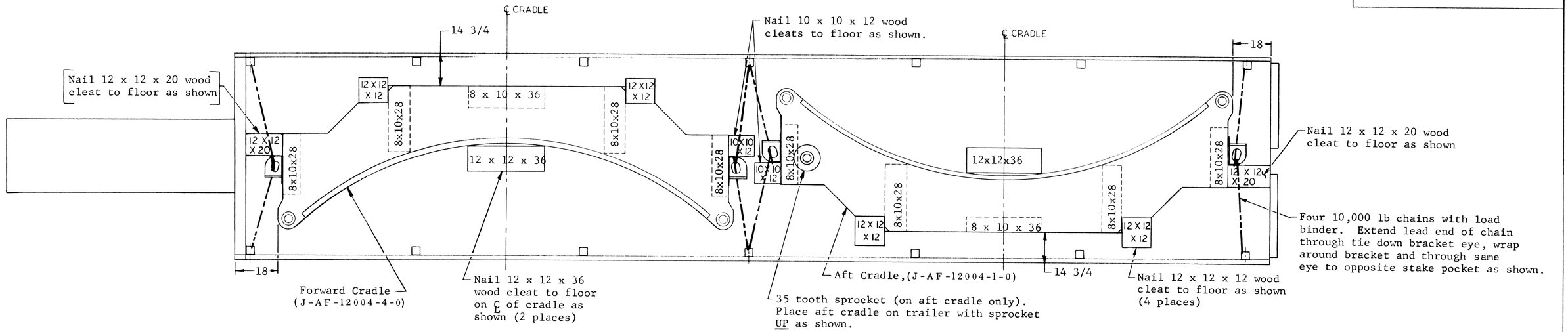


FIG. 57. PACKING AFT AND FORWARD CRADLES

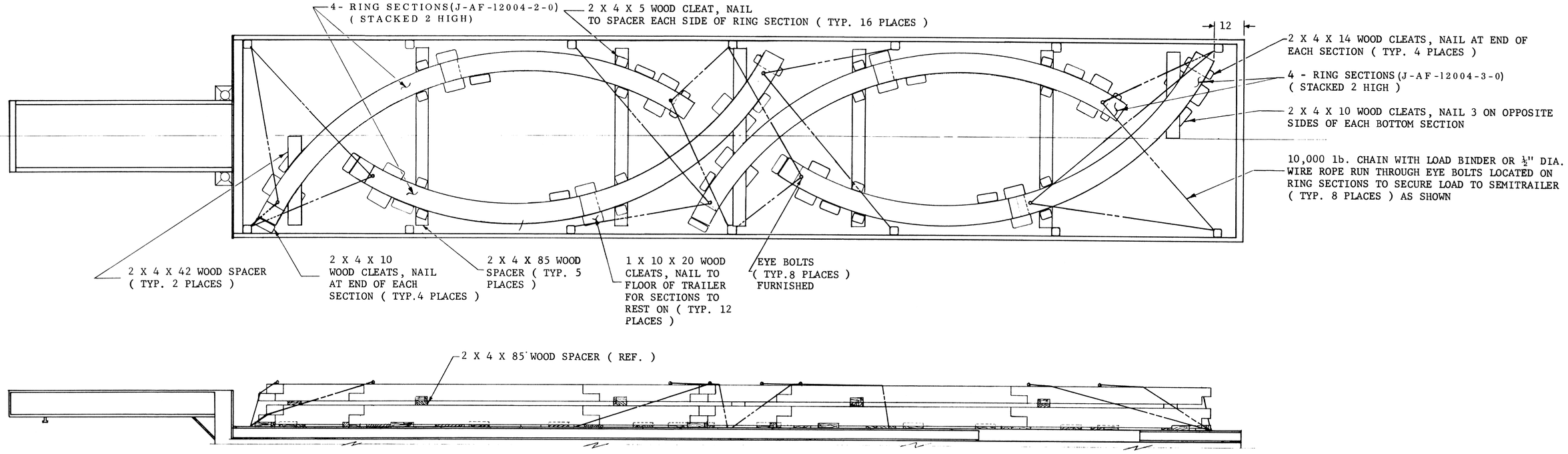


FIG. 58. PACKING RING SECTIONS

7.2.2 Clean attaching hardware (loose hardware) for assembly fixture with dry-cleaning solvent, Federal Specification P-S-661, in accordance with paragraph 3.2.1 of Military Specification MIL-P-116 and dip parts in P-9 preservative lubricating oil, Military Specification MIL-L-644. Package in accordance with Method 1 of Military Specification MIL-P-116.