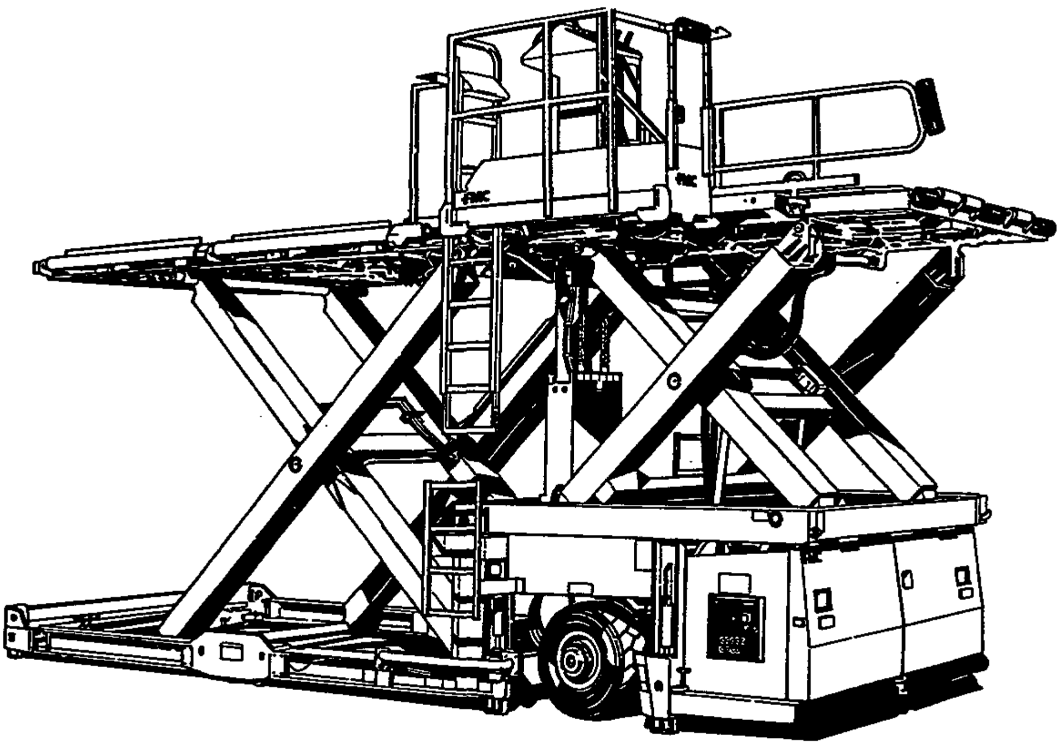
FMC
AIRLINE EQUIPMENT DIVISION

COMMANDER™
Container/Pallet Loader



FMC Corporation
Airline Equipment Division

FMC
AIRLINE EQUIPMENT DIVISION

COMMANDER CONTAINER/PALLET LOADER

OPERATION AND MAINTENANCE MANUAL

VOLUME 1 OF 2

EDITION 7, NOVEMBER 1991
FOR USE WITH LOADERS SERIAL NUMBER:

CR91115 & UP

ILLUSTRATED PARTS LIST IS
COVERED IN VOLUME 2 OF 2

REVISION 1

MANUFACTURED BY

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FEBRUARY 1992

THIS MANUAL IS PREPARED FOR
FEDERAL EXPRESS
COMMANDER

The following options are applicable:

620-9100-009	EXT. R/L TRANSFER W/CENTER PALLET ROTATION
621-1028-002	OPERATOR'S PANEL
620-6206-011	STEEL ROLLERS
620-8950-001	CONTAINER BRIDGE (9 ROWS OF HELI-ROLLS)
620-9304-004	HANDRAIL LEFT, FOLDING & NON-LOCKING
620-1866	OPERATOR'S CAB (STD. ON ALL MACHINES)
620-1865-001	PERKINS 4.236 DIESEL ENGINE W/PROT.
620-1824-001	DIESEL COVER ASSEMBLY
620-8439-002	INSTALLATION DRIVE TIRES (FOAM)
620-7705	MAIN FRAME HYDRAULIC ASSEMBLY M/D W/HOSES
620-6205	BRIDGE LOWERING ALARM
620-6213	ENGINE LOW COOLANT SHUTDOWN
620-4692	REAR PLATFORM LOWERING ALARM
620-2229	FLASHING AMBER BEACON
620-2219	WORK LIGHTS AIMED AT REAR PLATFORM
620-2221	HIGH PRESSURE FILTRATION (BYPASSING)
620-6375	SPIRAL WRAP REAR PLATFORM HOSES
620-6281	TRANSITION DECK ATTACHMENT
620-6192	FUEL WATER SEPARATOR - PERKINS
620-2652	SPARK ARRESTOR PERKINS 4.236
620-9526-006	WINTERIZATION 240V HYD TANK, ENG OIL HEATER & BAT. BLANK

SALES ORDER NUMBER(S): UI05169

UNIT SERIAL NUMBER(S): CR92093

THIS MANUAL IS PREPARED FOR
FEDERAL EXPRESS
COMMANDER

The following options are applicable:

620-1395-002	TACHOMETER
620-7675	FRONT MAINTENANCE STANDS (M/D & UNIVERSAL)
620-6248	TOW BAR WITH STOWAGE
620-6194	CONSOLE COVER, CANVAS WITH LANYARD ATTACHMENT
620-8413	OPERATOR HANDRAIL/CAB EXTENSION ASSY
620-4477	BOSCH ELECTRICAL EMERGENCY PUMP
620-4400	PROTECT-O-SEAL FUEL FILLER
620-4272	TRUCK TRANSFER, REAR & SIDE - 60" HIGH
620-3923	FWD RP STOP 38" (LD-1) (EXTENDED PLATFORMS ONLY
620-6240	REAR PLAT. HIGH SPEED BY-PASS (50 FPM)
620-6196	FED X ASSET NUMBERS
621-1930	MAGNETIC DRAIN PLUG (HYDRAULIC TANK)
621-1775	AIR FILTER MONITORING SYSTEM
620-9502	LADDER CAGE - (M/D/UNIVERSAL)
621-1029-010	KEYED IGNITION SWITCH 3-SPEED PROPEL
620-2536-001	STABILIZER GUARD (WIDE/UNIV)
621-2954	MODIFICATION OPTION - FRENCH REG

SALES ORDER NUMBER(S): UI05169

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AIRLINE EQUIPMENT DIVISION

COMMANDER CONTAINER/PALLET LOADER

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RECORD OF REVISIONS

REV NO.	ISSUE DATE	DATE INSERTED	BY	REV NO.	ISSUE DATE	DATE INSERTED	BY	REV NO.	ISSUE DATE	DATE INSERTED	BY

LIST OF EFFECTIVE PAGES

All pages in this issue are original.

LIST OF WARNINGS AND CAUTIONS USED IN THIS MANUAL

The following warnings and cautions are used in this manual. Read all of them and follow the instructions when performing the procedures. The symbol shown below is used to call your attention to some procedures that could cause death or injury to personnel and/or damage to equipment.

A WARNING MEANS THAT A PROCEDURE THAT FOLLOWS COULD CAUSE DEATH OR INJURY TO YOU OR OTHER PERSONNEL IN THE AREA IF THE PROCEDURE IS NOT FOLLOWED AS WRITTEN.

A CAUTION MEANS THAT A PROCEDURE THAT FOLLOWS COULD CAUSE DAMAGE TO EQUIPMENT IF THE PROCEDURE IS NOT FOLLOWED AS WRITTEN.

<u>WARNING</u>: DO NOT ATTEMPT TO OPERATE OR PERFORM ANY MAINTENANCE ON THE VEHICLE UNTIL ALL PROCEDURES AND WARNINGS IN THE MANUAL ARE READ AND PROPERLY UNDERSTOOD.

<u>WARNING</u>: BEFORE STARTING ANY TYPE OF POWER UNIT, OBSERVE ALL PRECAUTIONS BELOW:

ASSURE BOGY WHEEL PINS ARE REMOVED FOR NORMAL OPERATION.

ASSURE THAT ALL PERSONNEL ARE CLEAR OF LOADER.

AT BEGINNING OF SHIFT, ASSURE THAT ALL SCHEDULED SERVICES HAVE BEEN PERFORMED. (THIS INCLUDES CHECK OF TIRE CONDITION, FUEL AND FLUID LEVELS, AND OVERALL CHECK FOR LOOSE OR MISSING HARDWARE, AND GENERAL CONDITION OF LOADER.)

DO NOT ATTEMPT TO OPERATE THE LOADER WITHOUT HAVING BEEN PROPERLY TRAINED IN OPERATION AND SAFETY REQUIREMENTS.

DO NOT ATTEMPT TO OPERATE LOADER WHILE UNDER THE INFLUENCE OF DRUGS, ALCOHOL OR MEDICATION THAT MAY PREVENT FULL ABILITY TO CONTROL THE LOADER.

BE ALERT AT ALL TIMES DURING LOADER OPTATION.

WARNING: BEFORE PERFORMING ANY MAINTENANCE OR WHILE MAKING ANY ADJUSTMENTS OR REPAIRS TO THE LOADER, IT IS MANDATORY THAT THE MASTER SWITCH BE TURNED OFF (ENGINE STOPPED) AND THE BATTERY PLUG (72 VOLT) OR + TERMINAL (ENGINE) BE DISCONNECTED FOR ALL POWERED UNITS.

WARNING: THE COMMANDER IS NOT DESIGNED FOR USE AS A TRANSPORTING VEHICLE. ANY ATTEMPT TO USE IT FOR OPERATIONS OTHER THAN CARGO TRANSFER MAY RESULT IN INJURY TO PERSONNEL AND/OR DAMAGE TO EQUIPMENT.

WARNING: BEFORE DISENGAGING DRIVES OR RELEASING BRAKE, CHOCK BOTH DRIVE WHEELS FRONT AND BACK, TO PREVENT MOVEMENT IN EITHER DIRECTION. FAILURE TO DO SO MAY RESULT IN INJURY TO PERSONNEL AND/OR DAMAGE TO EQUIPMENT.

WARNING: DO NOT EXCEED 11 KPM (7 MPH) WHEN TOWING LOADER. EXCEEDING SPEED LIMIT MAY CAUSE INJURY TO PERSONNEL OR DAMAGE TO EQUIPMENT.

WARNING: IF BRAKE AND HUB DRIVES ARE NOT IMMEDIATELY ENGAGED, PLACE SUITABLE WARNING SIGN ON LOADER TO ASSURE THAT ALL PERSONNEL ARE AWARE OF THE CONDITION. FAILURE TO OBSERVE THIS WARNING MAY CAUSE INJURY TO PERSONNEL OR DAMAGE TO EQUIPMENT FOR ALL POWERED UNITS.

WARNING: BEFORE ENGAGING BRAKE OR HUBS, CHOCK BOTH DRIVE WHEELS FRONT AND BACK TO PREVENT MOVEMENT IN EITHER DIRECTION. FAILURE TO DO SO MAY RESULT IN INJURY TO PERSONNEL AND/OR DAMAGE TO EQUIPMENT.

WARNING: BEFORE STARTING ANY ADJUSTMENT PROCEDURE THAT REQUIRES BRIDGE OR PLATFORM TO BE IN RAISED POSITION, ASSURE THAT SAFETY STANDS AND/OR BRIDGE SAFETY LEGS ARE FIRMLY POSITIONED AND THAT DRIVE WHEELS ARE CHOCKED TO PREVENT MOVEMENT IN EITHER DIRECTION. FAILURE TO PROPERLY SUPPORT BRIDGE OR PLATFORM AND CHOCK WHEELS MAY RESULT IN DEATH OR INJURY TO PERSONNEL AND/OR DAMAGE TO EQUIPMENT.

WARNING: WEAR SAFETY GOGGLES WHEN MAKING PRESSURE CHECKS AND ADJUSTMENTS ON THE HYDRAULIC SYSTEM. EYE INJURY WILL OCCUR IF HYDRAULIC OIL SPRAYS INTO EYES. IF HYDRAULIC OIL GETS ON SKIN, WASH AFFECTED AREA AS SOON AS POSSIBLE TO AVOID IRRITATION. GET MEDICAL ATTENTION IMMEDIATELY.

WARNING: IMPROPERLY ADJUSTED RELIEF VALVES CAN CAUSE INJURY TO PERSONNEL OR DAMAGE TO EQUIPMENT. WHEN MAKING PRESSURE CHECKS OR ADJUSTMENTS, USE A GAUGE OF KNOWN ACCURACY. BEFORE MAKING CHECKS, ADJUST VALVES TO REDUCE PRESSURE THEN ADJUST VALVES TO REQUIRED INDICATION ACCORDING TO PROCEDURE BEING PERFORMED. EYE PROTECTION IS REQUIRED.

WARNING: DO NOT REMOVE GAUGE PORT PLUGS OR GAUGES FROM PORTS WITH POWER UNIT RUNNING. WHEN POWER UNIT IS RUNNING, RESULTING PRESSURE MAY CAUSE HYDRAULIC OIL TO SPRAY ON PERSONNEL.

WARNING: DO NOT ALLOW PERSONNEL UNDER BRIDGE OR PLATFORM UNLESS ADEQUATE SUPPORTS ARE IN PLACE. FAILURE TO SUPPORT BRIDGE OR PLATFORM MAY ALLOW THEM TO FAIL, RESULTING IN DEATH OR INJURY TO PERSONNEL AND/OR DAMAGE TO EQUIPMENT.

WARNING: FAILURE TO POSITION SAFETY STAND PROPERLY MAY RESULT IN DEATH OR INJURY TO PERSONNEL AND/OR DAMAGE TO EQUIPMENT IF BRIDGE OR PLATFORM SHOULD DROP.

WARNING: TIGHTEN LOCKSCREW AFTER EACH ADJUSTMENT. FAILURE TO DO SO MAY ALLOW ADJUSTMENT SCREW TO VIBRATE TO A POSITION THAT CAUSES ERRATIC OPERATION OF PLATFORM. THIS COULD CAUSE INJURY TO PERSONNEL AND/OR DAMAGE TO EQUIPMENT.

WARNING: ASSURE THAT ALL SAFETY GUARDS ARE REFITTED CORRECTLY ON COMPLETION OF SERVICING AND MAINTENANCE, AND THAT NO PART OF THE VEHICLE IS LEFT IN A DANGEROUS CONDITION.

WARNING: A BATTERY THAT IS ON CHARGE OR HAS JUST COME OFF CHARGE PRODUCES HYDROGEN GAS. DO NOT SMOKE OR PERMIT AN OPEN FLAME OR SPARKS IN THE VICINITY OF THE BATTERY. AN EXPLOSION COULD RESULT IN SEVERE BURNS CAUSED BY THE SULFURIC ACID CONTAINED IN THE BATTERY.

WARNING: TROUBLESHOOTING OF THIS EQUIPMENT SHOULD BE DONE ONLY BY PERSONNEL WHO ARE TRAINED IN THE USE AND FUNCTION OF THE EQUIPMENT. DO NOT GET UNDER RAISED BRIDGE OR PLATFORM UNLESS THEY ARE PROPERLY BLOCKED OR SUPPORTED TO PREVENT ACCIDENTIAL LOWERING. FAILURE TO OBSERVE GOOD SAFETY PRACTICES WHILE TROUBLESHOOTING COULD RESULT IN DEATH OR SERIOUS INJURY TO PERSONNEL AND/OR DAMAGE TO EQUIPMENT.

WARNING: FAILURE TO PERFORM CHAIN MAINTENANCE PROCEDURES INCLUDING REPLACEMENT, AS PRESCRIBED IN THE MANUAL, MAY RESULT IN DEATH OR INJURY TO PERSONNEL OR DAMAGE TO EQUIPMENT.

WARNING: OBSERVE ALL INSTRUCTIONS IN AIRPORT OPERATIONS MANUAL WHEN OPERATING LOADERS. FAILURE TO DO SO MAY RESULT IN INJURY TO PERSONNEL AND/OR DAMAGE TO EQUIPMENT.

WARNING: BURNING INSULATION WILL CAUSE NOXIOUS FUMES TO BE EMITTED. AVOID EXPOSURE OF PERSONNEL TO THESE FUMES BY PROVIDING ADEQUATE VENTILATION OR BY REMOVING PERSONNEL FROM THE AREA. INJURY OR DEATH MAY RESULT IF PROPER PRECAUTIONS ARE NOT EXERCISED.

<u>WARNING</u>: GROUND THE MACHINE PROPERLY, WHEN PERFORMING MAINTENANCE, TO AVOID SERIOUS INJURY TO PERSONNEL. GROUNDING SHOULD BE IN ACCORDANCE WITH NATIONAL ELECTRIC CODE AND CONSISTANT WITH LOCAL PRACTICES.

<u>WARNING</u>: HIGH VOLTAGE AND/OR ROTATING PARTS CAN CAUSE SERIOUS OR FATAL INJURY. THE USE OF CONCENTRATED POWER AND ROTATING EQUIPMENT, CAN BE HAZARDOUS, INSTALLATION, OPERATION, AND MAINTENANCE OF ALL MACHINERY SHOULD BE PERFORMED BY QUALIFIED PERSONNEL FAMILIAR WITH NEMA SAFETY STANDARDS FOR CONSTRUCTION AND GUIDES FOR THE SELECTION, INSTALLATION AND USE OF ENGINES, MOTORS AND GENERATORS. THE INSTALLER MUST ALSO BE FAMILIAR WITH THE NATIONAL ELECTRIC CODE AND SOUND LOCAL PRACTICES. INSTALLATION IN HAZARDOUS, INFLAMMABLE OR COMPUSTIBLE VAPORS OR DUSTS PRESENT A POSSIBILITY OF EXPLOSION OR FIRE AND MUST BE IN ACCORDANCE WITH THE NATIONAL ELECTRIC CODE ARTICLES 500-503, AND CONSISTANT WITH SOUND LOCAL PRACTICES.

<u>WARNING</u>: DO NOT ATTEMPT TO PLUG THE BATTERY CHARGER DIRECTLY INTO THE LOADER, AS THIS WILL CAUSE SERIOUS DAMAGE TO THE ELECTRIC POWERED VEHICLE'S ELECTRONIC CONTROL SYSTEM.

<u>WARNING</u>: DO NOT OPERATE ELECTRIC POWERED VEHICLES (EXCEPT TO MOVE TO A BATTERY CHARGER) IF BATTERY DISCHARGE INDICATOR RED LIGHT IS ON.

<u>WARNING</u>: DO NOT OPERATE AN ELECTRIC POWERED VEHICLE WHEN BATTERY WATER LEVEL IS LOW.

<u>WARNING</u>: DO NOT WORK IN THE ELECTRIC COMPARTMENT ON AN ELECTRIC POWERED VEHICLE, UNLESS THE BATTERY IS DISCONNECTED.

<u>WARNING</u>: IF AN ELECTRICAL FAILURE OR AN EXTREME OVERLOAD OCCURS IN AN ELECTRIC POWERED VEHICLE, ESPECIALLY IN A TOTALLY ENCLOSED MOTOR, PERSONNEL SHOULD NOT BREATH THE FUMES WHICH HAVE BEEN GENERATED INSIDE THE MACHINE. THE HEAT OF THE FAILURE ARC OR OVERLOAD MAY GENERATE NOXIOUS FUMES BY PYROLYSIS OF THE INSULATION MATERIALS. ALL POWER SHOULD BE DISCONNECTED FROM THE MOTOR BEFORE ANY INVESTIGATION OF THE FAILURE IS ATTEMPTED. THE AREA AROUND THE MOTOR SHOULD BE WELL VENTILIATED. PERSONNEL SHOULD NOT BREATH THE TOXIC FUMES PRODUCED BY THE FAILURE. IF POSSIBLE, TIME SHOULD BE ALLOWED FOR THE MOTOR TO COOL AND FOR DILUTION OF THE FUMES WITH AIR.

<u>WARNING</u>: DO NOT OPERATE A SERIES MOTOR UNLOADED, AS EXCESSIVE SPEED MAY OCCUR WHICH CAN CAUSE DAMAGE TO THE MOTOR AND INJURY TO PERSONNEL.

WARNING: WATER SHOULD NOT BE APPLIED TO ANY ELECTRICALLY ENERGIZED OR FOSSIL FUEL POWERED EQUIPMENT BECAUSE OF DANGER OF ELECTRIC SHOCK OR THE SPREADING OF FLAMES. EITHER COULD RESULT IN SERIOUS OR FATAL INJURY. IN CASE OF FIRE, DISCONNECT ALL POWER AND USE A CARBON DIOXIDE EXTINGUISHER TO QUENCH THE FLAME.

WARNING: DO NOT REMOVE ANY ELECTRICAL COMPONENT FROM THE VEHICLE WITHOUT FIRST DISCONNECTING THE BATTERY.

WARNING: TO AVOID SHORT CIRCUITING THE BATTERY, DO NOT PLACE ANY METAL OBJECTS (TOOLS ETC.) ON TOP OF THE BATTERY.

WARNING: SOME COMPONENTS OF THE ELECTRONIC SYSTEM MAY HOLD AN ELECTRICAL CHARGE EVEN THOUGH THE BATTERY IS DISCONNECTED, AND MAY RESULT IN INJURY IF CONTACT IS MADE.

CAUTION: NEVER USE SOLVENTS OR CLEANING LIQUIDS THAT CONTAIN MINERAL OIL, PETROLEUM, CARBON TETRACHLORIDE, OR DERIVATIVES OR HYDROCARBONS.

CAUTION: PARK LOADER ON LEVEL GROUND IN A SAFE WELL LIT MAINTENANCE AREA. SET THE PARKING BRAKE, EXTEND THE STABILIZERS, AND CHOCK THE BOGY WHEELS DURING MAINTENANCE PROCEDURES.

CAUTION: OPEN OR CLOSE AND SECURE CARGO DOOR CAREFULLY. FAILURE TO USE CARE MAY RESULT IN DAMAGE TO AIRCRAFT OR LOADER.

CAUTION: DO NOT STOP POWER UNIT WITH LOADER IN POSITION TO TRANSFER CARGO. DO NOT LEAVE LOADER UNATTENDED. FAILURE TO OBSERVE THIS CAUTION MAY RESULT IN DAMAGE TO AIRCRAFT OR LOADER.

CAUTION: IF AIRCRAFT FOLLOWING (OPTION) IS NOT IN USE, IT WILL BE NECESSARY TO MANUALLY ADJUST HEIGHT OF BRIDGE AS AIRCRAFT POSITION CHANGES DURING CARGO TRANSFER. FAILURE TO MAINTAIN ALIGNMENT OF AIRCRAFT AND BRIDGE MAY RESULT IN DAMAGE TO EQUIPMENT.

CAUTION: DO NOT OPERATE EMERGENCY PUMP ANY MORE THAN NECESSARY. IF CONDITIONS PERMIT, OPERATE PUMP FOR NO MORE THAN 1 MINUTE, AND ALLOW COOLING PERIOD OF 10 MINUTES BETWEEN PERIODS OF OPERATIONS. EXTENDED PERIODS OF OPERATION MAY OVERHEAT MOTOR AND CAUSE DAMAGE.

CAUTION: DO NOT USE MAXIMUM SPEED RANGE IF LOADER IS CLOSER THAN 3 METERS (10 FOOT) TO AIRCRAFT.

CAUTION: TOWING LOADER WITHOUT DISENGAGING HUBS AND RELEASING BRAKES WILL SERIOUSLY DAMAGE COMPONENTS.

<u>CAUTION</u>: DO NOT OPERATE OR TOW VEHICLE WITH BOGY WHEEL PINS IN SERVICE POSITION. PINS SHOULD BE IN STOW POSITION BEFORE OPERATING OR TOWING THE VEHICLE.

<u>CAUTION</u>: USE CARE TO PREVENT CONTAMINATION OF HYDRAULIC SYSTEM WHEN REMOVING OR INSTALLING GAUGES AND FITTINGS. CONTAMINATION CAN RESULT IN DAMAGE TO EQUIPMENT.

<u>CAUTION</u>: TO PREVENT DAMAGE TO THE STABILIZER CYLINDER ASSEMBLIES, IT IS NOT RECOMMENDED TO EXTEND THE STABILIZERS WHEN THE UNIT IS PARKED.

<u>CAUTION</u>: CHECK SECURITY OF POWER MODULE PIN BEFORE SHIPPING OR OPERATION OF LOADER.

<u>CAUTION</u>: EXERCISING ALL PRECAUTIONS, ROAD TEST THE LOADER TO ASSURE PROPER OPERATION BEFORE RETURNING TO SERVICE.

<u>CAUTION</u>: THE BATTERY SHOULD NEVER BE PERMITTED TO DISCHARGE BELOW 20% OF THE TOTAL BATTERY CAPACITY, TO ENSURE MAXIMUM SERVICE LIFE.

<u>CAUTION</u>: CHECK THAT THE BATTERY PLUGS ARE CORRECTLY INSTALLED TO AVOID CONTAMINATION OF THE BATTERY ELECTROLYTE (FLUIDS).

<u>CAUTION</u>: NEVER APPLY HOT WATER OR VAPOR TO THE BATTERY SURFACE.

<u>CAUTION</u>: DO NOT STEAM CLEAN THE POWER UNIT MODULE. STEAM CLEANING WILL CAUSE SERIOUS DAMAGE TO THE MAIN PUMP MOTOR AND THE ELECTRONIC CONTROLLER.

<u>CAUTION</u>: WELDING OPERATIONS ON MACHINERY CAN CAUSE COMPONENT DAMAGE IF THE WELDING CURRENT IS ALLOWED TO PASS THRU BEARINGS, WIRE LEADS, HARNESS WIRING, ETC., BECAUSE OF WELDER GROUND CLAMP PLACEMENT. WELDER SHOULD TAKE CARE TO CONNECT THE CLAMP SUCH THAT THE WELDING CURRENT WILL FLOW FROM ROD TO GROUND CLAMP ONLY THRU HEAVY FRAME MEMBERS AND NOT THRU JOINTS OR WIRE CONNECTIONS.

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SECTION 1. DESCRIPTION

1. GENERAL

The COMMANDER loader (Fig. 1) is a single-operator, self-propelled vehicle capable of lifting and transferring cargo weighing up to 6,800 kilograms (15,000 lb.). It can handle containers or pallets and service a variety of aircraft.

Design concepts utilizes the latest in technology and incorporates modular power units, improved conveying system, electrical systems, and hydraulic components. The use of light emitting diodes (LED's) on a system status panel simplifies troubleshooting. Power units can be gasoline, diesel, or 72-volt DC; the electrical system is a relay system, 24-volt DC, and the hydraulic system is closed-centered, load-sensing, and pressure-compensating. Two hydraulic motors power the planetary drive wheels to propel the loader.

A number of components of the COMMANDER loader are available in different configurations. For instance, the platform can be supplied for rear loading only, or for right side or left side and rear loading, or for right, left, and rear loading. Other components are standard for all loaders. The various configurations and features available are described in this section.

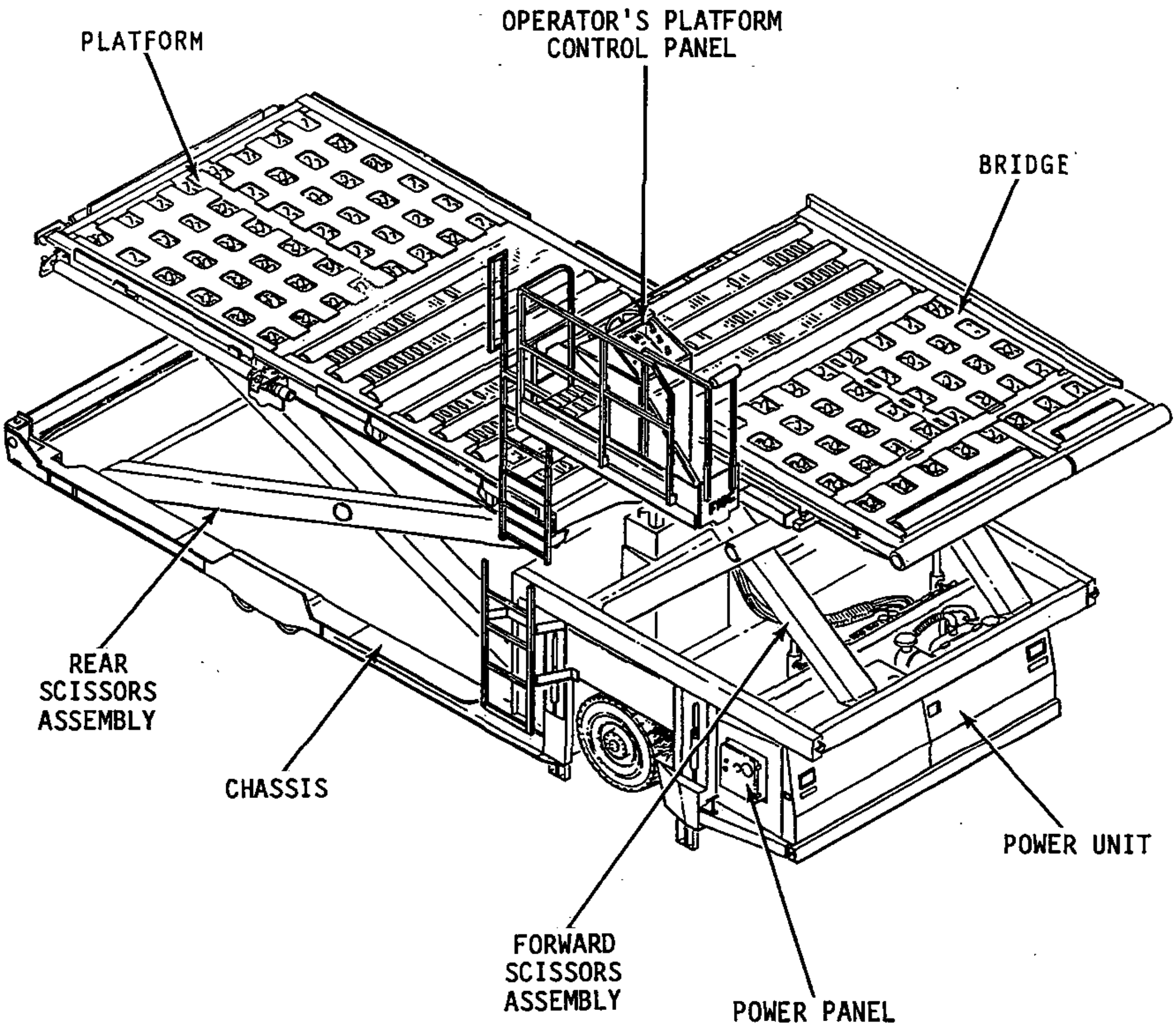
2. CAPABILITIES

The minimum height of 0.46 meter (18 in.) of the rear platform facilitates transfer of cargo from surface vehicles. The turning radius of 7.9 meters (26 ft) and inching capability of the propulsion system provide safe and precise control for positioning the loader. The maximum height to which cargo can be lifted is 3.55 meters (140 in.). A double scissors assembly is available to increase the lift height to 5.6 meters (220 in.).

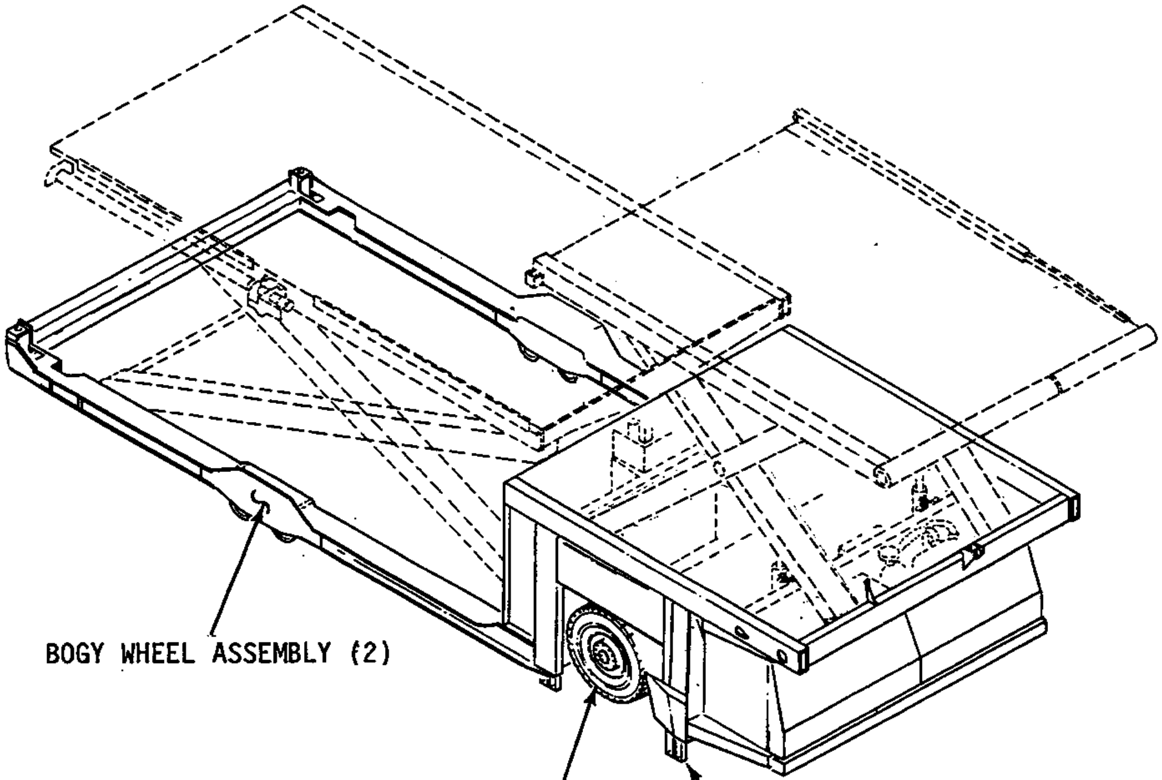
3. MAJOR COMPONENTS

A. Chassis (Fig. 2)

The chassis is a rigid steel framework on which all other components are mounted. Two steerable drive wheels support the chassis at the front, and two bogy wheel assemblies, consisting of two wheels each, support the rear of the chassis. The drive wheels propel the chassis hydraulically by means of two planetary gear hubs. The bogy wheel assemblies are supplied with a hydraulic height adjustment. Brakes and steering are also hydraulically powered. During cargo transfer, the chassis is supported by six stabilizers that are hydraulically controlled to provide a stable platform for cargo transfer.



TYPICAL COMMANDER CONTAINER/PALLET LOADER
Figure 1



CHASSIS COMPONENTS
Figure 2

B. Bridge (Fig. 3)

The bridge is raised and lowered by a scissors assembly that is powered by two hydraulic cylinders. A cargo convey system (patent applied for) provides for cargo movement and eliminates the need for manually adjusting position of cargo. The convey system consists of cluster roller assemblies and cylindrical rollers.

The roller assemblies provide the motive force that conveys the cargo. Each cluster roller assembly consists of a hub that supports six barrel-shaped rollers at an angle to the centerline of the hub.

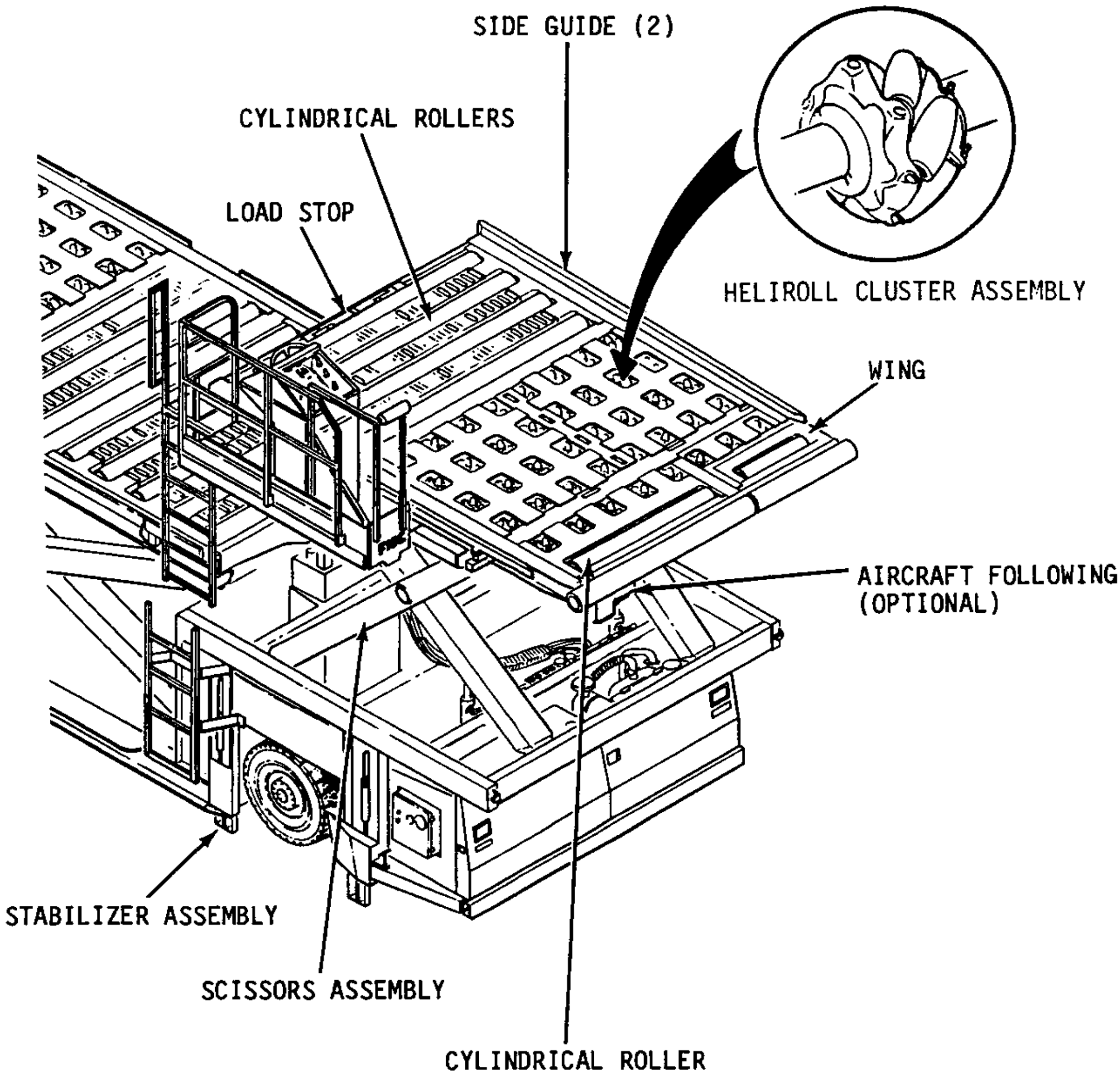
Direction of roller assembly rotation is controlled by switches (joysticks) that are mounted on the operator's control panel. Power is supplied by shafts that are driven by hydraulic motors. In some cases, several shafts are driven by one motor via sprockets and roller chains.

When cargo is conveyed forward or rearward, all of the roller assemblies rotate in the same direction. For movement to either side, some of the roller assemblies are driven in one direction, and others are driven in the opposing direction. The various combinations of rotation allow the operator to control cargo position without being required to manually shift it.

Two guides on the bridge are hydraulically adjustable from side to side to assist in aligning cargo for transfer onto the aircraft. The front of the bridge may be equipped with up to three folding wings (Fig. 4) so that the loader can be used to transfer cargo to or from aircraft with varying door width. Three folding wings are used only on the "wide option" of the loader, and are raised and lowered hydraulically. A one wing version is standard. The one-wing version can be hydraulically raised or lowered, or may be equipped with a mechanical latch that secures it in the horizontal position until manual lowering is required.

A load stop is located at the rear of the Bridge. It is spring loaded in the extended (up) position, except when the platform is at the same level as the bridge. The stop is mechanically operated, and automatically prevents cargo movement off the bridge unless the platform is in a position to accept the cargo. Powered cylindrical rollers at the front of the bridge support and transfer cargo as it is conveyed on or off the bridge. A hinged handrail is installed on the left side of the bridge.

A double scissors assembly can be provided to increase the maximum lifting height to 5.6 meters (220 in.), which provides a main deck loading capability.



BRIDGE COMPONENTS (TYPICAL)
Figure 3

The bridge can be equipped with an optional aircraft following assembly (tracking sensor) that automatically adjusts bridge height to compensate for change in aircraft height as cargo is transferred. The sensor hook assembly attaches to the aircraft at one point only; the requirement for a variety of adapter hooks is eliminated. The automatic feature can be bypassed, if desired, and the operator can manually change bridge height as necessary.

C. Operator's Platform

The operator's platform (Fig. 6) contains all of the controls required to drive the loader and transfer cargo. The stand-up design offers maximum visibility as well as safe, convenient, and comfortable access to loader and aircraft controls. The platform is hydraulically adjustable to allow the operator to gain access to aircraft controls during cargo transfer.

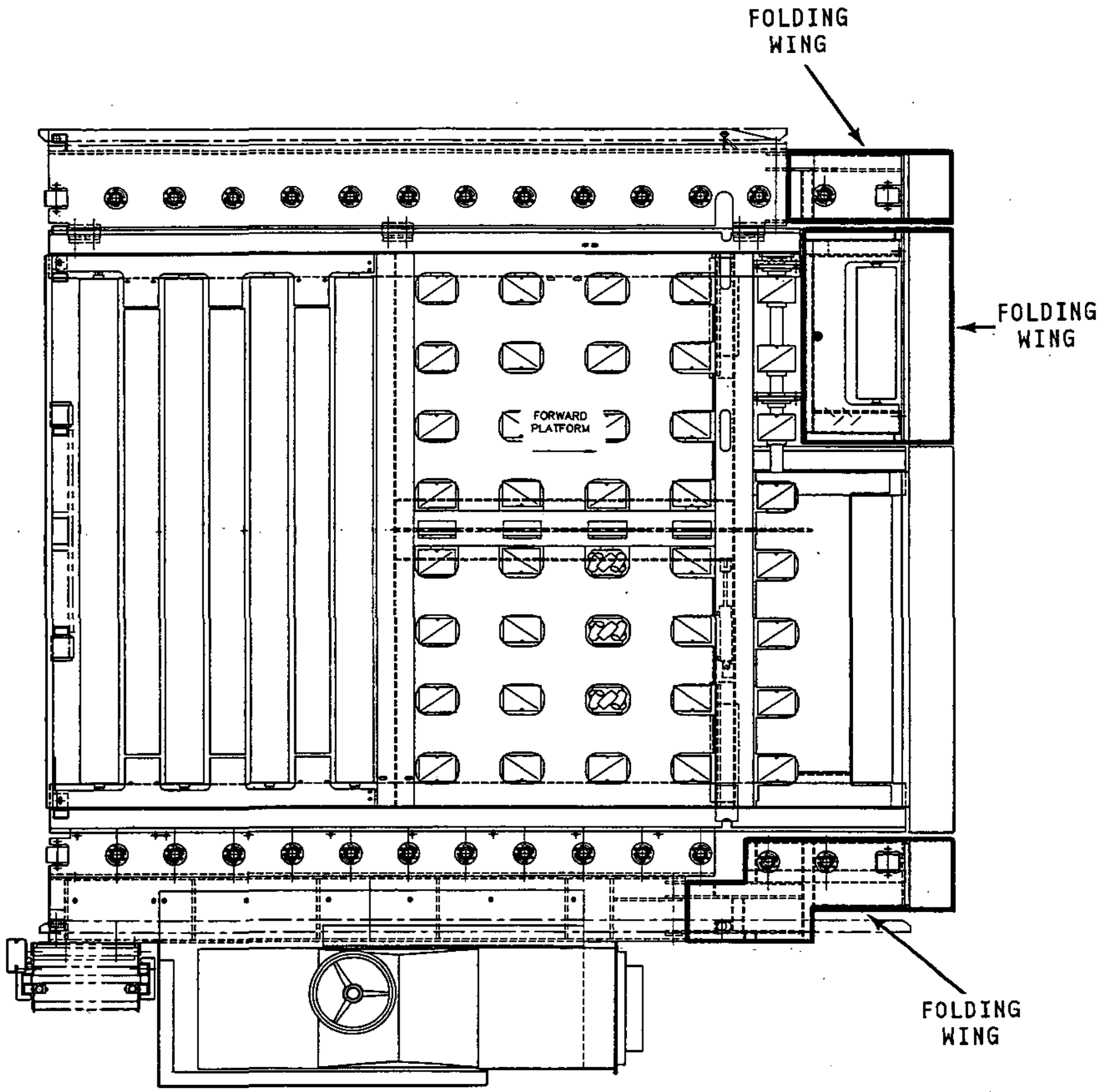
Controls and indicators used to drive the loader and position cargo are located on two panels on the operator's control. Gauges and indicators are placed on the driver's control panel (Fig. 7) so that operation of the loader can be monitored. Controls for propulsion speed and direction are also included. On the operator's control panel (Fig. 8) are the switches used to position and transfer the cargo to raise and lower the bridge and platform, and to operate the side and rear stops.

Also included is an accelerator pedal that proportionally controls the speed of the loader. The proportional control feature allows precise positioning of the loader and provides an inching capability as the aircraft is approached. A pedal actuates the hydraulic brakes. Handrails are an integral part of the platform for operator safety during operation of the loader.

D. Platform (Fig. 9)

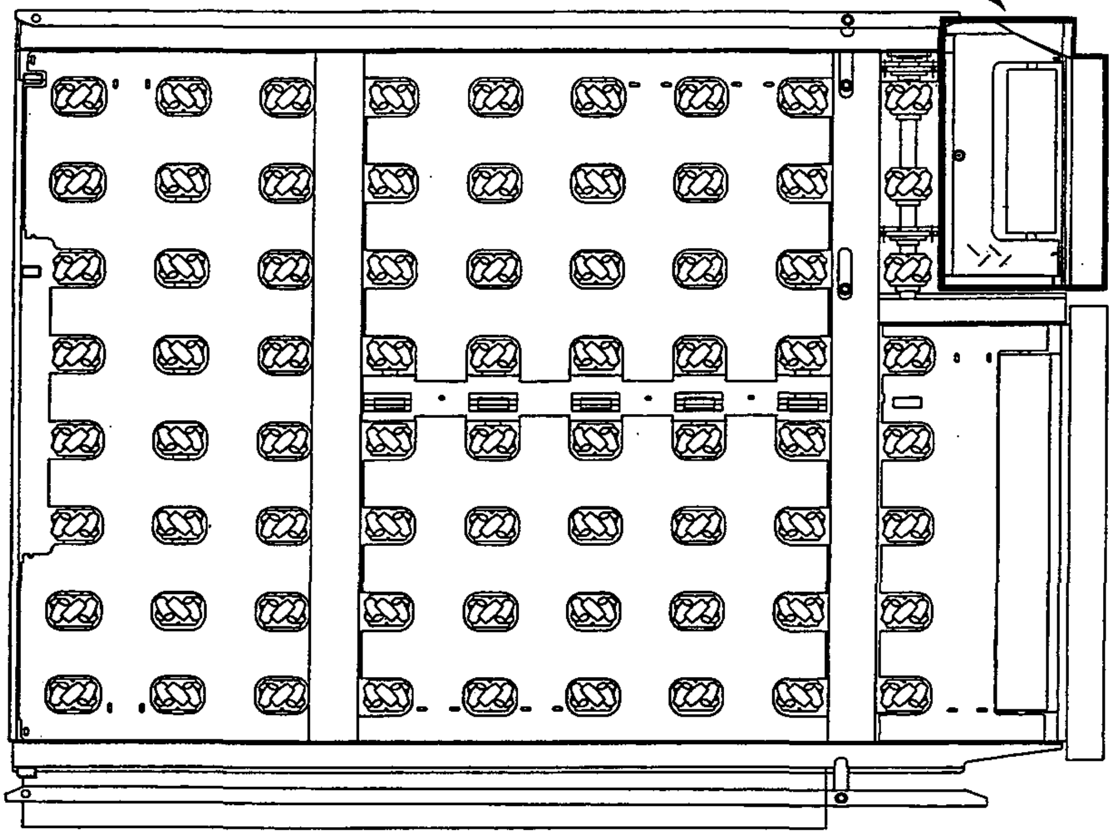
The platform is also raised and lowered by a scissors assembly; however, it is powered by one primary hydraulic cylinder and two secondary cylinders that operate in conjunction with four lift chain assemblies to position the platform.

Depending on the configuration of the platform, a cargo convey system similar to that of the bridge may be purchased. Hydraulically operated stops prevent unintentional off loading of cargo. The stops can be automaticallly or manually operated. Proximity switches prevent manual operations when the platform is not in the proper postion for loading or unloading. Proximity switches on the bridge must also sense correct position of the platform before cargo can be transferred to or from the platform.

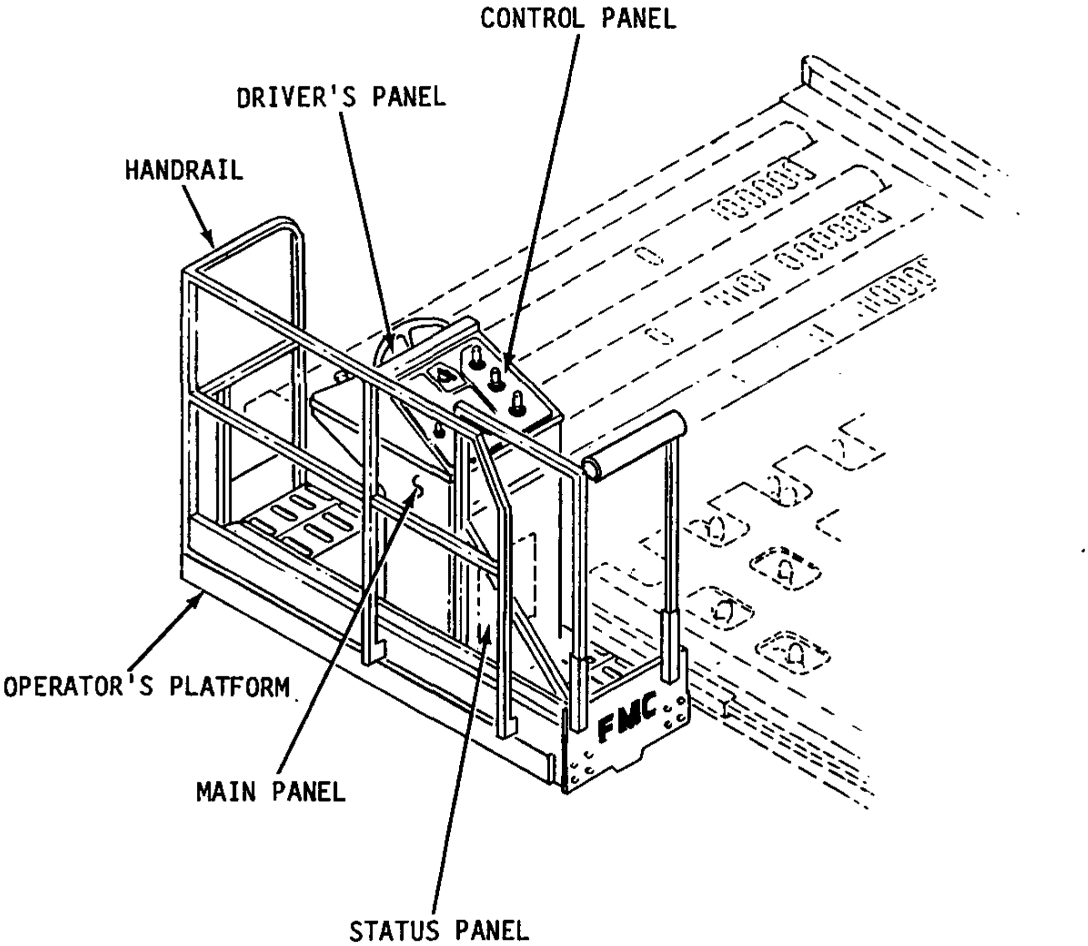


THREE WING OPTIONS ARE
HYDRAULICALLY RAISED AND LOWERED

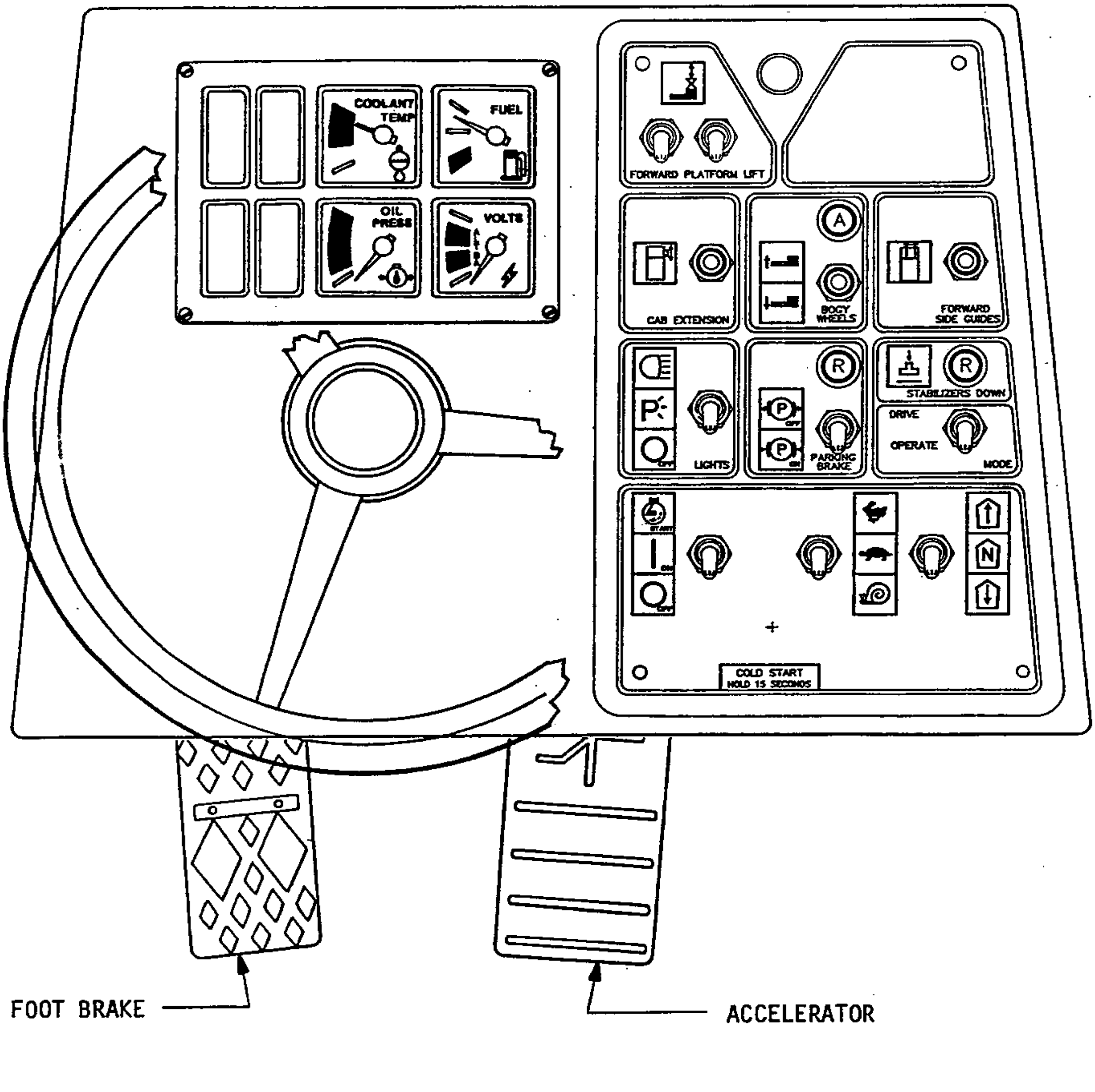
BRIDGE, THREE-WING VERSION
Figure 4



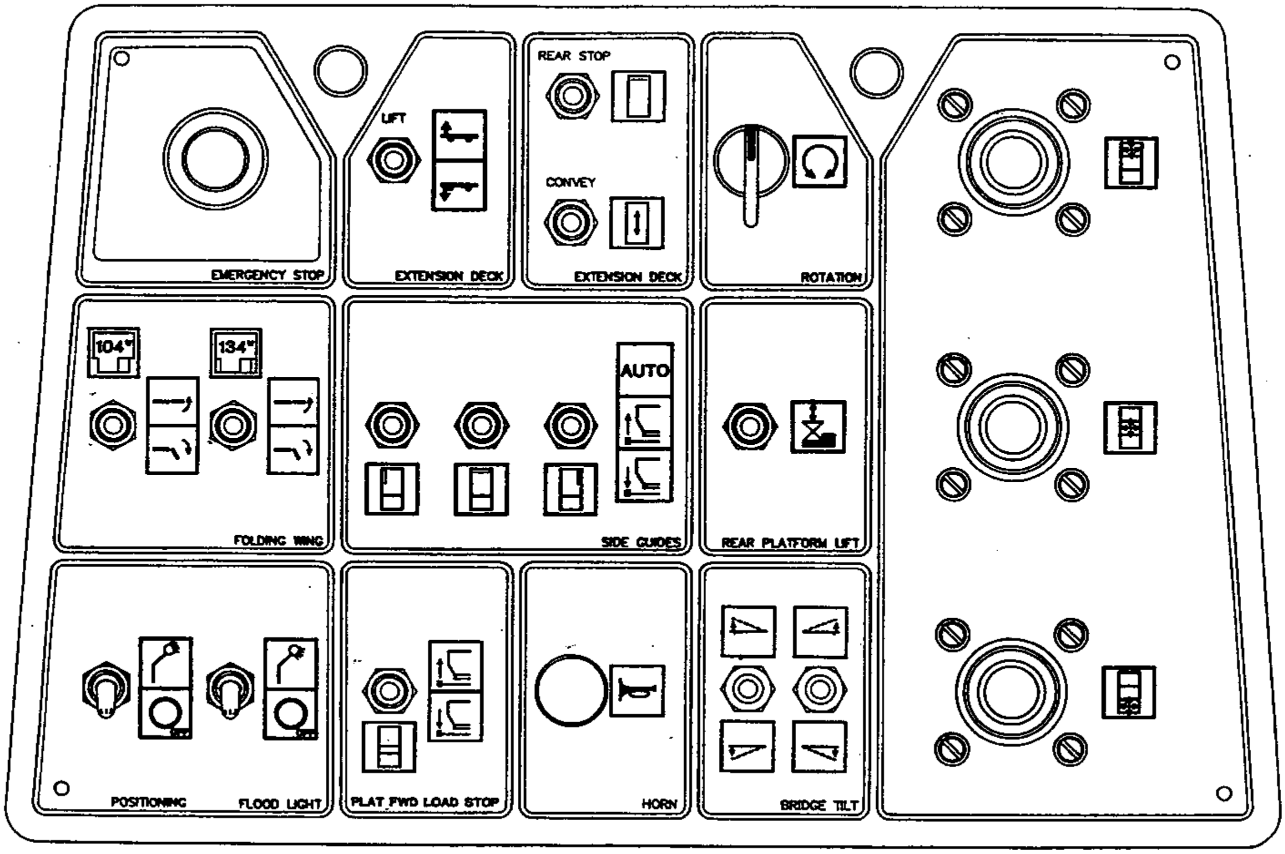
BRIDGE, ONE-WING VERSION
Figure 5



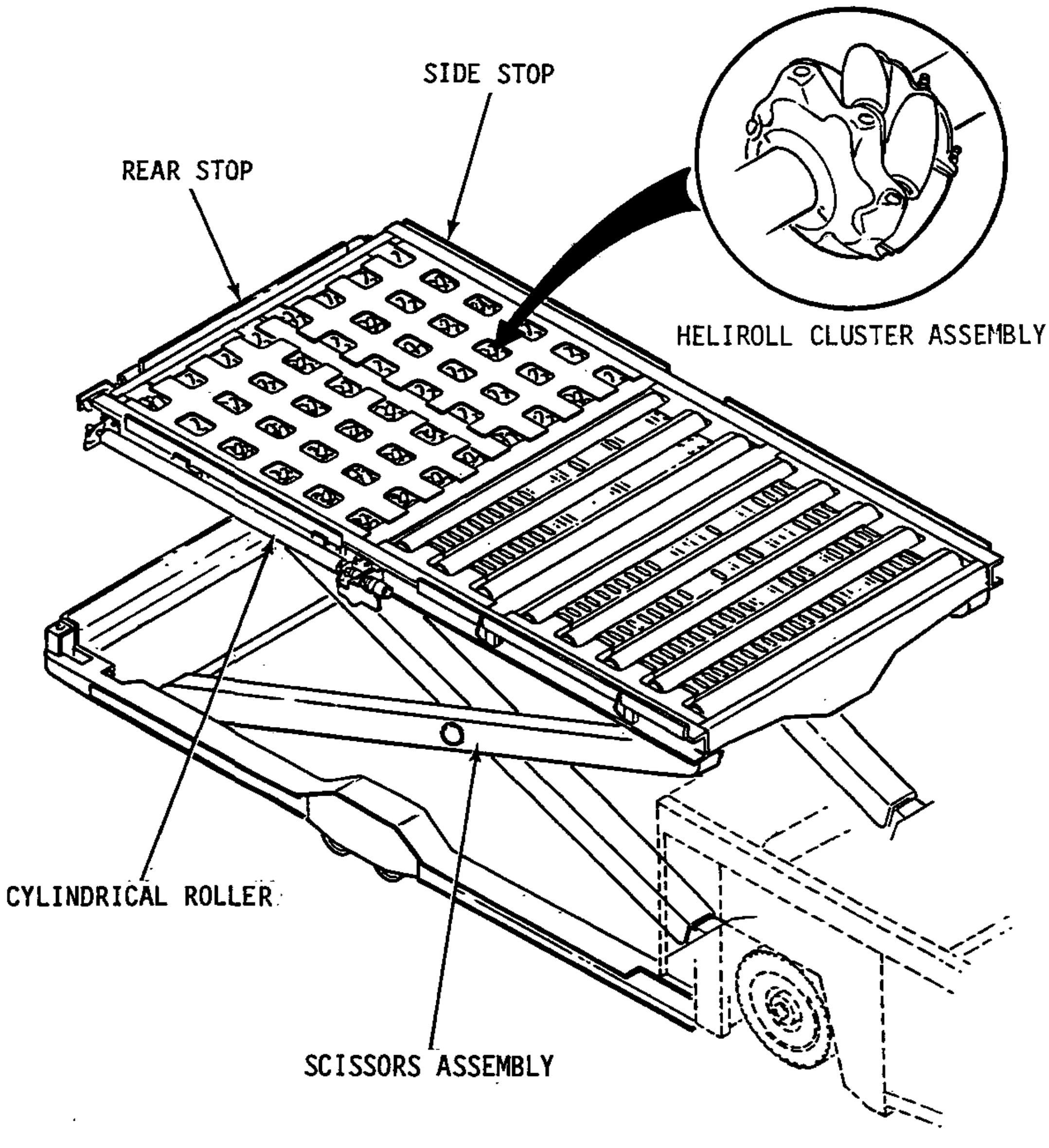
OPERATOR'S PLATFORM COMPONENTS
Figure 6



DRIVER'S PANEL
Figure 7



OPERATOR'S CONTROL PANEL
Figure 8



PLATFORM COMPONENTS (TYPICAL)
Figure 9

Ten Configurations of the platform are available. Types of rollers, number of movable stops, and other hardware vary with the configuration of a particular platform. Each of the configurations is explained below. All configurations, except the end palled load, allow the operator to mechanically rotate containers on the platform.

(1) End Pallet Load (Fig. 10)

Allows the operator to transfer palletized or containerized cargo to or from the rear of the loader. Fourteen cylindrical rollers move the cargo; no cluster roller assemblies are used. A hydraulically powered cylindrical roller at the rear assists in transferring cargo to and from the transporting vehicle.

Only the rear stop is hydraulically powered; the side stops are stationary.

(2) End Load W/Container Side Shift (Fig. 10)

Allows the operator to transfer containerized cargo to or from the rear of the loader. Cargo can be also side shifted or rotated for alignment. Six rows of cluster roller assemblies and eight cylindrical rollers move the cargo. A hydraulically powered cylindrical roller at the rear assists in transferring cargo to and from the transporting vehicle.

(3) Right Side Container Load (Fig. 10)

Allows the operator to transfer containerized cargo to or from the right side and rear of the loader. Six rows of cluster roller assemblies and eight cylindrical rollers move the cargo. Hydraulically powered cylinderical rollers at the right side and rear assist in transferring cargo to and from the transporting vehicle.

Hydraulically powered stops for the right side and the rear are provided for this configuration.

(4) Right and Left Side Container Load (Fig. 11)

Allows the operator to transfer containerized cargo to or from the right and left sides and the rear of the loader. Six rows of cluster roller assemblies and eight cylindrical rollers move the cargo. Hydraulically powered cylinderical rollers at both sides and the rear assist in cargo transfer to and from the transporting vehicle.

Hydraulically powered stops for the right and left sides and the rear are provided for this configuration.

(5) End Load W/Pallet Side Shift (Fig. 11)

Allows the operator to transfer palletized or containerized cargo to or from the rear of the loader. Pallets can be side shifted for alignment and containers can be either side shifted for alignment or rotated to meet aircraft profile. Six rows of cluster roller assemblies and eight cylindrical rollers move the cargo. A hydraulically powered cylindrical roller at the rear assists in transferring cargo to and from the transporting vehicle.

(6) Right Side Pallet Load (Fig. 11)

Allows the operator to transfer palletized or containerized cargo to or from the right side and rear of the loader. Nine cluster roller assemblies and five cylindrical rollers move the cargo. In addition, two hydraulically powered cylinderical rollers at the right side and rear assist in transferring cargo to and from the transporting vehicle.

Hydraulically powered stops for the right side and the rear are provided for this configuration.

(7) Right and Left Side Pallet Load (Fig. 12)

Allows the operator to transfer palletized orcontainerized cargo to or from the right and left sides of the loader and to or from the rear. Nine rows of cluster roller assemblies and five cylindrical rollers move the cargo. Two hydraulically powered cylinderical rollers on each side and one at the rear assist in transferring cargo to and from the transporting vehicle.

Hydraulically powered stops for the right and left sides and the rear are provided for this configuration.

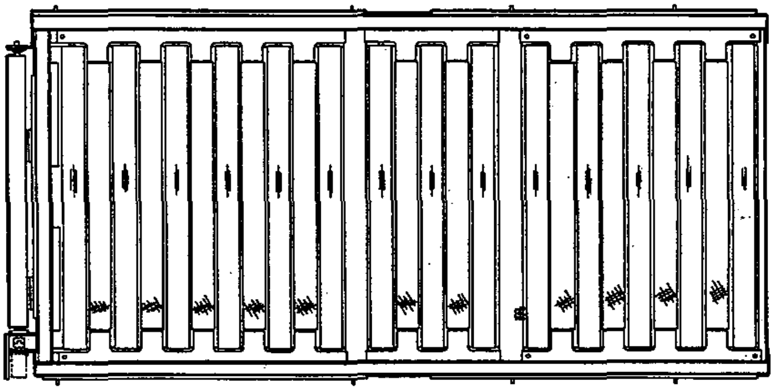
(8) Right & Left Pallet Extended Side Load (Fig. 12)

Allows the operator to transfer palletized or containerized cargo to or from the right and left sides of the loader and to or from the rear. Twelve rows of cluster roller assemblies and two cylindrical rollers move the cargo. Hydraulically powered cylindrical rollers at the right side and rear assist in transferring cargo to and from the transporting vehicle.

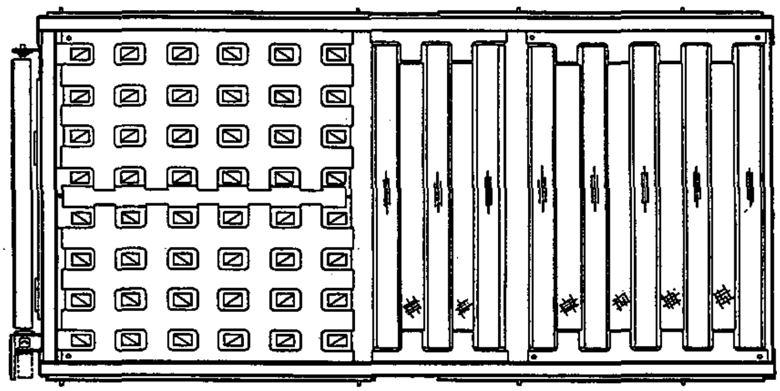
(9, 10) (Fig. 12)

Platforms equipped with cluster roller assemblies include a feature that allows containers to be rotated as required to align them for cargo convey.

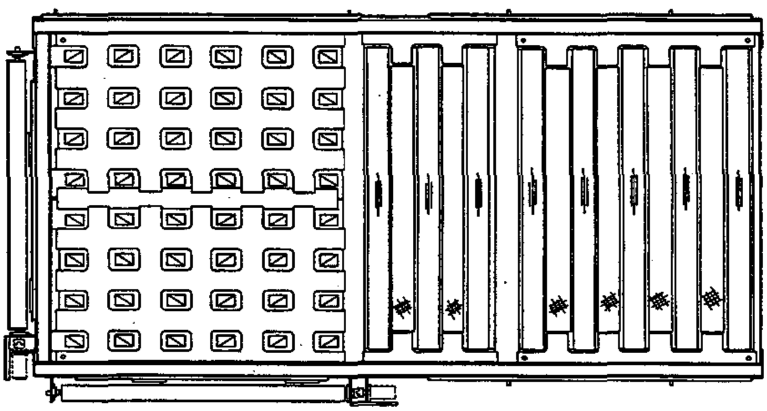
(1)



(2)

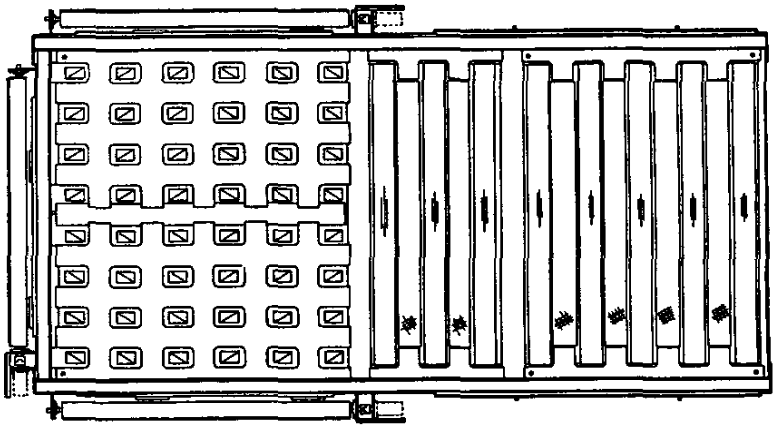


(3)

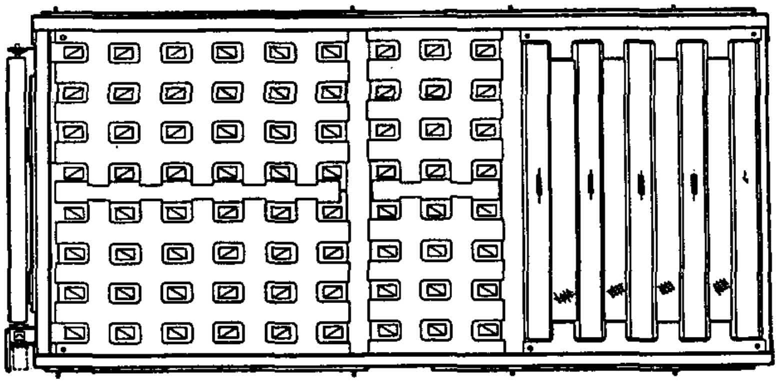


PLATFORM CONFIGURATIONS
Figure 10

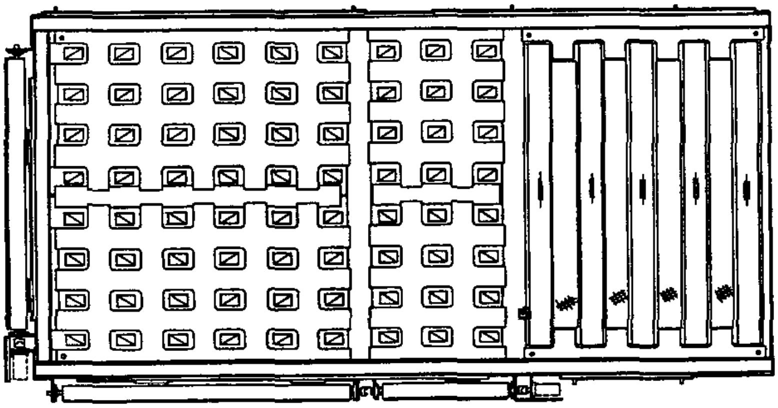
(4)



(5)

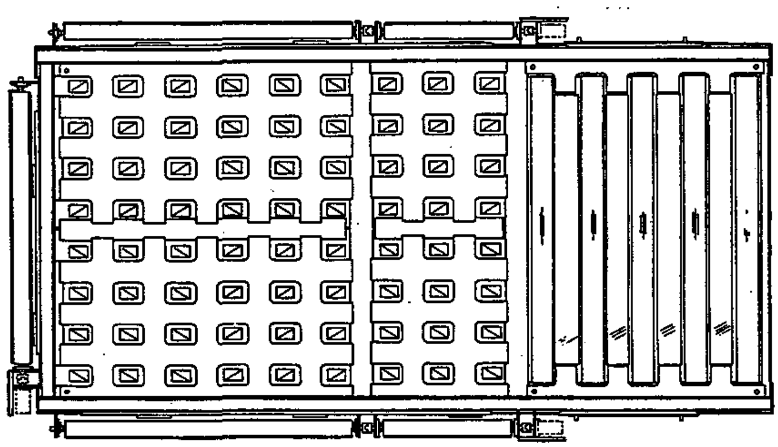


(6)

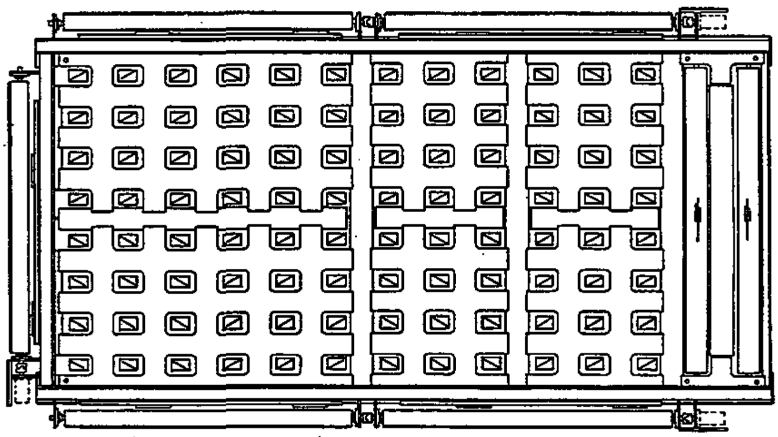


PLATFORM CONFIGURATIONS
Figure 11

(7)



(8)



(9 & 10)

SAME AS 7 & 8 ABOVE. NUMBER 7 CONFIGURATION WOULD HAVE POWERED SIDE GUIDES AND NUMBER 8 CONFIGURATION WOULD HAVE REAR OR CENTER ROTATION FEATURES.

PLATFORM CONFIGURATIONS
Figure 12

E. Power Unit (Fig. 13)

The power unit is located at the front of the loader. It is a modular unit that is hinged on the left side of the loader. A single bolt on the right side can be removed to permit the module to swing out for complete access to components when maintenance is required. A power panel on the right side of the module contains controls and indicators used to start and operate the power unit at ground level.

A gasoline engine, choice of several diesel engines, or 72-volt DC battery system is available as the primary source of power for the loader. Engines and battery system are easily interchangeable at field level; no major modifications to the loader are required.

F. Hydraulic System

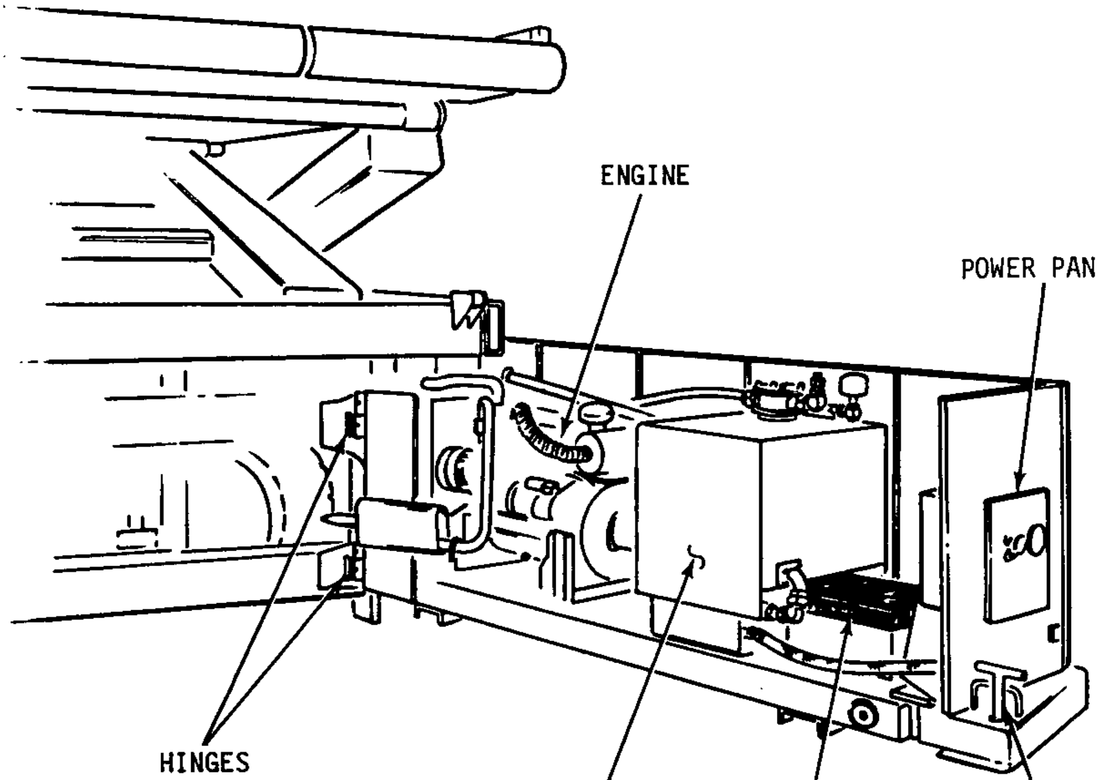
A closed-center, load-sensing, pressure-compensating hydraulic system is used on the COMMANDER loader. It provides hydraulic power for the cargo transfer, raising and lowering the bridge and platform, proportional propulsion, steering and braking, and operation of the various guides that are used to insure safe handling of cargo. A dynamic braking feature is also incorporated into the hydraulic system to provide smooth deceleration when the operator releases the accelerator.

The axial piston pump is direct driven by the power unit and delivers 120-176 liters per minute at 241 BAR (31.7 to 46.6 (GPM) at 3500 psi) depending on the power unit used.

Switches control fluid flow at correct pressure to operate the loader's hydraulic components. Check valves prevent load-bearing hydraulic cylinders from retracting if hydraulic pressure is not properly maintained in the system. An electrically-driven emergency pump is included to allow the operator to perform emergency procedures if the power unit or main hydraulic pump should fail.

G. Electrical System

The 24-volt electrical system provides power for control of the hydraulic system, ignition for the gasoline engine (if so equipped), for lights, and other accessories. Power is derived from two 12-volt batteries (connected in series) as the basic 24 volt electrical system. An engine driven alternator maintains battery charge. When a 72-volt power unit is supplied, the basic electrical system is also 24 volts, but the two batteries are charged by means of a 72-volt to 28-volt converter.



POWER UNIT (TYPICAL)
Figure 13

Operator controls and indicators feature plug in connectors, in most cases, for quick and easy replacement. Proximity switches throughout the system assure proper operational sequencing; circuit breakers protect critical components of the loader.

The design incorporates printed circuit boards, keyed plug-in connectors, and a STATUS PANEL. The STATUS PANEL which makes use of light emitting diodes (LED's) is provided to assist maintenance personnel in isolating the cause of malfunctions.

4. MISCELLANEOUS COMPONENTS

A. Lights

Sealed beam headlights are supplied for night operations. Parking lights, turn lights, and a turn signal control that incorporates a flasher control for hazardous conditions is also supplied.

B. Horns

Two electrical automotive-type horns are included.

C. Audible Alarms

Alarms sound when the loader is operated in reverse.

D. Powered Bogy Wheels

Hydraulically powered bogy wheel assemblies to increase angle of approach and departure from ramp or to adjust rear platform to a variety of transfer vehicle heights.

E. Folding handrail located on left side of forward bridge for added operator protection.

5. AVAILABLE OPTIONS

A. Bridge tilt, provides flexibility for uneven ramp conditions Bridge can be tilted to align with aircraft doorway.

B. Any combination of cargo transfer; rear only, right and rear, left and rear, or right, rear, and left. Container and pallet rotation feature can also be supplied.

C. Variety of engines, either gasoline or diesel, 72-volt DC battery power unit.

D. Double scissors for the bridge to increase cargo lift height to 5.6 meters (220 in.) for main deck loading. (Side shift feature is available on the bridge of main deck loaders.)

E. Wide platform (125") for increased cargo handling capabilities (pallet loads in Boeing 767).

F. Hydraulically controlled bridge wing(s) to provide added versatility in transferring cargo.

G. Aircraft following assembly (tracking sensor) to provide automatic adjustment of bridge height as cargo is transferred to or from aircraft.

H. Controls for operation of extension deck.

I. Alarm sound when certain conditions such as low fuel, low oil pressure, or high engine temperatures are sensed.

J. A flashing beacon mounted at the rear of the operator's platform.

K. Cold start for starting diesel engine in cold climate conditions.

SECTION 2, OPERATION

1. CONTROLS AND INDICATORS

A. Driver's Panel Gauge Cluster Indicators

NOTE: Panel indicators are shown in figure 1. Symbols are shown in figure 2.

(1) "G" INDICATOR (red) - indicates that alternator is not charging.

(2) COOLANT TEMPERATURE (red) - lights when coolant temperature is above 93.3°C (200°F).

(3) OIL PRESSURE LOW (red) - lights when engine oil pressure is below 1 BAR (15 psi).

(4) COOLANT TEMP GAUGE - indicator in green area indicates satisfactory operating temperature range. Indicator in red area indicates excessively hot temperature.

(5) FUEL GAUGE - indicator shows approximate level of fuel in tank. Red area at lower left shows limited amount of fuel available, and that loader should be refueled to insure that operations can be continued without interruption.

(6) VOLTS GAUGE - indicates voltage output of alternator.

(7) OIL PRESS GAUGE - indicator in green area shows satisfactory engine oil pressure. Indicator in red area shows that pressure is low.

(8) HYDRAULIC OIL TEMPERATURE (red) - lights when temperature of oil is above 82.2°C (180°F).

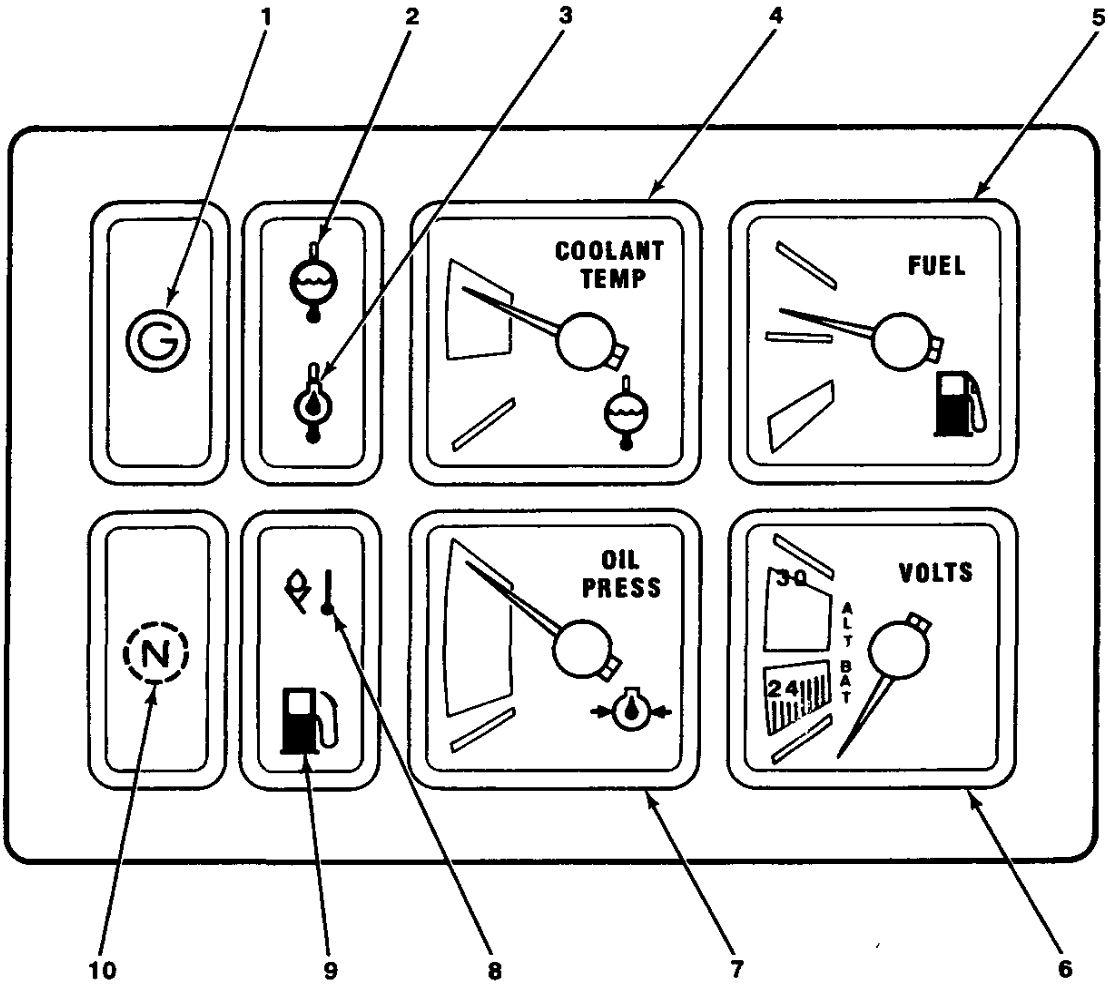
(9) LOW FUEL (red) - for engine installation, lights when remaining fuel is 19 liters (5 gallons) or less. For 72 volt power unit, indicates remaining charge in battery system is below 70% of full charge.

(10) "N" INDICATOR (red) - lights to notify driver to place drive control in neutral position before attempting to start power unit.

B. Driver's Panel Controls

NOTE: Panel controls are shown in figure 3. Symbols are shown in figure 4.

(1) BRIDGE LIFT SWITCH - three-position switch spring loaded to off position; raises bridge when placed in forward position, and lowers bridge when placed in rearward position.



DRIVER'S PANEL GAGE CLUSTER INDICATORS
Figure 1

1  ALTERNATOR NOT CHARGING

2  COOLANT TEMPERATURE (Indicator)

3  OIL PRESSURE LOW

4  COOLANT TEMPERATURE (Gage)

5  FUEL QUANTITY (Gage)

6  VOLTS (Gage)

7  OIL PRESSURE (Gage)

8  HYDRAULIC OIL TEMPERATURE HIGH

9  LOW FUEL

10  SHIFT TO NEUTRAL

INTERNATIONAL SYMBOLS FOR DRIVER'S PANEL
GAGE CLUSTER INDICATORS
Figure 2

(2) PANEL LIGHT - illuminates panel when loader is operated at night.

(3) TRACKING INDICATOR (OPTIONAL) - indicates when bridge is within range for sensing changes in aircraft position as cargo is transferred.

(4) TRACKING SWITCH (OPTIONAL) - two position toggle switch; allows driver or operator to select automatic tracking mode (aircraft following) or to select manual (non-automatic) mode for cargo transfer.

(5) BOGY WHEEL SWITCH - three position switch, spring loaded to off position; extends bogy wheels when placed in forward position and retracts them when placed in rearward position.

(6) FORWARD SIDE GUIDES SWITCH - three position switch spring loaded to center (OFF) position; shifts guides left when momentarily placed in left position, or to right when placed in right position.

(7) PARKING BRAKE INDICATOR - red indicator lights when parking brake is applied.

(8) STABILIZERS INDICATOR - red indicator lights when stabilizers are fully extended.

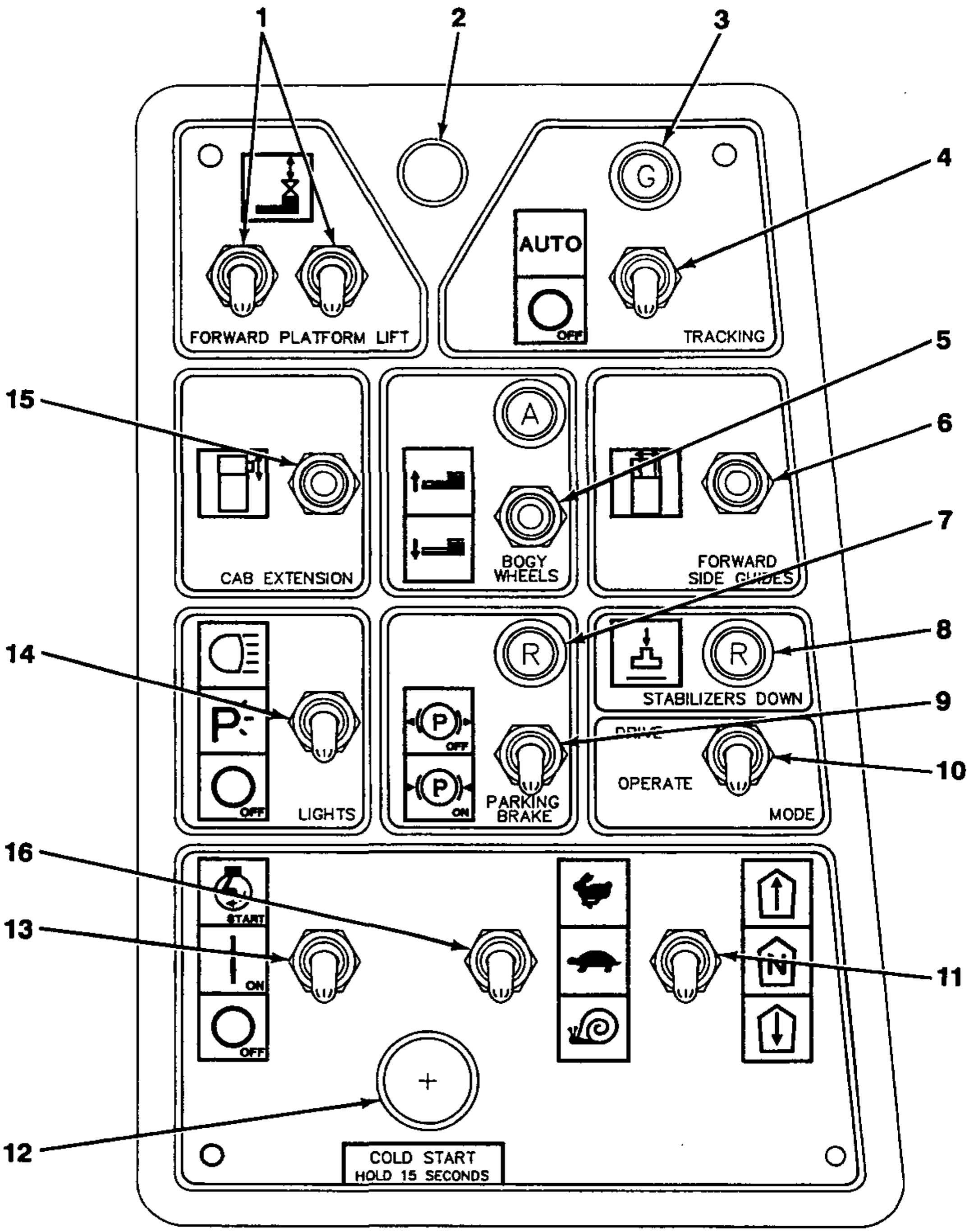
(9) PARKING BRAKE SWITCH - two position switch; applies parking brake when placed in ON position and lights red indicator to show that brake is applied. Releases brake when placed in OFF position, and causes red indicator to go out. Parking brake is automatically applied when power unit is stopped or stabilizers are extended.

(10) DRIVE/OPERATE MODE SWITCH - two position switch; extends (lowers) stabilizers when placed in operate position, and retracts stabilizers when placed in drive position. Red indicator lights when stabilizers are fully extended.

(11) DRIVE CONTROL - three position control used to select a forward direction, a neutral position, and a backward direction.

(12) COLD START SWITCH (OPTIONAL) - press and held when starting cold diesel engine.

(13) ENGINE OFF-ON-START SWITCH - three position toggle switch starts power unit when placed in start position; spring loaded to retrun to ON position. Shuts power unit off when placed in OFF position. May also be supplied as key operated rotary switch. For 72 volt power unit, starts electric motor.



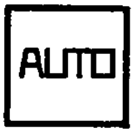
DRIVER'S PANEL CONTROLS
Figure 3

1 
FORWARD PLATFORM LIFT (BRIDGE LIFT)

2 NO SYMBOL
PANEL LIGHT

3 

TRACKING IN RANGE (Indicator)

4 

TRACKING

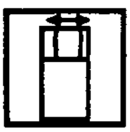
Auto Operation

Off

5 
BOGY WHEELS

Extend


Retract

6 
FORWARD SIDE GUIDES (BRIDGE SIDE GUIDES)

7 

PARKING BRAKE (Indicator)

8 

STABILIZERS (Indicator)

9 

PARKING BRAKE

Off

On

10 NO SYMBOL
MODE - DRIVE/OPERATE

INTERNATIONAL SYMBOLS FOR DRIVER'S PANEL CONTROLS
(SHEET 1 OF 2)
Figure 4

11  DRIVE CONTROL

Forward

Neutral

 Reverse

12 NO SYMBOL COLD START

13 

ENGINE

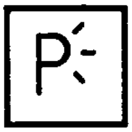
Start

On

Off

14  LIGHTS

Headlights



Parking Lights

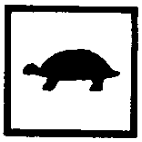
Off

15  CAB EXTENSION

16  SPEED CONTROL

Fast

(Rabbit)

 Slow

(Turtle)

 Creep

(Snail)

INTERNATIONAL SYMBOLS FOR DRIVER'S PANEL CONTROLS
(SHEET 2 OF 2)
Figure 4

(14) LIGHTS SWITCH - three position switch turns headlamps and running lights on in forward position. Turns parking lights on when placed in center position, and turns lights off when placed in rearward position.

(15) CAB EXTENSION SWITCH - spring loaded to off position; extends operator's platform when placed in forward position, and retracts platform when placed in rearward position.

(16) SPEED CONTROL - three position control used to select ranges of speed in forward and reverse direction. The fast (rabbit) position provides maximum speed for direction selected with drive control. In slow (turtle) position, approximately half of fast (rabbit) speed is available; and creep (snail) position provides minimum speed control.

(17) EMERGENCY HYDRAULIC SWITCH (NOT SHOWN) - a two position spring return to off position switch is located under console at right corner. A protective guard covers the switch. Switch on operates electric pump to perform various functions when power unit or hydraulic pump is inoperable.

(18) HORN SWITCH (NOT SHOWN) - pushbutton switch in center of steering wheel; sounds horns when pressed.

(19) TURN SIGNAL SWITCH (NOT SHOWN) - lever-operated to indicate direction of intended turn. Mounted on steering column; also contains flasher control for use in hazardous conditions.

(20) ACCELERATOR (NOT SHOWN) - foot pedal on operator's platform regulates speed of loader.

(21) BRAKE (NOT SHOWN) - foot pedal on operator's platform hydraulically applies brakes.

C. Operator's Control Panel Controls

<u>NOTE:</u> Panel controls are shown in figure 5. Symbols are shown in figure 6.

(1) EMERGENCY STOP SWITCH - stops power unit when pressed. Switch is not to be used for routine shutdown of the power unit.

(2) PANEL LIGHTS - two lights illuminate panel when loader is operated at night.

(3) EXTENSION DECK LIFT SWITCH (OPTIONAL) - three position toggle switch spring loaded to center position; raises or lowers extension deck.

(4) EXTENSION DECK CONVEY SWITCH (OPTIONAL) - three position toggle switch spring loaded to center position; operates rollers to convey cargo forward or rearward.

EXTENSION DECK REAR STOP - two position toggle switch spring loaded to center position. Retracts stops on extension deck when depressed rearward.

(5) ROTATION SWITCH (STANDARD ON ALL LOADERS EXCEPT END LOAD CONFIGURATION) - rotary switch spring loaded to off position. When turned, causes cargo to rotate on rear platform.

(6) PLATFORM CONVEY SWITCH - three position or five position joystick (depending on type of loader). Moves cargo on rear section of platform in direction of arrows on switch placard.

(7) PLATFORM CONVEY SWITCH - three position or five position joystick (depending on type of loader). Moves cargo on front section of platform in direction of arrows on switch placard.

(8) BRIDGE CONVEY SWITCH - five position switch moves cargo on bridge in direction of arrows on switch placard.

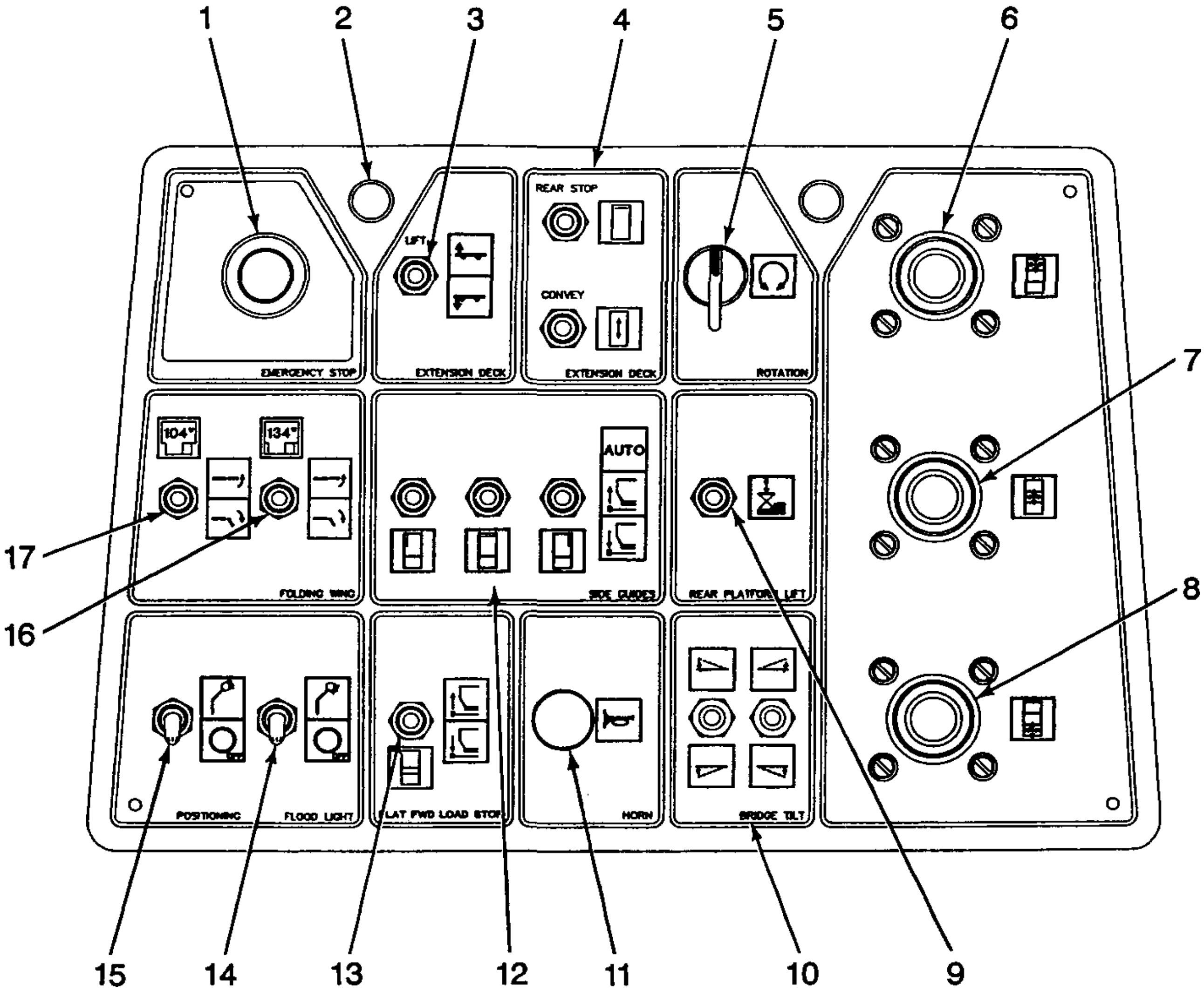
(9) PLATFORM LIFT SWITCH - three position switch spring loaded to off position; raises and lowers platform.

(10) BRIDGE TILT (OPTIONAL) - two toggle switch operation.

(11) HORN (OPTIONAL) - pushbutton switch sounds horns when pressed.

(12) SIDE GUIDES SWITCHES - up to three toggle switches, depending on type of loader. Retract platform stops when momentarily set to appropriately marked position. Return to AUTO position when released, causing stops to extend. Will remain in position for extending the stops until returned to AUTO position by operator.

(13) PLATFORM FORWARD LOAD STOP - two position toggle switch raises or lowers platform forward load stop to allow various operations.



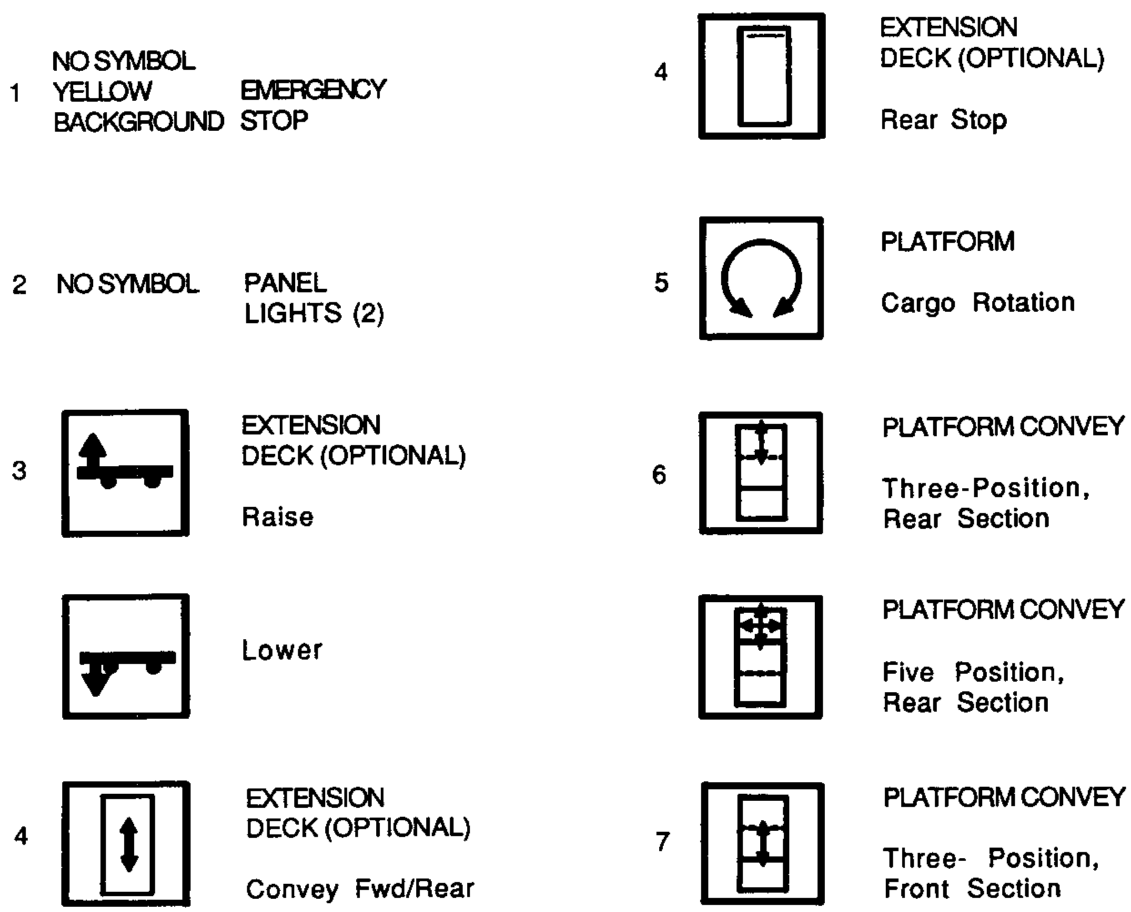
CONTROL PANEL
Figure 5

(14) FLOODLIGHT SWITCH (OPTIONL) - two position toggle switch; turns floodlights on or off.

(15) POSITIONING LIGHT (OPTIONAL) - two position toggle switch; turn floodlights on or off.

(16) FOLDING WING SWITCH 40.5m (134") (OPTIONAL) - three position toggle switch; spring loaded to off position. Raises or lowers bridge wings.

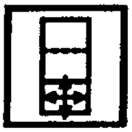
(17) FOLDING WING SWITCH 31.5m (104") (OPTIONAL) - three position toggle switch; spring loaded to off position. Raises or lowers bridge wings.



INTERNATIONAL SYMBOLS FOR OPERATOR'S CONTROL PANEL
(SHEET 1 OF 3)
Figure 6

7 
PLATFORM CONVEY

Five Position,
Front Section
(OPTIONAL)

8 
FORWARD
PLATFORM
CONVEY
(BRIDGE CONVEY)

9 
PLATFORM LIFT

10 
BRIDGE TILT
RIGHT

Up


Down


BRIDGE TILT
LEFT

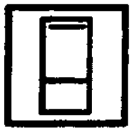
Up

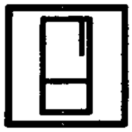

Down

11 
HORN

12 
SIDES GUIDES
EXTEND/RETRACT

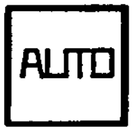
Right Side


Rear


Left Side

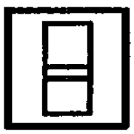

SIDE GUIDES
EXTEND/RETRACT

Extend



Automatic Mode


Retract

13 
PLAT FWD
LOAD STOP


Up

INTERNATIONAL SYMBOLS FOR OPERATOR'S CONTROL PANEL
(SHEET 2 OF 3)
Figure 6

Down

14 

FLOODLIGHT

15 

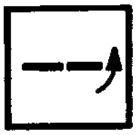
POSITIONING LIGHT

16 

FOLDING
WING

Raise

Lower

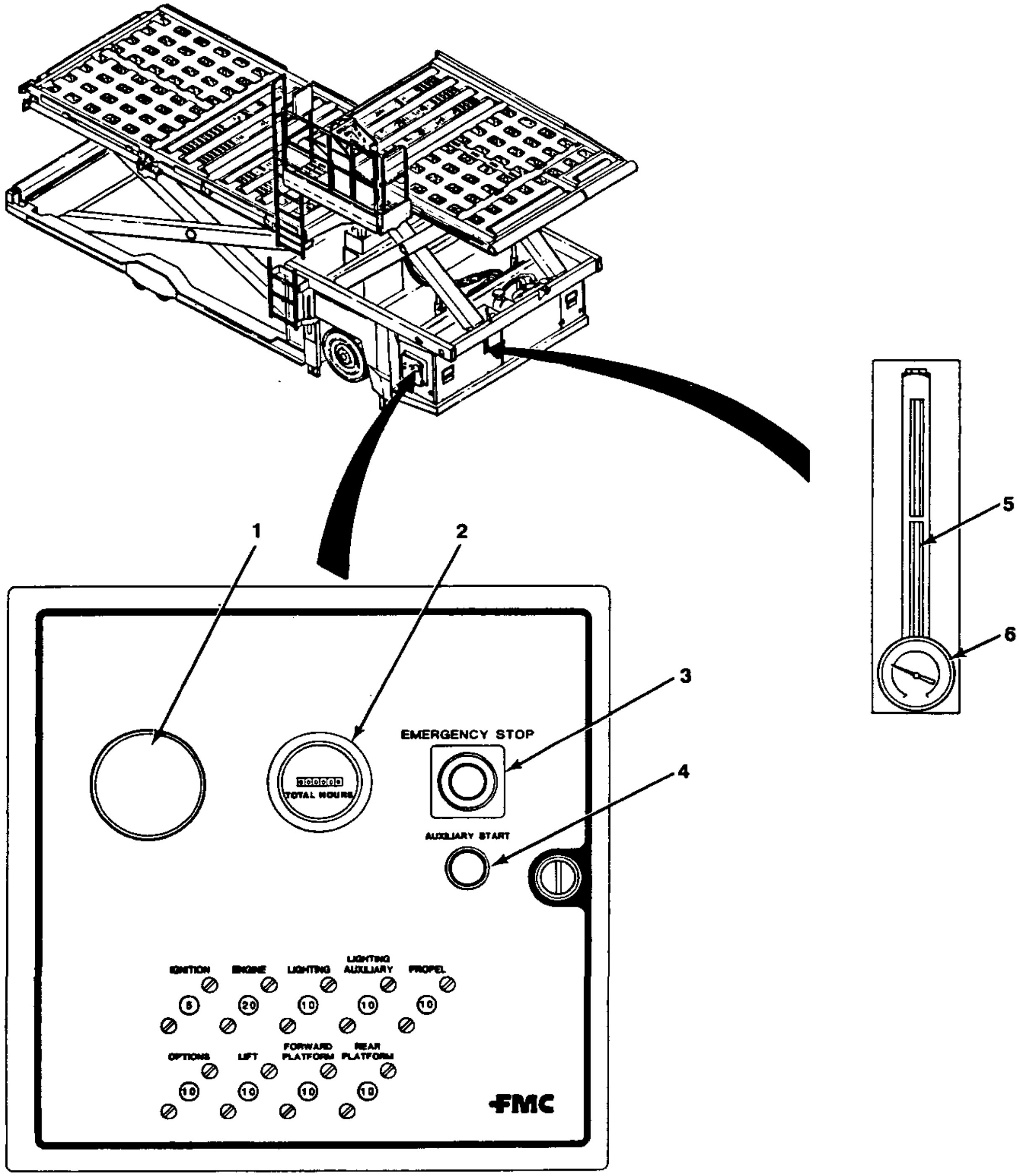
17 

FOLDING
WING

Raise

Lower

INTERNATIONAL SYMBOLS FOR OPERATOR'S CONTROL PANEL
(SHEET 3 OF 3)
Figure 6



ENGINE POWER & MISCELLANEOUS CONTROLS & INDICATORS
Figure 7

D. Engine Power Panel and Miscellaneous Controls (Fig. 7)

(1) TACHOMETER (OPTIONAL) - for engine installation, indicates engine RPM, or battery condition indicator for 72-volt power unit to indicate charge level.

(2) HOURMETER - indicates total number of hours of operation.

(3) EMERGENCY STOP SWITCH - when pushed in, shuts off power unit. Switch is not to be used for routine shutdown of power unit.

(4) AUXILIARY START SWITCH - Starts power unit.

(5) FLUID LEVEL INDICATOR - indicates oil level in hydraulic reservoir.

(6) TEMPERATURE INDICATOR - indicates temperature of hydraulic oil in reservoir.

2. PROCEDURES

A. Starting Power Unit

WARNING: BEFORE STARTING ANY TYPE OF POWER UNIT, OBSERVE ALL PRECAUTIONS BELOW.

- INSURE BOGY WHEEL PINS ARE REMOVED FOR NORMAL OPERATION.
- INSURE POWER MODULE PIN IS SECURELY FASTENED.
- INSURE THAT ALL PERSONNEL ARE CLEAR OF LOADER.
- AT BEGINNING OF SHIFT, INSURE THAT ALL SCHEDULED SERVICES HAVE BEEN PERFORMED. THIS INCLUDES CHECK OF TIRE CONDITION, FUEL AND FLUID LEVELS, AND OVERALL CHECK FOR LOOSE OR MISSING HARDWARE, AND GENERAL CONDITION OF LOADER.
- DO NOT ATTEMPT TO OPERATE THE COMMANDER WITHOUT HAVING BEEN PROPERLY TRAINED IN OPERATION AND SAFETY REQUIREMENTS.
- DO NOT OPERATE LOADER WHILE UNDER INFLUENCE OF DRUGS, ALCOHOL, OR MEDICATION THAT MAY PREVENT FULL ABILITY TO CONTROL LOADER.
- BE ALERT AT ALL TIMES DURING LOADER OPERATION.

(1) Gasoline Engine

(a) Place DRIVE CONTROL in N position.

(b) Insure that all EMERGENCY STOP switches are pulled out.

(c) Insure that parking brake is set.

(d) Adjust choke control as necessary.

(e) Set engine OFF-ON-START switch to START until engine starts, then release switch after oil pressure warning light goes out.

(f) Observe gage cluster to insure that all indicators show normal operation.

(g) Adjust choke control as required for smooth engine operation.

(h) Allow engine to warm up for several minutes and push choke control in.

(i) Refer to paragraphs B. through H. for required operational procedures.

(2) Diesel Engine

(a) Place DRIVE CONTROL in N position.

(b) Insure that all EMERGENCY STOP switches are pulled out.

(c) Insure that parking brake is set.

(d) Set engine OFF-ON-START to ON and press and hold COLD START switch for 15 seconds.

(e) Set engine OFF-ON-START switch to START until engine starts, then release switch to ON after oil pressure warning light goes out.

(f) Observe gage cluster to insure that all indicators show normal operation.

(g) Allow engine to warm up for several minutes.

(h) Refer to paragraphs B. through H. for required operational procedures.

(3) 72 Volt

WARNING: DO NOT ATTEMPT TO PLUG THE BATTERY CHARGER DIRECTLY TO THE LOADER, AS THIS WILL CAUSE SERIOUS DAMAGE TO THE VEHICLES SCR CONTROL SYSTEM.

(a) Check BATTERY CONDITION indicator to insure that sufficient power is available to perform required operations.

(b) Insure that the two 12 volt batteries are properly connected to the power panel, located at the front of loader and inside power units module compartment.

(c) Place DRIVE CONTROL switch in N position.

(d) Insure that all EMERGENCY STOP switches are pulled out.

(e) Insure that parking brake is set.

(f) Set ON-OFF-START switch to START, and release switch to ON.

(g) Refer to paragraphs B. through H. for required operational procedures.

B. Stopping Power Unit

(1) Gasoline or Diesel Engine

(a) Park loader (Para. K. Pg. 28).

(b) Set parking brake and note that indicator lights.

CAUTION: TO PREVENT DAMAGE TO THE STABILIZER CYLINDER ASSEMBLIES, IT IS NOT RECOMMENDED TO EXTEND THE STABILIZERS WHEN THE UNIT IS PARKED.

(c) Let engine idle for 3 or 4 minutes.

(d) Set engine OFF-ON-START switch to OFF.

(2) 72 Volt

(A) Park loader (Para. K. Pg. 28).

(b) Set parking brake and note that indicator lights.

CAUTION: TO PREVENT DAMAGE TO THE STABILIZER CYLINDER ASSEMBLIES, IT IS NOT RECOMMENDED TO EXTEND THE STABILIZERS WHEN THE UNIT IS PARKED.

(c) Set engine OFF-ON-START switch to OFF.

(d) Check BATTERY CONDITION indicator for charge level.

(e) Charge batteries, if required (see Parking loader Para. K, Pg. 28).

C. Mechanical Folding Wing

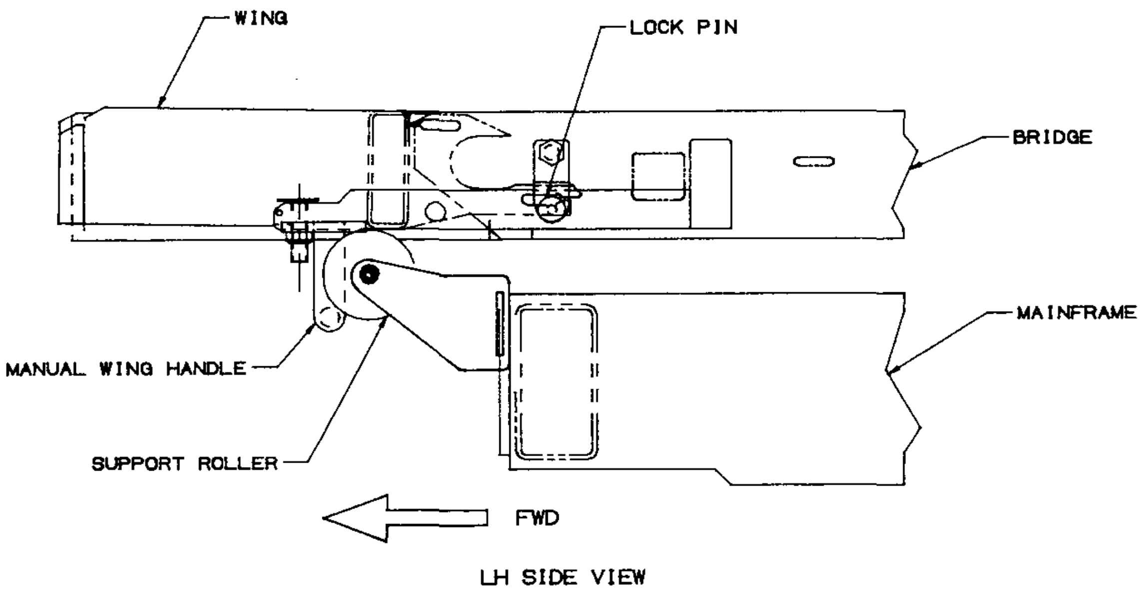
<u>WARNING:</u> DO NOT OPERATE OR ATTEMPT TO UNLATCH FOLDING WING UNTIL BRIDGE IS IN ITS LOWEST, FULL DOWN POSITION AND WING IS RESTING ON ROLLER STOP. FAILURE TO LOWER BRIDGE MAY ALLOW FOLDING WING TO FALL, RESULTING IN SERIOUS INJURY TO PERSONNEL.

(1) To avoid injury, lower bridge to its full down position before unlatching folding wing. Insure wing is resting on roller stop. (Fig. 8)

(2) Pull lock pin and push on manual wing handle rearward until locked.

(3) Raise bridge and observe that the folding wing tilts down when platform rises.

(4) Lower bridge to its full down position to return folding wing horizontal with bridge. ENGAGE LOCK PIN AND PULL HANDLE FORWARD UNTIL LOCKED.



MECHANICAL FOLDING WING
Figure 8

D. Approaching Aircraft for Cargo Transfer

WARNING: THE COMMANDER IS NOT DESIGNED FOR USE AS A TRANSPORTING VEHICLE. ANY ATTEMPT TO USE IT FOR OPERATIONS OTHER THAN CARGO TRANSFER MAY RESULT IN INJURY TO PERSONNEL OR DAMAGE TO EQUIPMENT.

WARNING: DO NOT ALLOW PERSONNEL UNDER BRIDGE OR PLATFORM UNLESS ADEQUATE SUPPORTS ARE IN PLACE. FAILURE TO SUPPORT BRIDGE OR PLATFORM MAY ALLOW BRIDGE OR PLATFORM TO FALL, RESULTING IN DEATH OR INJURY TO PERSONNEL AND/OR DAMAGE TO EQUIPMENT.

WARNING: USE EXTREME CAUTION WHEN WALKING ON BRIDGE OR PLATFORM AT ALL TIMES. AVOID STEPPING ON ROLLERS OR CLUSTER ROLLER ASSEMBLIES. FAILURE TO DO SO COULD RESULT IN PERSONAL INJURY OR DEATH.

(1) Start power unit (Para. A. Engine Starting).

(2) Lower bridge and platform and safety fences (where applicable).

(3) Retract the operator's compartment fully.

(4) Actuate bridge tilt (optional) (Para. G. Pg. 24) switches so that both sides are at their lowest height.

(5) Retract bogy wheels for chassis lowest position.

(6) Lower the left hand safety rails.

(7) Check area to be sure that intended drive path is free of obstructions.

(8) Insure that STABILIZERS indicator unit is out.

(9) Set PARKING BRAKE switch to OFF, and note that indicator light goes out.

(10) Set DRIVE MOVE DIRECTIONAL switch to the FWD or REVERSE position.

CAUTION: DO NOT USE MAXIMUM SPEED RANGE (RABBIT) IF LOADER IS CLOSER THAN 3 METERS (10 FT.) TO AIRCRAFT.

(11) Set DRIVE CONTROL for desired speed. Start with DRIVE CONTROL in MID range (TURTLE), then to high range (RABBIT) at about 5 kph (3 mph).

(12) Press accelerator pedal; as soon as loader moves, release accelerator pedal and press brake pedal to check for smooth and positive brake operation.

WARNING: OBSERVE ALL INSTRUCTIONS IN AIRPORT OPERATIONS MANUAL WHEN DRIVING LOADER. FAILURE TO DO SO MAY RESULT IN INJURY TO PERSONNEL OR DAMAGE TO EQUIPMENT.

(13) Drive loader to within 3 meters (10 ft.) of aircraft.

(14) Stop loader; set DRIVE CONTROL to LOW range (SNAIL).

(15) Adjust height of bridge as required so that aircraft cargo door will clear bridge when loader is positioned and door is opened.

NOTE: Some aircraft configurations require bridge to be fully lowered.

(16) Slowly drive loader toward aircraft; stop when bridge is approximately 0.3 meters (12 in.) from aircraft. Be sure that loader is squarely positioned relative to aircraft fuselage.

(17) Set parking brake and note that indicator lights.

CAUTION: OPEN DOOR CAREFULLY. FAILURE TO USE CARE MAY RESULT IN DAMAGE TO AIRCRAFT OR LOADER.

(18) Open aircraft cargo door.

(19) Raise the bridge to level of aircraft cargo deck.

(20) Release parking brake and position loader so that rubber bumpers on bridge face are close to but DO NOT touch the aircraft.

(21) Set DRIVE CONTROL to N. Set parking brake and extend stabilizers. Note that parking brake and stabilizers indicators light.

(22) Set FORWARD SIDE GUIDES switch to left or right position to align side guides and door for cargo transfer.

(23) Extend operator's platform as required for cargo transfer.

(24) Actuate aircraft auto-follow system (optional), (Para F. Pg. 21).

(25) Raise safety fences where applicable.

CAUTION: DO NOT STOP POWER UNIT WITH LOADER IN POSITION TO TRANSFER CARGO. DO NOT LEAVE LOADER UNATTENDED. FAILURE TO OBSERVE THIS CAUTION MAY RESULT IN DAMAGE TO AIRCRAFT OR LOADER.

(26) Transfer cargo from aircraft to ground equipment (Para. H. Pg. 25) or to aircraft (Para. I. Pg. 26).

E. Hydraulic Powered Folding Wing. (Optional)

WARNING: WHEN RAISING OR LOWERING THE HYDRAULIC POWERED FOLDING WINGS, IT IS MANDATORY THAT THE BRIDGE BE IN THE FULL DOWN POSITION. FAILURE TO DO SO COULD RESULT IN DAMAGE TO AIRCRAFT OR LOADER AND POSSIBLE INJURY TO THE OPERATOR OR GROUND PERSONNEL.

NOTE: An interlock incorporated in the hydraulic powered wings electric circuit prevents operation when the bridge is not in the full down (lowered) position.

(1) Lower bridge to the full down position.

(2) Push forward on either the 104" or the 134" folding wing toggle switches to lower the wings according to the aircraft door width required. Hold switch forward for approximately 15-20 seconds to allow full travel.

(3) To raise the wings, lower bridge to the full down position. Pull back on either the 104" or 134" folding wings toggle switch to raise the wings. Hold switch for approximately 15-20 seconds to allow full travel.

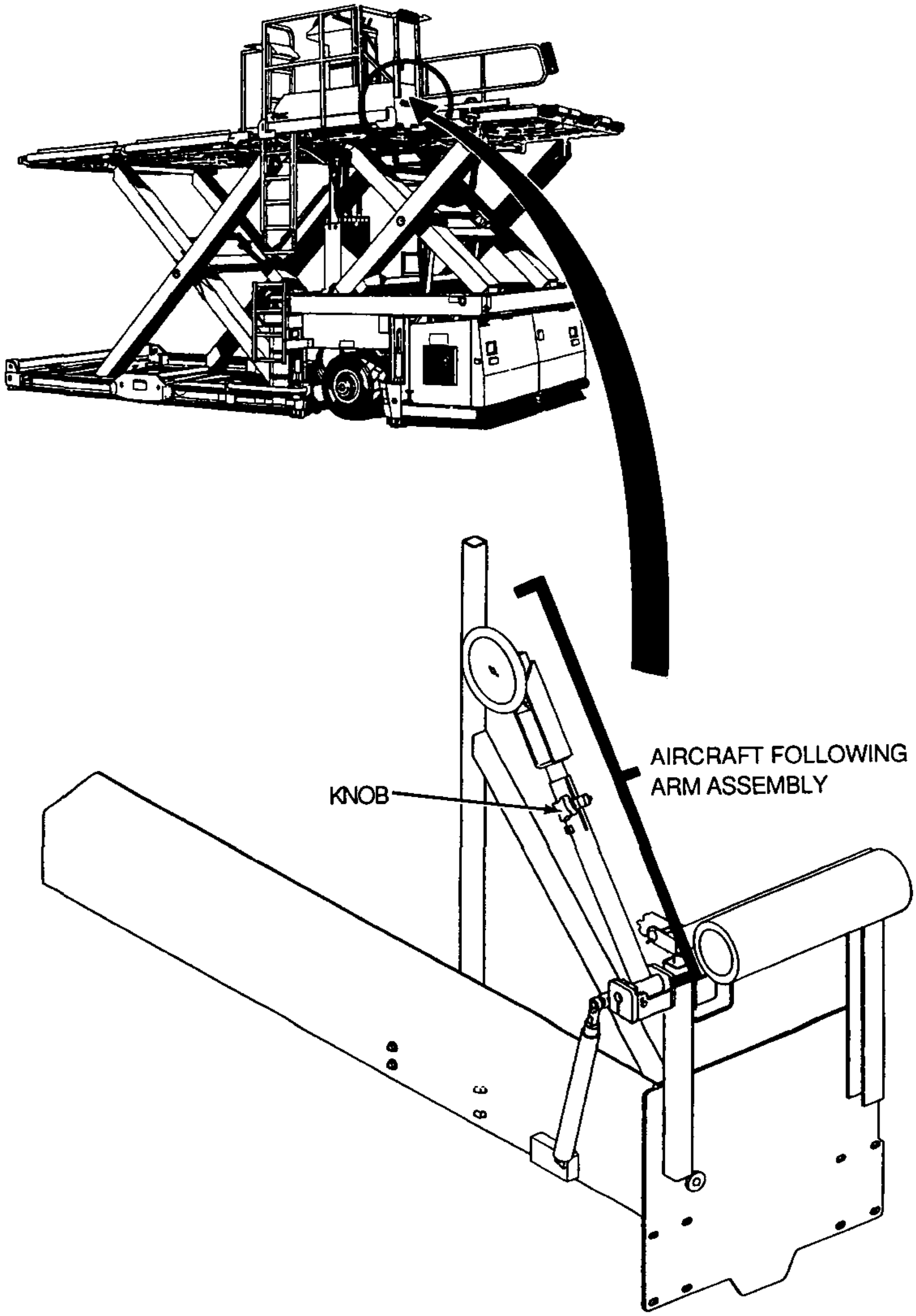
F. Aircraft Following (Optional) (Fig. 9 & 10)

(1) Position loader on aircraft and adjust bridge height to be level with aircraft cargo deck.

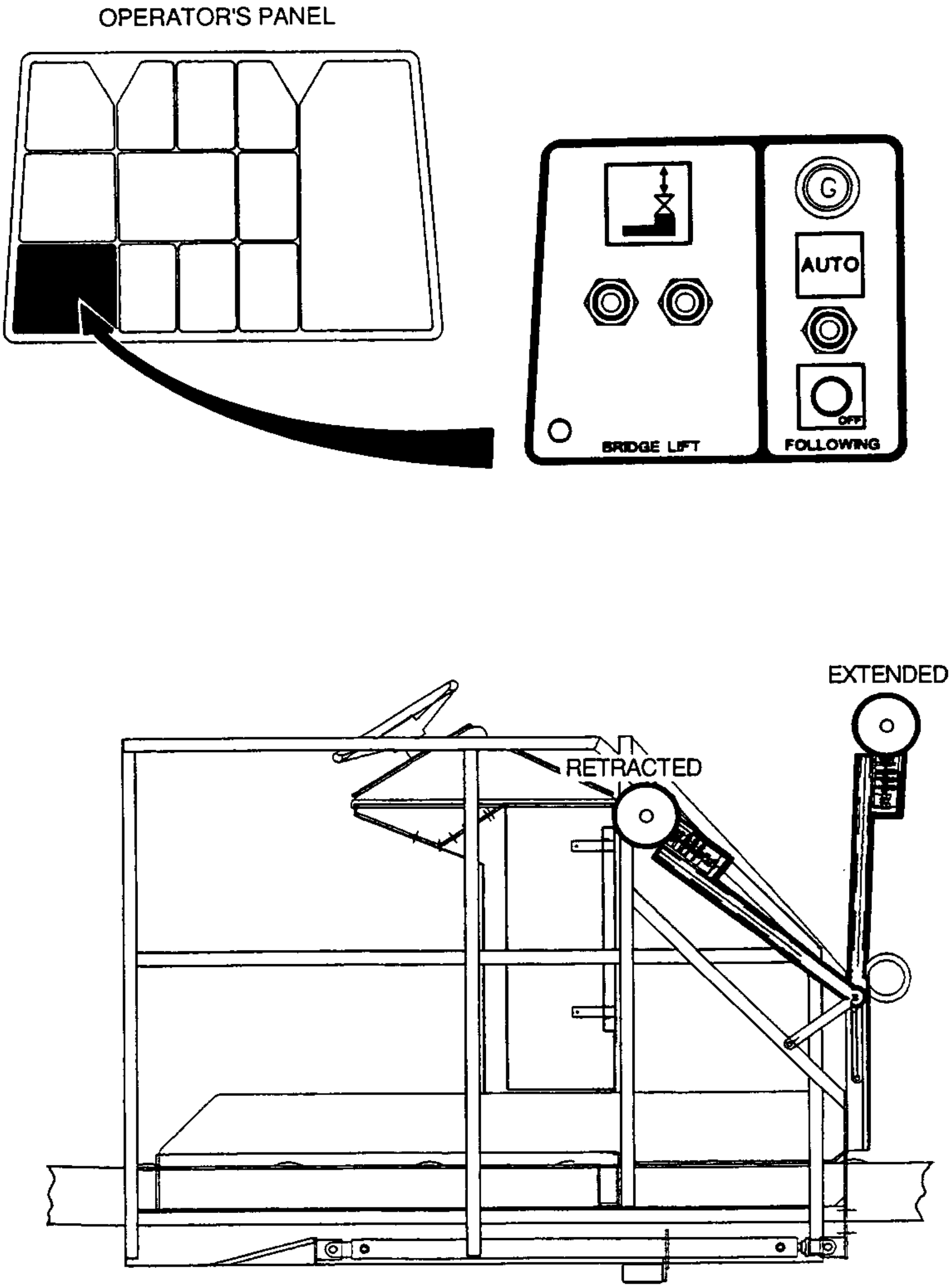
(2) Extend operator's cab until rubber bumper JUST touches the aircraft.

(3) Actuate the "FOLLOWING" switch to AUTO Momentarily. (The indicator light will illuminate and the following arm will begin to extend).

NOTE: When the aircraft following indicator is ILLUMINATED, the system is "ON" and the bridge elevation, up and down, will be controlled by the following system.



AIRCRAFT FOLLOWING SYSTEM (OPTIONAL)
Figure 9



AIRCRAFT FOLLOWING SYSTEM (OPTIONAL)
Figure 10

(4) When the aircraft following arm assembly is fully extended, check and make sure the wheel is on a smooth surface of the aircraft.

NOTE: If the wheel is not on a smooth surface, or has interference with any part of the aircraft, adjust the length of the arm by loosening the knob on the side of the arm. Extend or retract the arm and tighten knob securely.

(5) If the level of the bridge and the aircraft are not level, or the level would change during operations, readjust the level with the bridge switch.

NOTE: Actuating the bridge switch will de-energize the following system and it will be necessary to re-actuate the system by momentarily holding the following switch in the "AUTO" position.

(6) The aircraft following system will automatically de-energize if:

(a) Bridge switch is actuated, up or down, to change the level of the bridge.

(b) Automatic following requires more than 1 1/2 seconds to level the bridge and the aircraft cargo deck.

Re-actuate the system by momentarily holding the following switch in the "AUTO" position and observe the indicator light is illuminated.

NOTE: Whenever the aircraft following system is de-energized, the aircraft following assembly will immediately begin to retract away from the aircraft.

G. Bridge Tilt (Optional)

WARNING: WHEN USING BRIDGE TILT ENSURE ADEQUATE CLEARANCE BETWEEN LOADER AND AIRCRAFT. FAILURE TO DO SO COULD CAUSE DAMAGE TO AIRCRAFT OR LOADER.

NOTE: When using bridge tilt with the optional aircraft following, it is recommended to adjust the left hand side of the bridge for loader to aircraft interfacing. The aircraft following will monitor the right side in relation to aircraft and loader height when in the auto follow mode.

(1) With loader in position at the aircraft doorway, operate either bridge tilt actuating switches to obtain desired interface angle.

H. Transferring Cargo From Aircraft

<u>NOTE</u>: It is assumed that all procedures for approaching the aircraft (Para. D. Pg. 19) have been performed.

(1) Place PLATFORM LIFT switch in LIFT position until platform automatically stops at same level as bridge. Note that STOP at rear of bridge retracts.

(2) When cargo is in position to be moved onto bridge, set bridge joystick to rearward convey position until cargo is completely on bridge.

(3) Adjust position of cargo on bridge by operating joystick in required directions until cargo is laterally centered on bridge.

(4) Insure that side and rear stops on platform are extended.

(5) Set all three joysticks simultaneously to rearward position until cargo is as far back as possible on platform.

<u>CAUTION</u>: IF AIRCRAFT FOLLOWING (OPTION) IS NOT IN USE, IT WILL BE NECESSARY TO MANUALLY ADJUST HEIGHT OF BRIDGE AS AIRCRAFT POSITION CHANGES DURING CARGO TRANSFER. FAILURE TO MAINTAIN ALIGNMENT OF AIRCRAFT AND BRIDGE MAY RESULT IN DAMAGE TO EQUIPMENT.

<u>NOTE</u>: It may be necessary to rotate cargo on platform. Use rotation switch as required.

(6) If another container is to be transferred, repeat (3) through (5) but do not operate rear joystick; then go to (7) below.

(7) Place PLATFORM LIFT switch in LOWER position until platform is at same level as ground vehicle.

(8) Set SIDE GUIDES switch to AUTO position or hold in lower position to retract left, right, or rear stop on platform (whichever is closest to ground vehicle).

(9) Set platform joystick to move cargo onto ground vehicle, then release joystick and SIDE GUIDES switch (if not in AUTO position).

(10) If more cargo is to be transferred, repeat (1) through (9). If transfer is complete, go to (11) below.

(11) Place PLATFORM LIFT switch in lower position until platform stops automatically, then perform procedures in Para. J. Pg. 27.

I. Transferring Cargo To Aircraft

NOTE: It is assumed that all procedures for approaching the aircraft (Para. D. Pg. 19) have been performed.

(1) Operate PLATFORM LIFT switch until platform is at same level as ground vehicle that contains cargo.

(2) Set SIDE GUIDES switch to AUTO position or hold in retract position to retract left, right, or rear stop on platform (whichever is closed to ground vehicle).

(3) Set platform joystick to move cargo onto platform; release joystick when cargo is approximately centered laterally on platform, then release SIDE GUIDES switch (if not in AUTO).

NOTE: If a second container is to be moved onto platform, operate rear and center joysticks simultaneously to move first container to front of platform, then repeat (2) and (3) above. Use ROTATION switch as required to position container.

(4) Place PLATFORM LIFT switch in LIFT position until rear platform automatically stops at same level as bridge. Note that stop at rear of bridge retracts.

(5) Set center and forward joysticks to forward position until container is on forward platform.

(6) Set bridge joystick to forward position until cargo is on aircraft.

CAUTION: IF AIRCRAFT FOLLOWING (OPTION) IS NOT IN USE, IT WILL BE NECESSARY TO MANUALLY ADJUST HEIGHT OF BRIDGE AS AIRCRAFT POSITION CHANGES DURING CARGO TRANSFER. FAILURE TO MAINTAIN ALIGNMENT OF AIRCRAFT AND MAY RESULT IN DAMAGE TO EQUIPMENT.

NOTE: For second container, operate joysticks simultaneously to move container onto bridge, then repeat (5) and (6) above.

(7) Set PLATFORM LIFT switch in LOWER position until platform is again at same level as ground vehicle that contains cargo.

(8) If more cargo is to be transferred, repeat (2) through (7). If transfer is complete, go to (9) below.

(9) Set PLATFORM LIFT switch to LOWER position until platform stops automatically, then perform procedures in Para. J. Pg. 27.

J. Departing From Aircraft

<u>WARNING</u>: THE COMMANDER IS NOT DESIGNED FOR USE AS A TRANS-PORTING VEHICLE. ANY ATTEMPT TO USE IT FOR OPERATIONS OTHER THAN CARGO TRANSFER MAY RESULT IN INJURY TO PERSONNEL OR DAMAGE TO EQUIPMENT.

(1) Check area to be sure that intended drive path is free of obstructions.

(2) Red indicator light for parking and stabilizers should be illuminated.

(3) Switch off Auto-Following System and observe that Auto-Following Assembly fully retracts.

(4) Retract operator's platform so that is will clear aircraft when bridge is moved.

(5) Position bridge so that it will clear cargo door when it is closed.

<u>CAUTION</u>: CLOSE CARGO DOOR CAREFULLY, FAILURE TO DO SO MAY RESULT IN DAMAGE TO AIRCRAFT OR LOADER.

(6) Carefully close and latch cargo door.

(7) Set MODE switch to DRIVE position. Note that stabilizers retract and indicator goes out.

(8) Set DRIVE CONTROL to reverse position.

(9) Set PARKING BRAKE switch of OFF position and note that indicator goes out.

(10 Slowly back loader away from aircraft.

(11) Lower bridge until it stops automatically.

<u>WARNING</u>: OBSERVE ALL INSTRUCTIONS IN AIRPORT OPERATIONS MANUAL WHEN DRIVING LOADER. FAILURE TO DO SO MAY RESULT IN INJURY TO PERSONNEL OR DAMAGE TO EQUIPMENT.

(12) Set DRIVE CONTROL to LOW or MID range (SNAIL or TURTLE).

(13) Drive loader to assigned location.

<u>NOTE</u>: When forward speed reaches approximately 5 kph (3 mph), set DRIVE CONTROL to high range (RABBIT).

(14) If no further operations are required, park loader (Para. K. below) and stop power unit (Para. B. Pg. 17).

K. Parking Loader

(1) Set DRIVE CONTROL to N position.

(2) Set the parking brake switch to ON. Note that the parking brake indicator lights. Do not set the stabilizer switch to the extend position as this will unnecessarily set the stabilizers.

(3) Stop power unit (Para. B. Pg. 17).

NOTE: If loader is being parked for short or long term storage, refer to section 5.

CAUTION: TO PREVENT DAMAGE TO THE STABILIZER CYLINDER ASSEMBLIES, IT IS NOT RECOMMENDED TO EXTEND THE STABILIZERS WHEN THE UNIT IS PARKED.

WARNING: DO NOT ATTEMPT TO PLUG THE BATTERY CHARGER DIRECTLY TO THE LOADER, AS THIS WILL CAUSE SERIOUS DAMAGE TO THE VEHICLES SCR CONTROL SYSTEM.

SECTION 3. SPECIFICATIONS

1. PERFORMANCE

Lift capacity............................6,800 kg (15,000 lb)

Load capacity............................Two containers (LD-3)
(or similar in dimensions)
or one pallet 3.17 m x 2.4 m)
(125 in. x 96 in.)

Platform lift speeds

Platform...........................13.7 m/min (45 fpm)
Bridge (standard)..................3.6 m/min (11.7 fpm)
Bridge (main deck capable).........4.6 m/min (15.2 fpm)

Minimum transfer height

Platform...........................0.46 m (18 in.)
Bridge.............................1.7 m (66 in.)

Maximum transfer height

Platform and bridge (standard)......3.54 m (140 in.)
Bridge (main deck capable).........5.6 m (221 in.)

Conveying speed..........................18.3 m.min (60 fpm)

Drive speed (maximum)....................11 km/hr (7 mph)

Stopping distance (full speed)...........4.6 m (15 ft) approx.

Turning radius (swept)...................7.9 m (26 ft)

Operating temperature (ambient)..........-32 to 52°C
(-25 to 125°F)

Wind speed (maximum during operation).....73 km/hr (45 mph)

Wind speed (withstand)...................161 km/hr (100 mph)

2. POWER UNIT DATA

Engines

MODEL	NO. OF CYL	COOLING	IDLRPM DTRPM BPH*	FUEL	DISPLACEMENT
Perkins 4.236 D	4	Liquid	1400 2400 78	Diesel	3.86 L (235 in3)
Isuzu QD-60	4	Liquid	1500 2800 52	Diesel	2.369 L (145 in3)
Deutz FrL912	4	Air	1400 2400 68	Diesel	3.77 L (230 in3)
Ford 300 CID	6	Liquid	1500 2800 68	Gas	4.9 L (300 in3)
Detroit	3	Liquid	1500 2400 86	Diesel	N/A (159 in3)

IDLE RPM/DEMAND THROTTLE RPM/HORSEPOWER @ DEMAND THROTTLE

Electric Power Module

DC Motor: General Electric, 72V - 38.8 horsepower; 2 operating speeds @ 1500 RPM & demand throttle @ 1800 RPM.

Battery Power: 72 Volt, 36 cells, 600 amp hours @ 6 hours. (battery not provided.)

Electrical System: 24 VDC; (2) 12 volt batteries connected in series.

3. HYDRAULIC SYSTEM

Closed center, pressure compensating, load sensing

Filters: Breather/filler..............Replaceable

Return........................Replaceable

Hydraulic oil............................Mobil DTE 11 (or equivalent)

Temperature range........................-32° to 66°C (-25° to 150°F)

Main pump rating.........................120-176 L/min @ 241 BAR (31.7-46.6 gpm @ 3500 psi)

Emergency pump rating (electrically powered).....................4.5 L/min @ 172 BAR (1.2 gpm @ 2500 psi)

4. ELECTRICAL SYSTEM

Alternator capacity......................24 VDC (Amps. vary with engine option)

Battery..................................2 (two) 12 VDC connected in series

5. BRAKE SYSTEM

Drive wheels: Parking.................Spring applied hydraulically released

Service.................Hydraulically applied

Fluid...................Hydraulic Oil

6. WHEELS AND TIRES

Drive wheels: Wheels..................8.00 BD x 15

Tires...................Pneumatic, (or optional foam filled) 300 x 15 NHS 20 ply

Tire Pressure...........9.65 BAR (140 psi)

Bogy wheels (rear).......................Solid

Steering.................................Hydraulically actuated, power assisted

Maximum steering angle....................43°

Drive hubs: Type....................Planetary torque hubs

Model...................Fairfield Mfg. W2B2
(assy. #W2B @ F0337N)

7. CAPACITIES

Fuel.....................................151.4 L (35 gal) total
113.6 L (30 gal) usable

Gasoline................Unleaded regular

Diesel..................#2 Diesel

Engine coolant............................Varies with engine

Engine oil................................Varies with engine

Planetary hub (oil EP-90 or equivalent)...503 cc (35 oz. approx.)

Hydraulic fluid reservoir.................190 L (50 gal)

Hydraulic hose lines......................114 L (30 gal)

Hydraulic fluid total.....................304 L (80 gal)

8. WEIGHT AND DIMENSIONS

Weight....................................16,900 kg (37,000 lb and up, depending on features supplied)

Wide....................18,200 kg (40,000 lb)

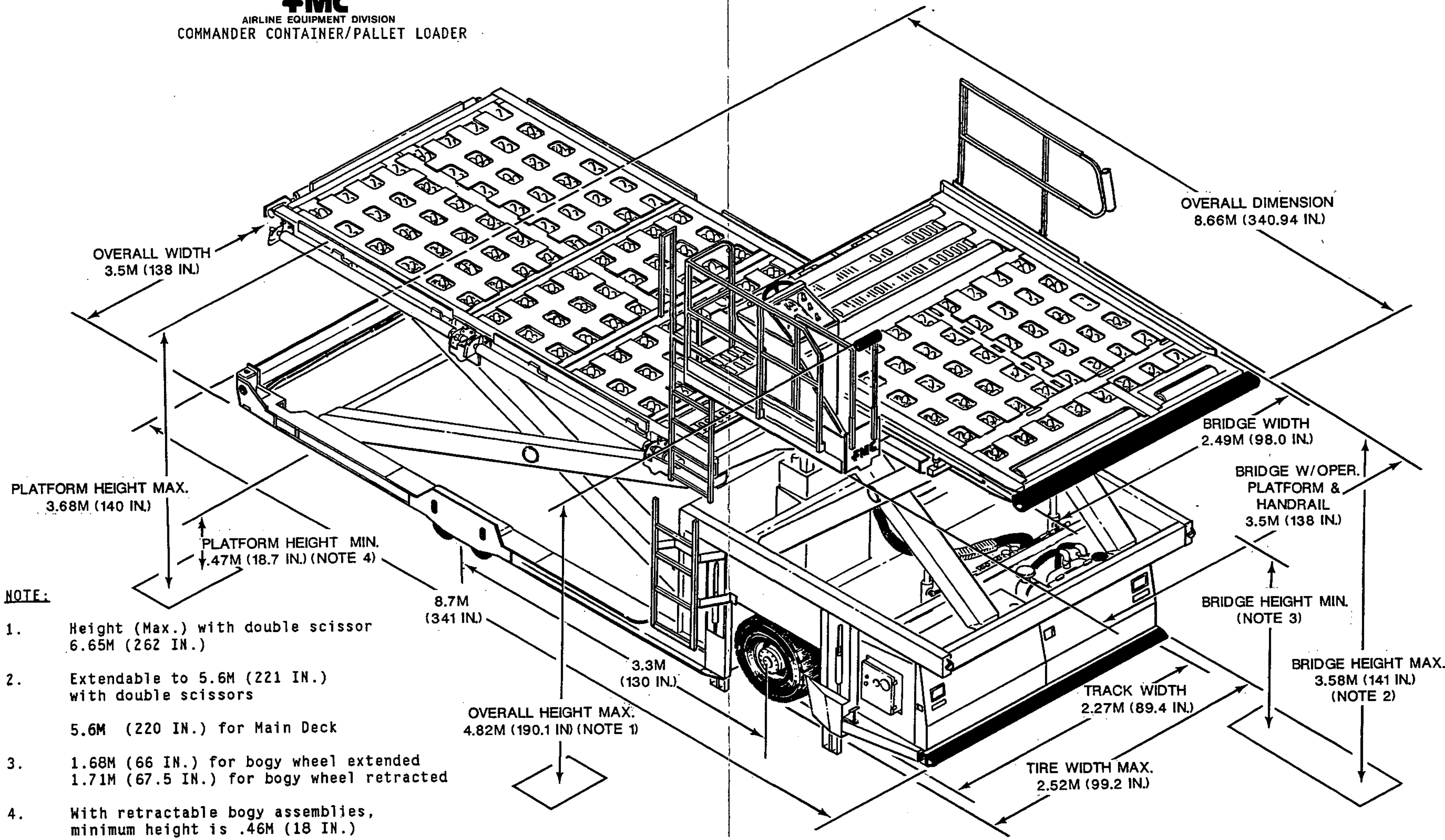
Universal...............19,100 kg (42,000 lb)

Length....................................9.8 m (386.3 in.)

Width (with standard platform)......3.1 m (121 in.)
(with wide platform)..........3.38 m (132 in.)

Height (with handrails)...................4.77 m (187 in.)

Wheelbase.................................4.2 m (164.1 in.)



NOTE:

1. Height (Max.) with double scissor 6.65M (262 IN.)

2. Extendable to 5.6M (221 IN.) with double scissors

   5.6M (220 IN.) for Main Deck

3. 1.68M (66 IN.) for bogy wheel extended
   1.71M (67.5 IN.) for bogy wheel retracted

4. With retractable bogy assemblies, minimum height is .46M (18 IN.)

5. Center of gravity varies with choice of power units and other features.
   Forklift pointsare marked with decals.

DIMENSIONS
Figure 1

9. ADJUSTMENT SETTINGS

A. Hydraulic Adjustments

(1) Standby (sensing) pressure 21 BAR (300 psi

(2) System relief pressure 262 BAR (3800 psi)

(3) Compensator relief pressure 193 BAR (2800 psi)

(4) Steering pressure reducing relief 172 BAR (2500 psi)

(5) Insure proper bogy wheel speed before adjusting stabilizers (3 to 7 sec.)

(6) Stabilizers relief 5/8" lift

(7) Stabilizer pressure switch. Unit should lift 13mm from ground (1/2 inch).

(8) Last stabilizer down needle valve 1-1/2 to 2 turns open

(9) Stabilizer speeds set 6 to 10 sec. retract 4 to 8 sec.

(10) Platform lowering pressure reducing relief 124 BAR (1800 psi)

(11) Platform pilot needle valve 1 to 2 turns open

(12) Parking brake release pressure 76 BAR (1100 psi) stabilizer up, parking brake off to set

(13) Bridge speeds unloaded full extension up 29 to 34 sec. down 19 to 24 sec.

(Main Deck) unloaded full extension up 48 to 53 sec. down 29 to 34 sec.

(14) Bridge flow control and counterbalance valve adjustments
travel level up .25"
travel level down .25"

(15) Bridge counterbalance valve pressure down
lower lobe 1250 to 1350 psi

(Option) main deck 1700 to 1800 psi

(16) Main deck pilot needle valve bridge 1/4 to 1/2 turn open to stop bridge bounce when lowering readjustable at load

(17) Platform speeds unloaded full extension up 17 to 22 sec. down 10 to 15 sec.

(18) Fast speed delay control (30 inches spd. shift) smooth spd. shift from slow to fast readjustable at load no bounce

(19) Cab extend and retract speeds 14 to 20 sec.

(20) Bridge tilt speeds (optional) up and down 2 to 3 sec.

(21) Bridge guide speeds left and right 3 to 7 sec.

(22) Bogy wheel speeds up and down 3 to 8 sec.

(23) Power wing speeds (optional) adjustable for smooth operation no sticking or binding

(24) 135" Left door wing needle valve 1/8 to 1/4 turn open for last up and down of cycle (optional)

(25) Set guide pilot relief valve to insure smooth auto guide function down

(26) Lifting unit slides (side to side) with in 2mm of difference

(27) Lifting unit chains adjusted to full down so plat. rests on frame bed

(28) Lifting unit chains perpendicular to frame and parallel to lift cylinders

(29) All conveyor chains adjusted to 2% slack

B. Electrical Adjustments

(1) Adjust all proximity switches per specifications (see Adjustment Procedures and Schematics)

(2) Drive speed pot adjustments (set ramp first) (see Adjustment Procedures Section 2-2 Page 31)

SECTION 4. SHIPPING

1. GENERAL

This section contains general information on preparation of the loader for transportation by surface or air. Check regulations of the states and/or countries through which the loader will be transported for specific requirements such as dimensional limitations, whether or not the loader can be transported with fuel, etc.

Review storage requirements (section 5) for information on protection that may be required if time enroute is expected to be more than two or three days.

2. SURFACE TRANSPORTATION

Refer to section 1-3 (specifications) for weight and dimensions of the loader to determine the load carrying requirements for the vehicle to be used for transportation.

To comply with surface transportation standards, it is recommended that the operator's platform and ladder be removed for transport. When lifting loader for transport, use longer length cables or chains on the rear chassis than on the front of unit. This is to enable the loader to lift evenly off the surface from its center of gravity (Fig. 1).

Insert bogy wheel pins ONLY when LIFTING unit from the surface. Remove pins before operating or towing unit. The power module pin should also be secured prior to positioning loader onto a vehicle.

Restrain the loader with universal tie-down straps, chains and over center tensioning devices, and chocks. Do not route tie-downs across handrails or ladders. See figure 1 for tie-down location and use a cross tie method when securing vehicle. Do not use tie-down hooks for towing or lifting of loader.

Inspect all attaching points to insure that the restraints are secure, and that straps (if used) do not bear against angular surfaces that may cause failure enroute due to chafing or vibration.

Check for presence of any loose items. If necessary, pack the items separately and place in a secure location.

3. AIR TRANSPORTATION

Depending on type of aircraft used for transportation, it may be necessary to remove the operator's platform and ladder prior to transporting the loader.

If the operator's platform and ladder is removed from the loader, cover all hydraulic line connectors with protective caps, plugs, or tape. Secure lines and electrical conductors to prevent damage during transportation.

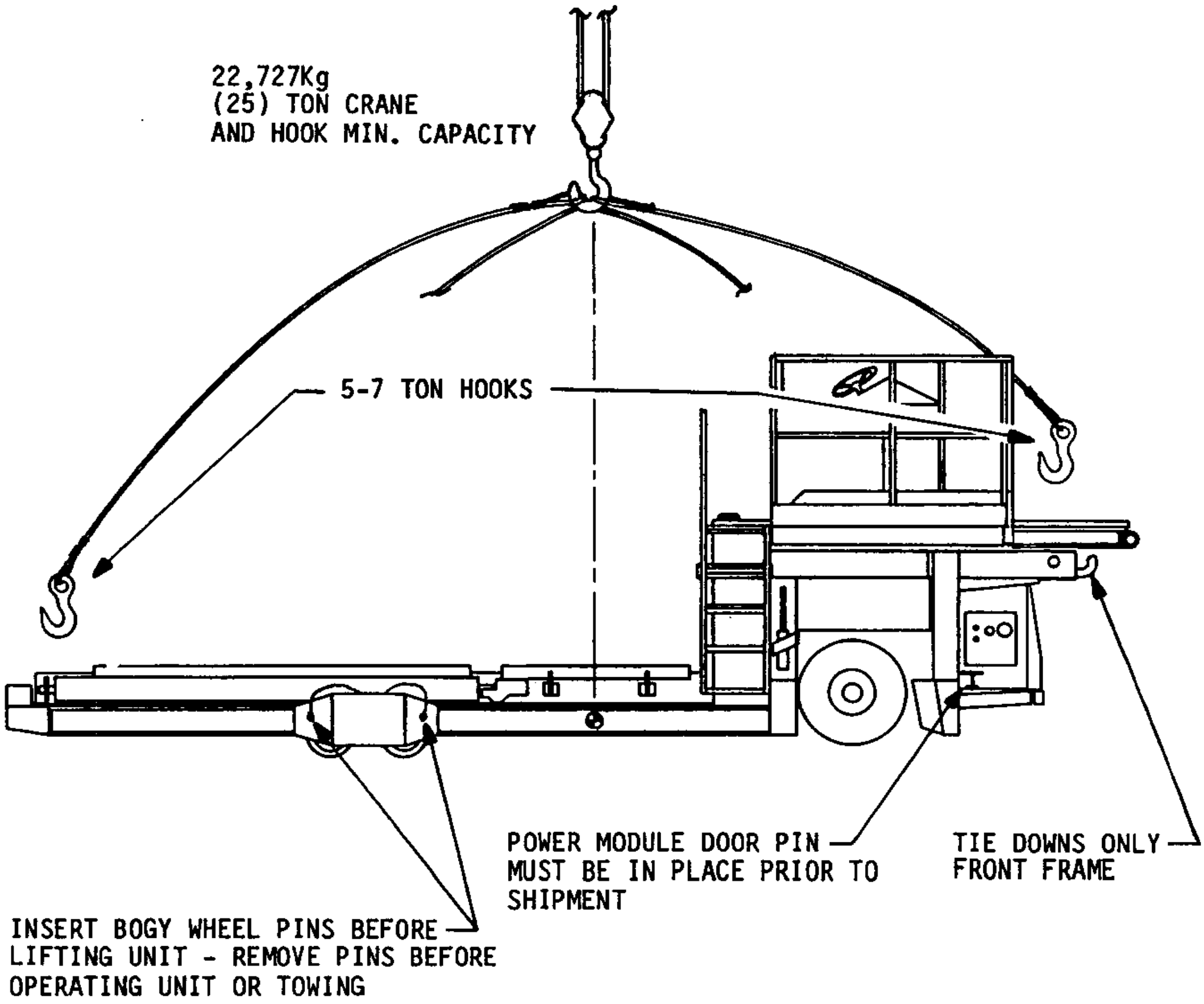
If the loader is to be towed aboard the aircraft, insure that the hub drives are disengaged (section 6) and bogy wheel pins are removed before the loader is towed or operated.

Restrain the loader with universal tie-down straps, chains and over center tensioning devices, and chocks. Do not route tie-downs across handrails or ladders. See figure 1 for tie-down location and use a cross tie method when securing vehicle. Do not use tie-down hooks for towing or lifting of loader.

Inspect all attaching points to insure that the restraints are secure, and that straps (if used) do not bear against angular surfaces that may cause failure enroute due to chafing or vibration.

Check for presence of any loose items. If necessary, pack the items separately and place in a secure location.

CAUTION: LIFT UNIT ONLY ON POINTS INDICATED ON FIGURE 1. FAILURE TO USE DESIGNATED LIFT POINTS WILL RESULT IN EQUIPMENT DAMAGE.



SHIPPING
Figure 1

SECTION 5. STORAGE

1. SHORT TERM STORAGE (1 MONTH MAXIMUM)

   A. Perform all periodic maintenance services that are due as prescribed in chapter 2.

   B. Chock drive wheels front and rear to prevent movement in any direction.

   C. Disconnect and remove two 12-volt batteries and store in cool, dry location.

      NOTE: For 72-volt power plant, disconnect, but do not remove, 72-volt battery assembly. If battery assembly is not fully charged, charge it.

   D. Coat all exposed unpainted metal surfaces with rust preventative. Especially important are exposed hydraulic cylinder rods, roller chains, sprockets, and lift chains.

2. LONG TERM STORAGE

   Ideally, the loader should be stored in a shelter to protect it from the weather. If a shelter is not available, use protective material such as tarpaulins, plastic sheets, etc., to cover the loader.

      NOTE: Refer to the manufacturer's manual (chapter 5) for procedures to be performed for engine preservation.

   A. Perform all periodic maintenance services that are due as prescribed in chapter 2.

   B. Raise and block chassis so that all wheels are off ground.

   C. Disconnect and remove two 12-volt batteries and store in cool, dry location.

      NOTE: For 72-volt power unit, disconnect, but do not remove battery assembly. If battery assembly is not fully charged, charge it. Check charge level every 30 days, and recharge as necessary.

   D. Coat all exposed unpainted surfaces with rust preventative. Especially important are exposed hydraulic cylinder rods, roller chains, sprockets, and lift chains.

   E. If shelter is not available, cover bridge and platform with tarpaulins or other protective material. Cover and tape instrument panels to provide a moistureproof seal.

SECTION 6. EMERGENCY PROCEDURES

1. DEPARTING AIRCRAFT

Use these procedures if an engine-driven or 72-volt power unit fails, or if the main hydraulic pump fails.

CAUTION: DO NOT OPERATE ELECTRICAL PUMP CONTINUOUSLY FOR MORE THAN 1 MINUTE. OPERATION FOR MORE THAN 1 MINUTE WILL OVERHEAT MOTOR AND MAY CAUSE DAMAGE. IF EMERGENCY PROCEDURES CANNOT BE COMPLETED WITHIN 1 MINUTE, WAIT AT LEAST 10 MINUTES TO ALLOW MOTOR TO COOL, THEN CONTINUE.

A. Ensure the OFF-ON start switch is in the ON position

B. Open electrical pump switch guard, jog the switch and note that pump starts.

CAUTION: ENERGIZE THE EMERGENCY POWER UNIT ONLY WHILE OTHER SWITCHES ARE TURNED ON. CONTINUOUS OPERATION WHILE NOT IN USE CAUSES THE ELECTRIC MOTOR TO OVERHEAT UNNECESSARILY.

C. Actuate joystick switches ONLY TO REMOVE cargo from loader to aircraft or to a ground vehicle. DO NOT CONTINUE LOADING.

D. Raise bridge slightly, to disengage optional auto tracking sensor if engaged.

E. Set platform lift switch in lower position until platform stops automatically.

F. Slightly retract operator's platform to clear aircraft when bridge is lowered.

G. Position bridge to allow cargo door to be closed and secured.

CAUTION: CLOSE AND SECURE CARGO DOOR CAREFULLY. FAILURE TO USE CARE MAY RESULT IN DAMAGE TO AIRCRAFT OR LOADER.

H. Chock drive wheels to prevent movement until tow vehicle is properly attached.

I. Set stabilizers switch to retract position. Note stabilizers retract and indicator light goes out.

J. Close electrical pump switch guard and note that pump stops.

K. Set OFF-ON-START switch to OFF.

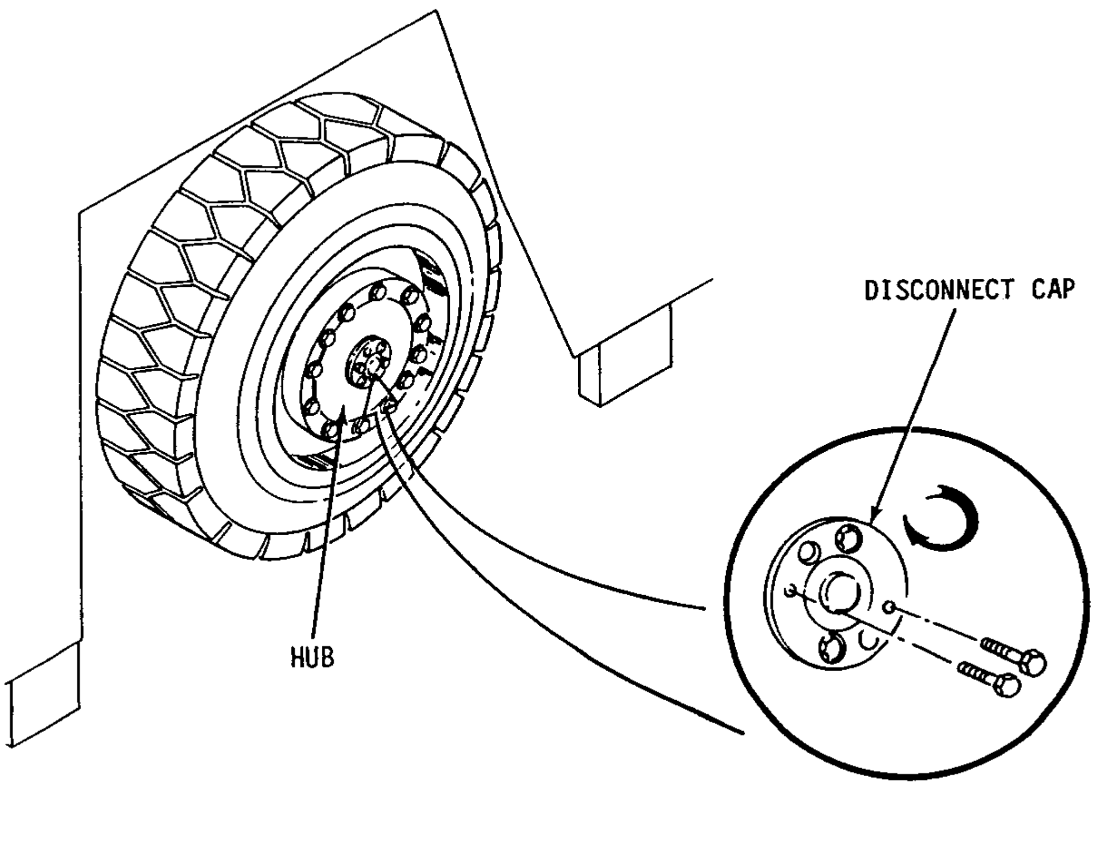
NOTE: See instructions on Page 6 Section 1-6 for OPTIONAL-MANUAL-PUMP, EMERGENCY PROCEDURES.

CAUTION: DISCONNECT BATTERY BEFORE TOWING LOADER.

WARNING: BEFORE DISENGAGING HUB DRIVES, CHOCK BOTH DRIVE WHEELS FRONT AND BACK TO PREVENT MOVEMENT IN EITHER DIRECTION. FAILURE TO DO SO MAY RESULT IN INJURY TO PERSONNEL OR DAMAGE TO EQUIPMENT.

L. Disengage hub drives (Refer to Section 1-6 Page 3, Paragraph A).

M. Tow loader from aircraft to a safe parking or maintenance area. (Refer to Towing Section 1-6 Page 3, Paragraph B).



DRIVE HUB DISENGAGEMENT AND ENGAGEMENT
Figure 1

A. Disengaging Hub Drives

<ins>WARNING</ins>: BEFORE DISENGAGING HUB DRIVES, CHOCK BOTH DRIVE WHEELS FRONT AND BACK TO PREVENT MOVEMENT IN EITHER DIRECTION. FAILURE TO DO SO MAY RESULT IN INJURY TO PERSONNEL OR DAMAGE TO EQUIPMENT.

(1) Chock drive wheels front and back to prevent movement in either direction.

(2) Remove disconnect cap (Fig. 1) on one hub by removing two screws and pulling cap away from hub.

(3) Reverse position of cap so that nipple faces inward, place against hub, then install and tighten the screws.

(4) Repeat (2) and (3) above for other hub.

B. Towing

<ins>WARNING</ins>: DO NOT EXCEED 11 KPM (7 MPH) WHEN TOWING LOADER. EXCEEDING SPEED LIMIT MAY CAUSE INJURY TO PERSONNEL OR DAMAGE TO EQUIPMENT.

<ins>CAUTION</ins>: TOWING LOADER WITHOUT DISENGAGING HUBS WILL SERIOUSLY DAMAGE COMPONENTS.

(1) Insure that hubs have been disengaged before proceeding.

(2) Connect tow bar between towing vehicle and loader.

(3) Remove chocks and tow loader to desired location.

(4) Upon arrival at selected location, immediately chock drive wheels and disconnect tow bar.

(5) Engage hub drives (Para. D.) as soon as possible.

<ins>WARNING</ins>: IF HUB DRIVES ARE NOT IMMEDIATELY ENGAGED, PLACE SUITABLE WARNING SIGN ON LOADER TO INSURE THAT ALL PERSONNEL ARE AWARE OF THE CONDITION. FAILURE TO OBSERVE THIS WARNING MAY CAUSE INJURY TO PERSONNEL OR DAMAGE TO EQUIPMENT.

C. Lift Towing

(1) Insure stabilizers are retracted and drive hubs are disengaged before proceeding.

(2) Locate (Steering Lock Arm Weldment" in wheel well on operator side of loader. Remove pin from stow position and pivot arm weldment to the steering lock position. Replace pin to secure. (Fig. 2)

(3) Insert bogy wheel pins before lifting to tow loader. Remove pins to stow position when towing is complete and loader is lowered onto surface.

WARNING: DO NOT ALLOW PERSONNEL DIRECTLY IN FRONT OF LOADER. KEEP AREA CLEAR DURING LIFTING PROCEDURES.

(4) Use a minimum 10 ton lift capacity tow truck and raise loader from rear chassis a maximum of 0.45m (1 1/2 ft.). Inspect front of loader from operator side of loader for ground clearance.

(5) Slowly tow loader to maintenance location.

(6) Upon arrival at selected location, lower loader onto ground surface and immediately chock drive wheels; stow bogy wheel pins and "Steering Lock Arm Weldment".

D. Engaging Hub Drives

WARNING: BEFORE ENGAGING HUB DRIVES, CHOCK BOTH DRIVE WHEELS FRONT AND BACK TO PREVENT MOVEMENT IN EITHER DIRECTION. FAILURE TO DO SO MAY RESULT IN INJURY TO PERSONNEL OR DAMAGE TO EQUIPMENT.

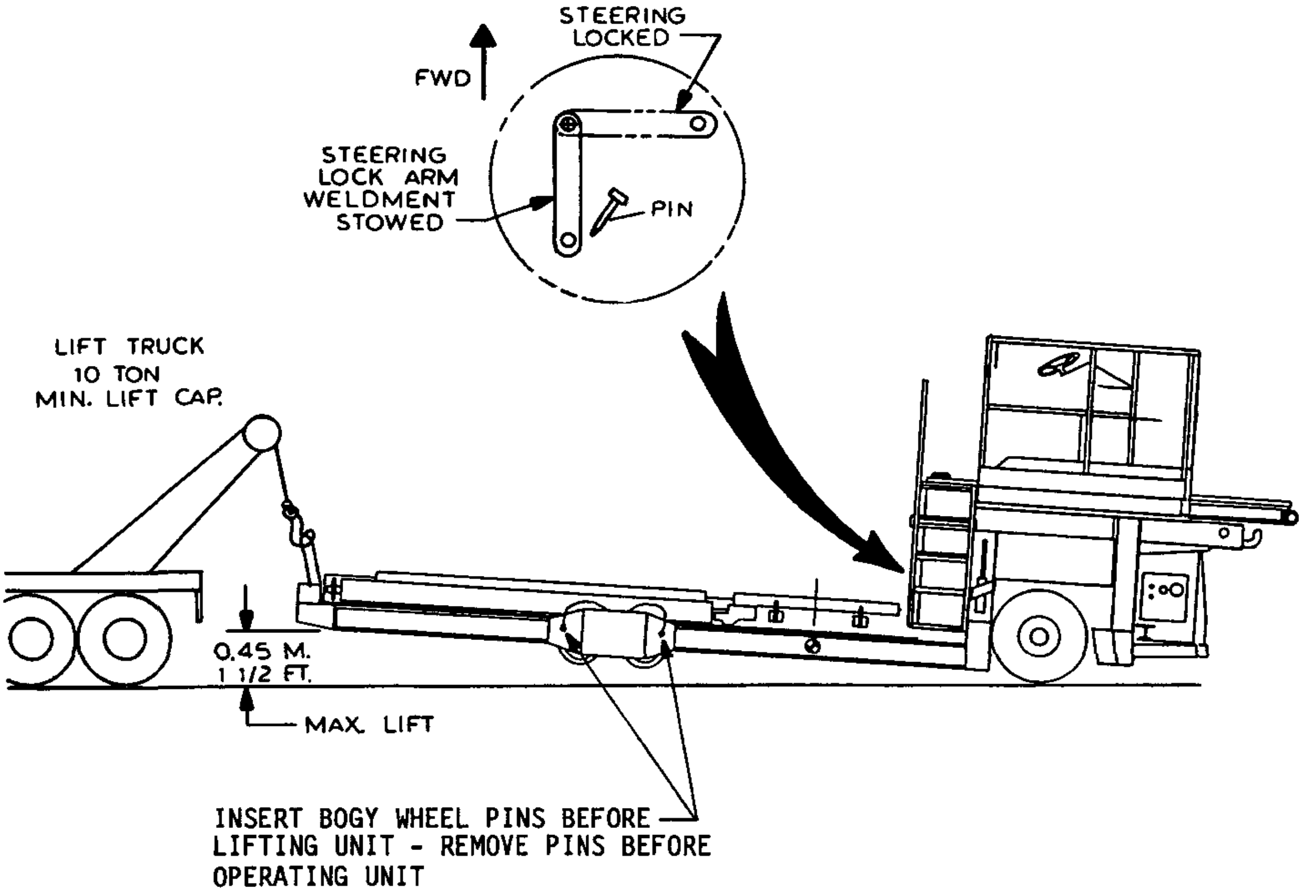
(1) If wheels are not already chocked, chock them front and back.

NOTE: When performing step (2) below, remove cap slowly to prevent disconnect rod from coming out of hub.

(2) Remove disconnect cap (Fig. 1) on one hub by removing tow screws and slowly pulling cap away from hub.

(3) Reverse position of cap so that nipple faces outward, place cap against hub, then screw and torque to 7.9 to 9.0 newton - meters (70-80 lb-in.).

(4) Repeat steps (2) and (3) for other hub.



LIFT TOWING
Figure 2

2. <u>MANUAL EMERGENCY PUMP (OPTIONAL)</u>

The manual emergency pump may be used in the event that the electrically driven emergency pump fails. Reference should be made to Page 1 Section 1-6 Item A through K, with exception to the emergency pump switch. To operate any function it is necessary to actuate the appropriate control switch while actuating the manual emergency pump with firm deliberate strokes.

<u>WARNING</u>: DO NOT ALLOW PERSONNEL UNDER BRIDGE OR PLATFORM UNLESS ADEQUARE SUPPORTS ARE IN PLACE. FAILURE TO SUPPORT BRIDGE OR PLATFORM MAY ALLOW THEM TO FALL, RESULTING IN DEATH OR INJURY TO PERSONNEL AND/OR DAMAGE TO EQUIPMENT.

In the event of an electrical failure, the solenoid valves to raise the stabilizers (6SOL & 11SOL) may be manually actuated while actuating the manual emergency pump; <u>USE EXTREME CAUTION</u>.

<u>NOTE</u>: For platform lowering, the sequencing valve 20SOL-B located to the right of the lift cylinder mechanism should be actuated. This procedure applies if Commander has platform sequencing.

To actuate 20SOL-B, pull out on knurled knob and twist to lock in the actuated position. To lower platform, actuate 22SOL while actuating manual emergency pump; <u>USE EXTREME CAUTION</u>. Do not forget to reset the sequencing valve 20SOL-B.

CHAPTER 2

TABLE OF CONTENTS

Maintenance (Continued)

Maintenance (Continued)	Chapter/ Section	Page

REFERENCE DESIGNATORS

CHAPTER 2

LIST OF FIGURES

CHAPTER 2 MAINTENANCE

SECTION 1. SERVICING

1. NEW EQUIPMENT CHECK LIST

CHECK LIST	CHECK (√)
Perform walk around inspection and check for obvious damage, missing parts, and fluid leaks.	
Check power unit fluid levels (fuel, oil, coolant for engines; electrolyte for batteries). Fill to specified level as required.	
Check level of oil in hydraulic reservoir.	
Check operator's access ladder for security.	
Check all handrails and mounting brackets. Lubricate latches.	
Check lights and turn signals.	
Check horns.	
Check accelerator and brake mechanisms for ease of operation.	
Retorque front drive wheels to 230-244 Newton-Meters (170-180 foot pounds).	
Check tire inflation, 9.30 bar (135 PSI)	
Check roller assemblies for damage.	
Check leaf chains on lift mechanism for lubrication.	
Check platform guides (stops) for lubrication.	
Start power unit. Check gauges and indicators for indication of proper operation, THEN MAKE OPERATIONAL CHECK OF UNIT.	
Stabilizers, Extend and Retract	
Parking Brake, Released and Applied.	
Cab, Extend and Retract	

CHECK LIST			CHECK (✓)
Bogy wheels, Extend and Retract			
Bridge Guides, Left and Right			
Bridge, Raise and Lower			
Platform, Raise and Lower			
Bridge Convey	Left & Right		
	Fwd & Aft		
Platform Convey Front Section)	Left & Right		
	Fwd & Aft		
(Rear Section)	Left & Right		
	Fore & Aft		
Container Rotation	Clockwise		
	Counterclockwise		
Bridge Tilt	Left & Right		
Platform Forward Load Stop			
Bridge Forward Load Stop			
Platform Guides (Raise and Lower)		Left Side	
		Right Side	
		Rear	
Bridge Folding Wings (Raise and Lower)		Left Side	
		Right Side	
Extension Deck (Optional)	Lift, (Raise and Lower)		
	Convey, Fwd & Aft		
	Rear Stop, (Up & Down)		
	Forward Stop, Up and Down		
Propulsion - Forward & Reverse			
Brakes	Service		
	Parking		
	Dynamic		
Steering			
Aircraft following			

CHECK LIST	CHECK (√)
Inspect all hydraulic hoses and fittings for leaks.	
Inspect all hydraulic motors for fluid leakage.	
Inspect steering valve for fluid leakage.	
Inspect scissors pivot pins and rollers for lubrication.	
Inspect pivot points of forward platform lift cylinders for lubrication.	
Inspect operator's cab slides and rollers for lubrication.	
Inspect all wiring harnesses and wires for security.	
Inspect roller assembly chains for correct tension and lubrication.	
Check emergency pump operation.	
Check oil level in planetary gear torque hubs.	
Make performance checks. (See performance specifications)	
BATTERY POWERED UNITS	
Check all batteries for clean connections and fluid levels	
Clean and remove any corrosion or foreign particles from batteries.	
Check 72V-DC motor for correct operating RPM.	
Low Speed - 1500 RPM	
High Speed - 1800 RPM	

2. PERIODIC MAINTENANCE

Regular maintenance is required to insure optimum loader performance and long life for machine components. Maintain a loader by performing periodic maintenance at the intervals listed in the periodic maintenance table.

If a loader is being operated in severe weather conditions, such as extreme heat or cold, or in sandy, dusty, or snowy areas, increase the frequency of periodic maintenance as necessary.

PERIODIC MAINTENANCE

PROCEDURE	PERIOD (HOURS)			
	8	50	100	OTHER
Perform walk around inspection and check for obvious damage, missing parts and fluid leaks.	X			
Check condition of drive wheel tires.	X			
Check tire inflation, 9.30 bar (135 PSI)	X			
Check condition of bogy wheel tires.	X			
Check power unit fluid levels. Fuel engine oil and engine coolant.	X			
Check batteries for clean connections and correct electrolyte level	X			
Check "POP-UP" indicator on hydraulic filter; replace filter element if indicator is "UP".	X			
Check fluid level in hydraulic reservoir.	X			
Check condition of operator's access ladder and mounting.	X			
Check condition of all hand rails and mounting brackets.	X			
Check all lights and turn signal operation	X			
Check horn operation	X			

PERIODIC MAINTENANCE

PROCEDURE		PERIOD (HOURS)			
		8	50	100	OTHER
Start power unit. Check gauges and indicators for indication of proper operation		X			
Check platform edge rollers for damage and drive couplings for being secure.		X			
MAKE OPERATIONAL CHECK OF UNIT					
Stabilizers, Retract and Extend		X			
Parking Brake, Released & Applied		X			
Cab, Extend & Retract		X			
Bogy Wheels, Retract and Extend		X			
Bridge Guides, Left and Right		X			
Bridge, Raise and Lower		X			
Bridge Convey	Left & Right	X			
	Fwd & Aft	X			
Platform Convey (Front Section)----------	Fwd & Aft	X			
	Left & Right	X			
(Rear Section)-----------	Left & Right	X			
	Fwd & Aft	X			
Container Rotation	Clockwise	X			
	Counterclockwise	X			
Bridge Tilt	Left & Right	X			
Platform Forward Load Stop		X			
Platform Guides	Raise & Lower				
	Left Side	X			
	Right Side	X			
	Rear	X			
Folding Wings	Raise & Lower				
	Left Side	X			
	Right Side	X			

PERIODIC MAINTENANCE

PROCEDURE	PERIOD (HOURS)			
	8	50	100	OTHER
Extension Deck				
Lift----------Raise & Lower	X			
Convey--------Fwd & Aft	X			
Rear Stop-----Up & Down	X			
Propulsion Forward & Reverse	X			
Brakes				
Service	X			
Parking	X			
Dynamic	X			
Steering	X			
Demand throttle operation	X			
Emergency pump operation	X			
Inspect for fluid leaks upon completion of operational check.	X			
Check all roller assemblies for condition, missing parts or damage.		X		
Check aircraft following for proper operation.		X		
Check access door latches for ease of operation and lubricate.		X		
Lubricate all pivot points on platform guides. (stops)		X		
Check oil level in planetary gear hubs.		X		Change after 1st. 50 hours of operation and every 1000 hours thereafter.
Check scissors pivot pins and rollers for wear. Lubricate		X		
Check leaf chains on platform lift mechanism for wear & correct adjustment. Lubricate chains.		X		

PERIODIC MAINTENANCE

PROCEDURE	PERIOD (HOURS)			
	8	50	100	OTHER
Inspect condition of all hydraulic hoses and fittings and check for leakage.			X	
Inspect all hydraulic components for fluid leakage.			X	
Inspect pivot pins on bridge lift cylinders for wear and lubricate.			X	
Inspect HeliRoll and roller assemblies for damage and wear.			X	
Inspect accelerator and brake assemblies for wear. Lubricate pivot points.			X	
Inspect operator's cab slides and rollers for wear. Lubricate			X	
Inspect all wiring harnesses for damage and security.			X	
Check all wiring terminals for being secure			X	
Check chain tension on all HeliRoll and roller shafts. Lubricate chains.			X	
Replace engine oil, fuel and air filters				Refer to engine manufacturer's recommendations (Chapter 5)
Check engine and service				Refer to engine manufacturer's recommendations on service intervals and procedures (Chapter 5)
Replace hydraulic reservoir breather				Annually
Change oil in hydraulic reservoir and replace filter element.				Annually

PERIODIC MAINTENANCE

PROCEDURE	PERIOD (HOURS)			
	8	50	100	OTHER
Replace filter element				Whenever indicator is "UP"
Make performance check				Annually
BATTERY POWERED UNITS				
Check all batteries for clean connections and correct electrolyte level	X			
Clean batteries and remove any corrosion on terminals			X	
Check electric motor for correct operating speeds.			X	
Check electric motor for brush wear and excessive vibration.			X	

3. COMMANDER LOADER PERFORMANCE SPECIFICATIONS

ENGINE SPECIFICATIONS AND OPERATING RPM

ENGINE MODEL	LOW IDLE	HIGH IDLE FULL LOAD	HIGH IDLE NO LOAD	RATED HORSE POWER
Perkins Diesel 4.236	1400 RPM	2400 RPM	2640 RPM	68 @ 2400 RPM
Deutz Diesel F4L-912D	1480 RPM	2400 RPM	2550 RPM	66 @ 2400 RPM
Deutz Diesel F4L-913D	1480 RPM	2400 RPM	2550 RPM	66 @ 2400 RPM
Ford Gas 300 Cubic Inch	600 RPM	2800 RPM	2800 RPM	101 @ 2800 RPM
Detroit Diesel 3-53N	1500 RPM	2400 RPM	2550 RPM	86 @ 2400 RPM
Onan Diesel L634 D-P	1500 RPM	2800 RPM	3010 RPM	64.3 @ 2800 RPM
Isuzu Diesel QD-60	1500 RPM	2800 RPM	3010 RPM	51 @ 2800 RPM
Electric Motor	1500 RPM, Low Speed		1800 RPM, High Speed	

PROPULSION SPEEDS	(Time to travel over 100 measured feet)
Snail Mode	60 to 70 Seconds 30 Meters (100 feet)
Turtle Mode	20 to 24 Seconds 30 Meters (100 feet)
Rabbit Mode	10 to 12 Seconds 30 Meters (100 feet)

BRAKES (SERVICE)

Must stop loader in 4.5 meters (15 feet), or less, from full speed. (Rabbit Mode)

BRAKES (DYNAMIC)

Must stop loader within 10.5-12 meters (35-40 feet) from full speed. (Rabbit Mode)

BOGY WHEELS

Extend and Retract	3 to 8 Seconds

STABILIZERS

Extend	6 to 10 Seconds
Retract	4 to 8 Seconds

NOTE: Right center stabilizer is last stabilizer to extend and retract, this stabilizer MUST lag by 2 to 3 seconds.

BRIDGE SPEEDS, FULL EXTENSION, STANDARD LOADER

Bridge Raise	29 to 34 Seconds
Bridge Lower	19 to 24 Seconds

BRIDGE SPEEDS, FULL EXTENSION, MAIN DECK CAPABILITY

Bridge Raise	48 to 53 Seconds
Bridge Lower	29 to 34 Seconds

BRIDGE TRANSFER SPEEDS

Forward and Aft	60 Feet Per Minute (39-41 RPM)
Side Transfer	30 Feet Per Minute (19-21 RPM)

PLATFORM SPEEDS

PLATFORM SPEEDS, FULL EXTENSION, STANDARD LOADER

Platform raise	17 to 22 Seconds
Platform Lower	10 to 15 Seconds

PLATFORM SPEEDS, FULL EXTENSION
(HIGH SPEED PLATFORM OPTION)

Platform Raise	15 to 16 Seconds
Platform Lower	10 to 15 Seconds

PLATFORM TRANSFER SPEEDS

All Transfer Speeds (39-41 RPM)	60 Feet Per Minute

CAB

Extend and Retract	14 to 20 Seconds

BRIDGE GUIDES

Side to Side	3 to 7 Seconds

BRIDGE TILT CYLINDERS

Extend and Retract	2 to 3 Seconds

4. HYDRAULIC OIL RECOMMENDATIONS

Use Mobile DTE series, or equivalent, for temperatures listed below in the Commander loader:

In the Commander loader:

OIL	OIL OPERATING TEMPERATURE RANGE
MOBILE DTE 11M	-18°C to 60°C (0°F to 140°F)
SEVERE HOT WEATHER OPERATION	
MOBILE DTE 13M	-7°C to 79°C (20°F to 175°F)

Mobile DTE 13M is to be used only when maximum oil operating temperature exceeds 60°C (140°F)

SEVERE COLD WEATHER OPERATION

MIL-5606	-32°C to 49°C (-25°F to 125°F)

MIL-5606 is to be used only when minimum oil temperature is below -18°C (0°F).

5. LUBRICATION

A. Grease Points (fig. 1)

Wipe grease fittings clean and apply EP lithium base NLGI Grade 1 or 2 grease. Before coating other surfaces with grease, clean surfaces to remove dirt and foreign material.

B. Pivot Points and Chains (fig. 2)

Apply SAE 30 oil with brush or oil can as appropriate.

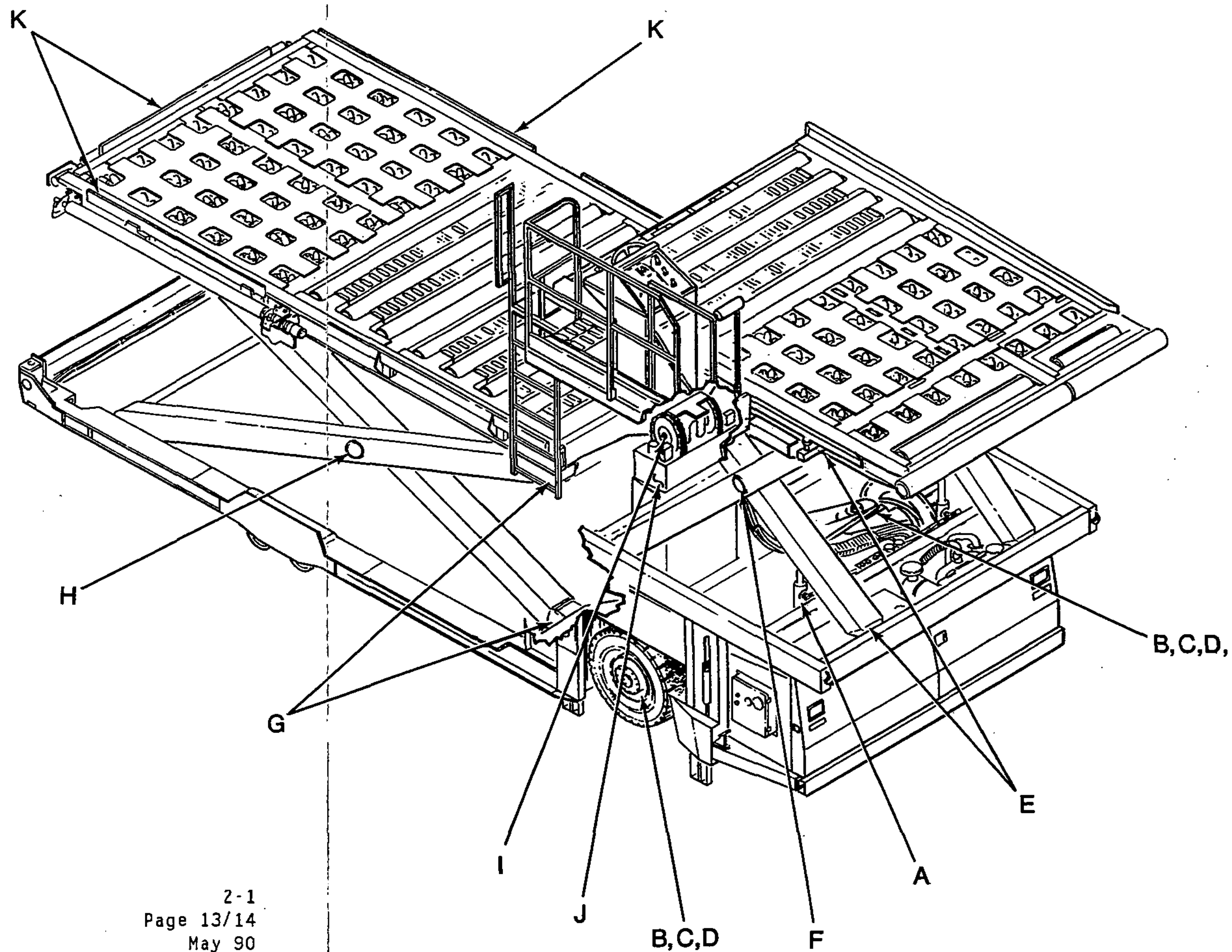
C. Fill Points (fig. 3, 4)

Refer to Fig. 3 for locations of fill points for hydraulic oil reservoir and drive wheel hubs.

GREASE

NOTE: Q = QUARTERLY, S = SEMIANNUALLY, A = ANNUALLY. CHECK AT INTERVALS LISTED AND LUBRICATE AS REQUIRED. IN UNUSUAL WEATHER CONDITIONS, CHECK AT MORE FREQUENT INTERVALS.

GREASE POINTS		
ITEM-DESCRIPTION	TOTAL FITTINGS	INTERVAL
A - Bridge lift cylinders (top and bottom)	4	S
B - Steering pivot bearings (top and bottom each side)	4	Q
C - Tie rod	2	Q
D - Power steering cylinder (rod end)	1	Q
E - Bridge scissors (upper & lower front pivot points)	4	S
F - Bridge scissors (midpoint)	2	S
G - Platform scissors (upper & lower front pivot points)	4	S
H - Platform scissors (midpoint)	2	S
I - Platform leaf chain sheaves (top & bottom)	4	S
J - Platform lift assembly slides. Apply light coat of grease to sliding surfaces.	-	S
K - Platform guides (left, rear, right). Apply light coat of grease to three ramps on each.	9	S

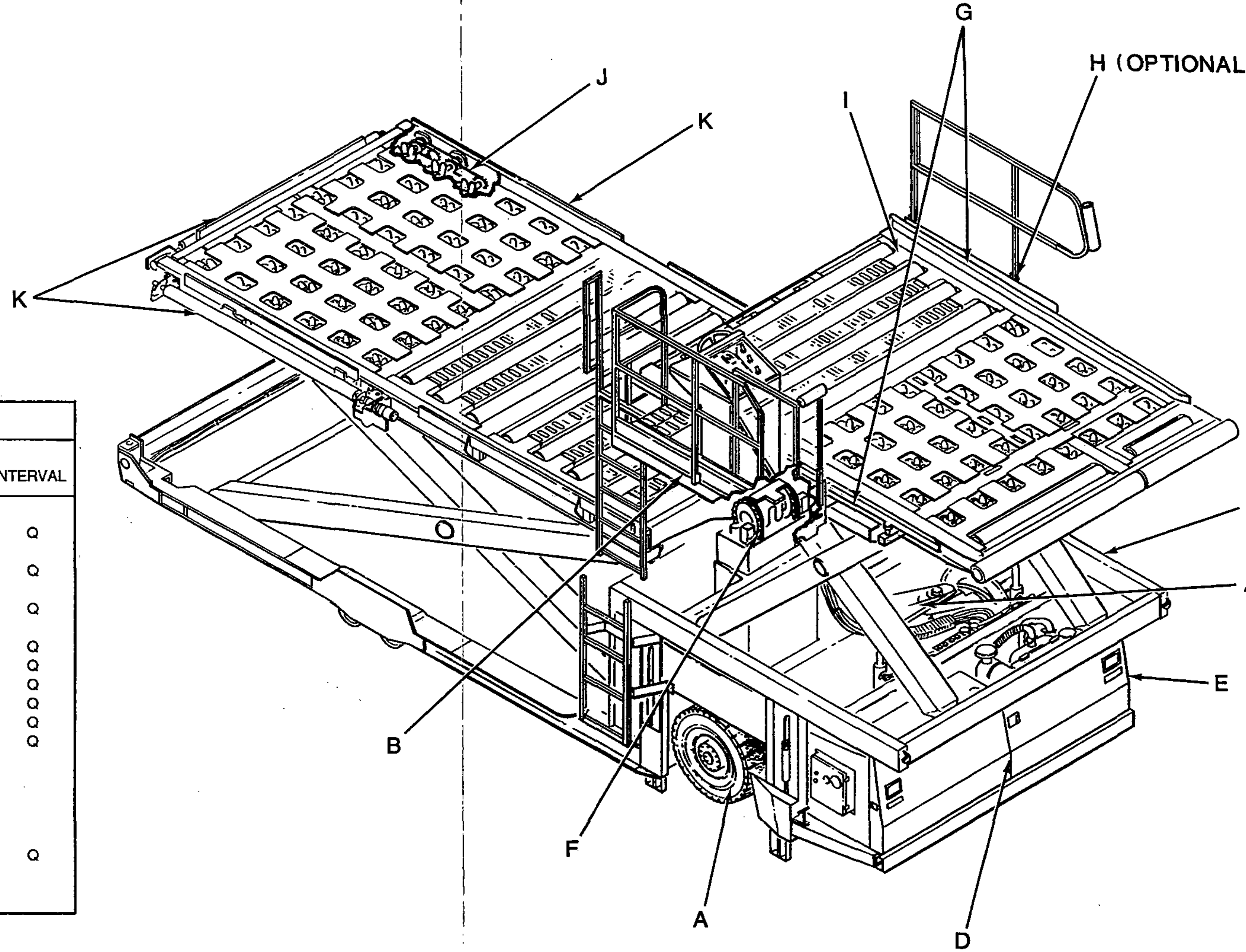


LUBRICATION LOCATIONS
Figure 1

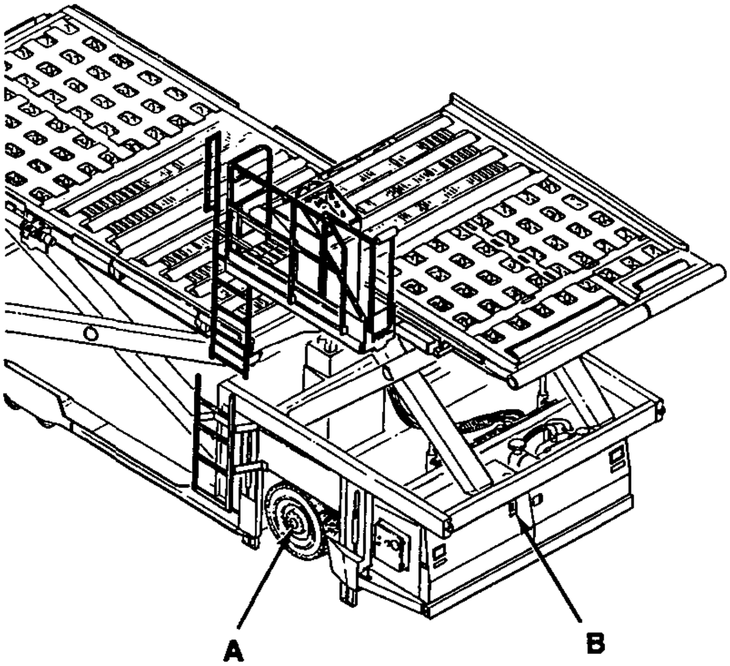
NOTE: Q = QUARTERLY, S = SEMIANNUALLY, A = ANNUALLY. CHECK AT INTERVALS LISTED AND LUBRICATE AS REQUIRED. IN UNUSUAL WEATHER CONDITIONS, CHECK AT MORE FREQUENT INTERVALS.

OIL

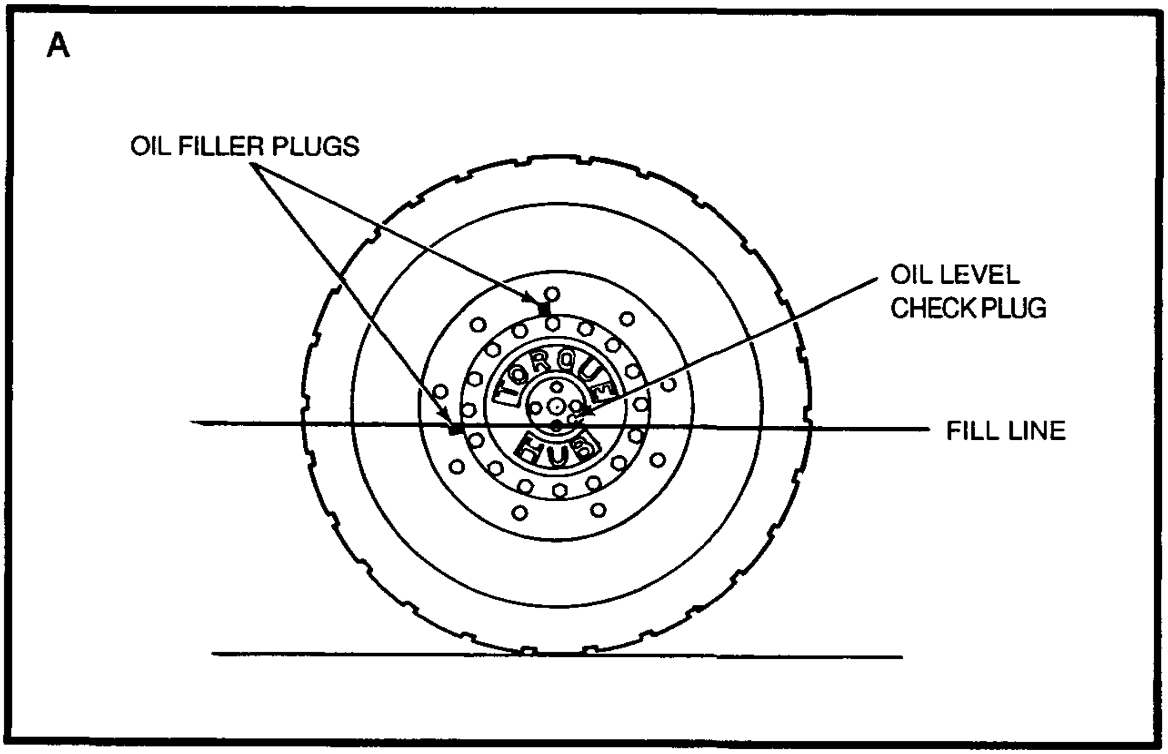
OIL POINTS		
ITEM-DESCRIPTION	TOTAL FITTINGS	INTERVAL
A - Power steering cylinder pivot point	1	Q
B - Operator's platform hydraulic cylinder pivot points	2	Q
C - Power unit module pivot pins (2)	2 ea.	Q
D - Access panel hinge	1	Q
E - Access panel hinges	1	Q
F - Leaf chains	4	Q
G - Bridge side guide pivot points	4	Q
H - Bridge handrail hinge points	2	Q
I - Bridge roller chains (qty. varies with features supplied)		Q
J - Platform roller chains (qty. varies with features supplied)		
K - Platform guide hydraulic cylinder pivot points (left, rear, and right)	6	Q



LUBRICATION LOCATIONS
Figure 2

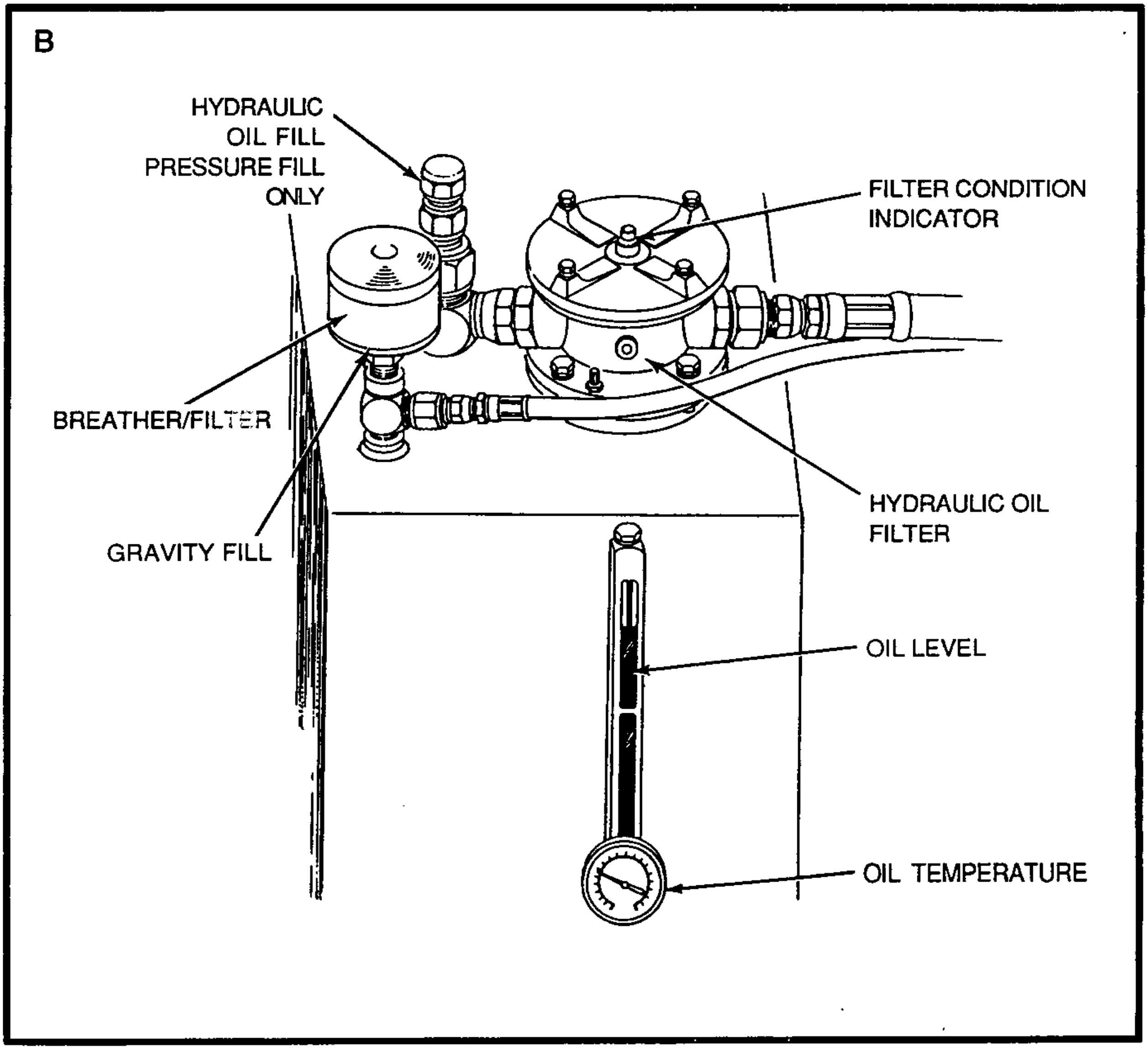


FILL



FILL POINTS
Figure 3

FILL



FILL POINTS
Figure 4

SECTION 2 ADJUSTMENT PROCEDURES

WARNING: BEFORE STARTING ANY ADJUSTMENT PROCEDURE THAT WOULD REQUIRE THE PLATFORM TO BE IN AN ELEVATED POSITION, MOVE THE MAINTENANCE STANDS INTO POSITION AND LOWER THE PLATFORM FULLY AGAINST THE MAINTENANCE STANDS. DRIVE WHEELS MUST BE CHOCKED TO PREVENT MOVEMENT OF THE LOADER IN EITHER DIRECTION.

IT IS MANDATORY THAT EYE PROTECTION (SAFETY GOGGLES OR FACE SHIELD) BE WORN WHEN MAKING PRESSURE CHECKS AND/OR ADJUSTMENTS ON THE HYDRAULIC SYSTEM. HYDRAULIC OIL WILL CAUSE EYE INJURIES. IF HYDRAULIC OIL GETS ON THE SKIN, WASH AFFECTED AREA IMMEDIATELY TO AVOID IRRITATION.

WHEM MAKING PRESSURE CHECKS OR ADJUSTMENTS, USE GAUGES WITH KNOWN ACCURACY. IMPROPER HYDRAULIC ADJUSTMENTS CAN CAUSE INJURY TO PERSONNEL OR DAMAGE TO EQUIPMENT.

DO NOT REMOVE GAUGE PORT PLUGS, GAUGES OR LOOSEN HYDRAULIC CONNECTIONS WITH THE POWER UNIT RUNNING. HYDRAULIC PRESSURE IN THE SYSTEMS COULD CAUSE HYDRAULIC OIL TO SPRAY ON PERSONNEL.

CAUTION: USE EXTREME CARE TO PREVENT CONTAMINATION OF HYDRAULIC SYSTEM WHEN INSTALLING GAUGES, FITTINGS, OR REPLACING A COMPONENT. CONTAMINATION CAN RESULT IN DAMAGE TO EQUIPMENT.

WHENEVER AN ADJUSTABLE HYDRAULIC RELIEF VALVE OR PRESSURE REDUCING VALVE IS REPLACED, REDUCE THE PRESSURE SETTING PRIOR TO STARTING THE POWER UNIT. ADJUST THE REPLACED COMPONENT TO SPECIFICATION AS OUTLINED IN THE ADJUSTMENT PROCEDURES.

1. MECHANICAL INSPECTION AND ADJUSTMENT

A. Sprocket Inspection

(1) Inspect sprockets for broken teeth.

(2) Inspect for aligment and secure attachment to shafts.

NOTE: If sprockets are replaced, replace the chain also. Using an old chain on new sprockets will cause premature wear of the sprockets.

B. Roller Chain Inspection

(1) Inspect chains for elongation by comparing with a new chain. If elongation is three percent or more (three links in 100, or about 1/2 link in 17), replace the chain.

(2) Inspect chain for discoloration. Brown or red color on chain or in oil indicates presence of rust. Remove chain and inspect rollers, links, and pins. If evidence of galling, excessive wear, or corrosion exists, replace chain.

(3) Inspect chain for tension. The chain should be snug but not taut. Return side of chain should be slack. See (C) below Roller Chain Adjustment.

C. Roller Chain Adjustment

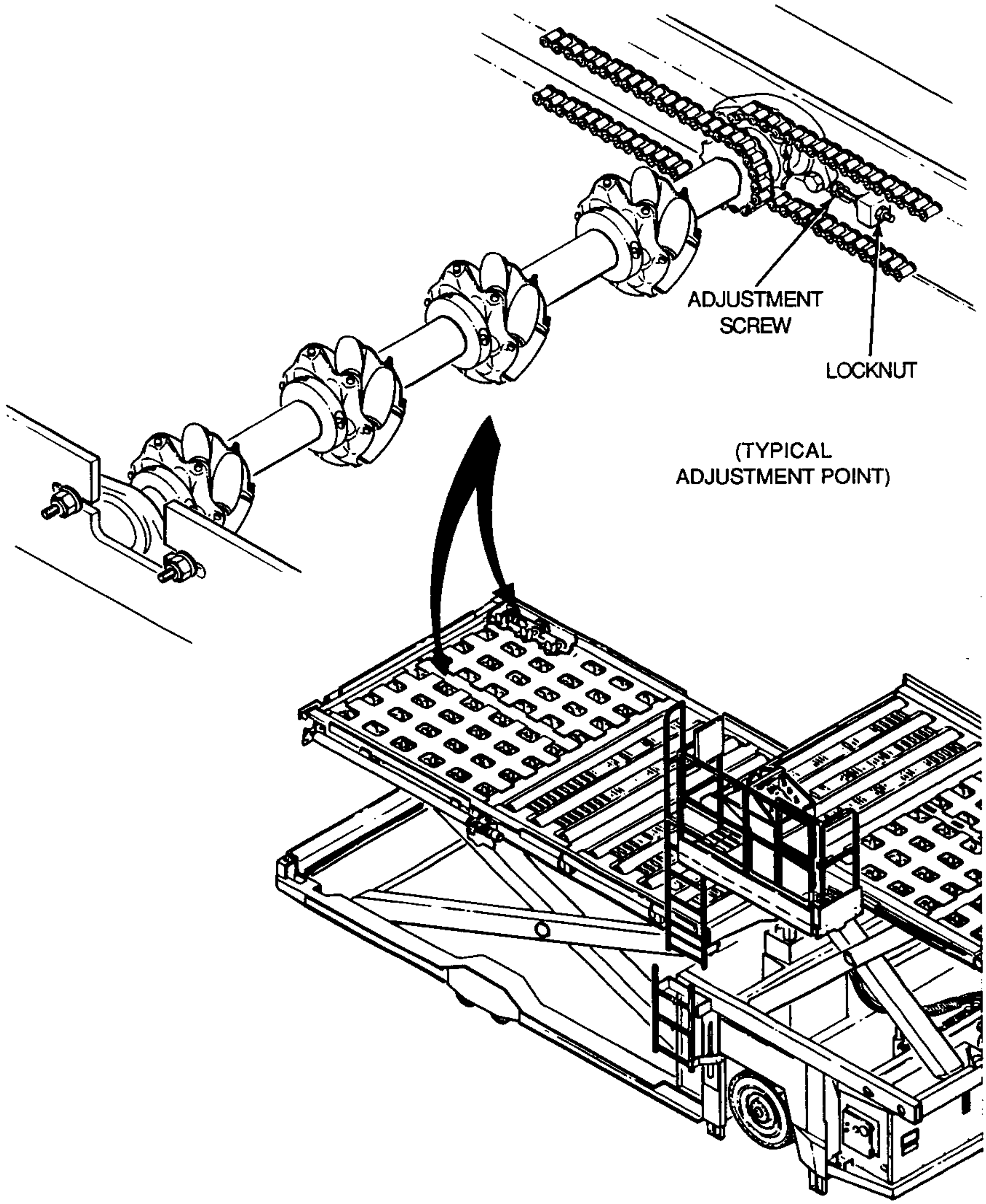
Frequent adjustment of roller chains should not be required; however, a check should be made periodically as listed in the periodic maintenance table (section 1). A general procedure is given below. After adjusting chain tension on one side, make a corresponding adjustment on the opposite side of the roller assembly to maintain sprocket/chain alignment. Note also that in some cases, movement of a roller assembly to increase tension may cause another chain to loosen. Check all chains and continue progressive adjustment until all are properly tensioned. A typical chain adjustment point is shown in Fig. 1.

NOTE: Remove deck plates as required to gain access for adjustments. To determine the proper amount of slack in a roller chain, measure the distance between the centers of the sprockets. Multiply this distance by 0.015. The result is the allowable flex of the chain at the midpoint.

Example: The distance between centers of two sprockets is 0.9 meters. To determine the amount of allowable slack, multiply 0.9 by 0.015 to get a result of 0.0135 , which is the amount of allowable slack in meters. If the distance was 36 inches, the allowable slack would be 36 multiplied by 0.015, which is 0.54, or approximately 1/2 inch.

(1) Measure distance between two sprockets of the chain to be checked, and multiply the distance by 0.015.

(2) Check up and down movement of chain at midpoint. If movement is less than calculated, go to step 3. If movement is more, go to step 7.



ROLLER CHAIN ADJUSTMENT
Figure 1

(3) Loosen locknut on adjustment screw and turn screw several turns counterclockwise. Move roller assembly to obtain slack in chain. If necessary, use plastic or rubber mallet to move roller assembly.

(4) While checking slack in chain, turn adjusting screw clockwise until proper slack is obtained, then tighten locknut.

(5) Check other side of roller assembly and adjust as required to maintain sprocket/chain alignment.

(6) Repeat procedures in step 1 through step 5 or perform procedures in step 7 through step 9 below for other chains as required.

(7) Loosen locknut on adjustment screw. While checking slack in chain, turn adjusting screw clockwise until proper slack is obtained, then tighten locknut.

(8) Check other side of roller assembly and adjust as required to maintain sprocket/chain alignment.

(9) Repeat procedures above as required for other chains.

(10) If deck plates were removed, install them.

D. LIFT MODULE REAR ASSEMBLY (Fig. 2, 3)

(1) Chain Wear Inspection

During chain operation, some metal-to-metal contact does occur, and parts eventually wear. The progressive joint wear elongates chain pitch, causing the chain to lengthen. By placing a certain number of pitches under tension, elongation can be measured. When elongation reaches the limit of 12 1/4" over any 8 pitches in areas receiving the most wear, or recommended by the manufacturer "Wear Indicator", the chain should be replaced. It is imperative that chain replacement be done in pairs.

<u>WARNING:</u> CHOCK BOTH DRIVE WHEELS FRONT AND BACK TO PREVENT MOVEMENT IN EITHER DIRECTION. FAILURE TO DO SO MAY RESULT IN INJURY TO PERSONNEL OR DAMAGE TO EQUIPMENT.

<u>WARNING:</u> DO NOT ALLOW PERSONNEL UNDER THE PLATFORM UNLESS MAINTENANCE STANDS ARE IN PLACE. FAILURE TO SUPPORT THE PLATFORM MAY ALLOW PLATFORM TO FALL, RESULTING IN DEATH OR INJURY TO PERSONNEL OR DAMAGE TO EQUIPMENT.

<u>WARNING:</u> BEFORE PERFORMING ANY MAINTENANCE OR WHILE MAKING ANY ADJUSTMENTS OR REPAIRS TO THE LOADER, IT IS MANDATORY THAT THE MASTER SWITCH BE TURNED OFF (POWER UNIT STOPPED) AND THE BATTERY PLUG DISCONNECTED FOR 72 VOLT POWERED UNITS.

<u>NOTE:</u> Park loader on level ground in a safe well lit maintenance area and extend the stabilizers.

<u>NOTE:</u> Red indicator light for parking and stabilizers should be illuminated.

(2) Secondary Chain Adjustment (Only if Required) (Fig. 2)

(a) With the rear platform full down, examine the top of the rear lift mechanism. The gap between the inner slide assembly and the outer stationary housing should be the same on both sides. If the gap is equal on both sides, go to step b. If the gap is not the same, see step c.

(b) Tighten the chain on the side with the smallest gap by rotating the secondary chain adjuster nut clockwise. Use a 38mm or 1 1/2 inch socket and 36 inch long .75 inch drive extension. The secondary chain adjuster nut is located on the front side of the secondary lift cylinders on top of the casting to which the three lift cylinders are bolted. Continue to tighten the nut until the gap is equal on the left and right sides.

(c) With an equal gap on the left and right sides between the inner slide assembly and the outer housing, tighten both the left and right secondary chain adjuster nuts one-half turn. Observe the inner slide assembly while raising the rear platform. The inner slide assembly should not shift to the side when the platformn starts to lift or when the transition between primary and secondary cylinders occur. This transition occurs when the rear platform is 74 inches above ground level. If the inner slide assembly does side shift while lifting, repeat step c. Continue to repeat this step until side shifting is eliminated. While performing this adjustment, maintain an equal gap between the left and right inner slide assembly and the outer stationary housing by tightening the secondary chain adjuster nut on the side with the smallest gap.

(d) When step c is completed, the inner slide assembly should extend no more than .25 inches above the stationary outer housing.

(e) When satisfied with inspection and adjustment, proceed to primary chain adjustment and/or platform interfacing if necessary.

E. Primary Chain Anchor Adjustment (Only if Required) (Fig. 3)

(a) Inspect for chain wear prior to primary chain anchor adjustment and insure that secondary chains are inspected and adjusted correctly.

(b) Raise rear platform and place maintenance stands in "SERVICE" position.

(c) Lower rear platform onto maintenance stands, releasing tension from chain.

(d) With power unit stopped or battery plug disconnected, loosen chain anchor nut approximately 20mm (3/4").

(e) Protect the chain anchor threads and use a hammer to drive the chain anchor forward until the end of the chain anchor is in line with the surface of the chain sheave and the chain is vertical.

(f) Inspect chain clevis pin for damage and replace if required.

(g) With maintenance stands in place, use a level to check each lift cylinder housing (forward and rear) so they are PARALLEL with each other.

(h) Tighten the chain anchor nut until it contacts the chain anchor washer. DO NOT TORQUE THE NUT. The nut prevents the chain anchor from moving forward in operation. Any torque on the nut will move the chain anchor out of adjustment.

(i) Start power unit and raise the rear platform. Do not stow the safety stands at this time.

<u>WARNING:</u> DO NOT ALLOW PERSONNEL UNDER PLATFORM UNLESS MAINTENANCE STANDS ARE IN PLACE. FAILURE TO SUPPORT PLATFORM MAY ALLOW PLATFORM TO FALL, RESULTING IN DEATH OR INJURY TO PERSONNEL OR DAMAGE TO EQUIPMENT.

(j) With the primary cylinder extended, the center of the primary chain sheave will be in line with the center of the secondary cylinders on the left and right sides. Stow the maintenance stands, then with the platform full down, the primary chain will be parallel to the rear face of the lift housing. Verify this by placing a straight edge across the lift housing and measuring to the left and right chains at top and bottom. All dimensions should agree within 3mm (1/8").

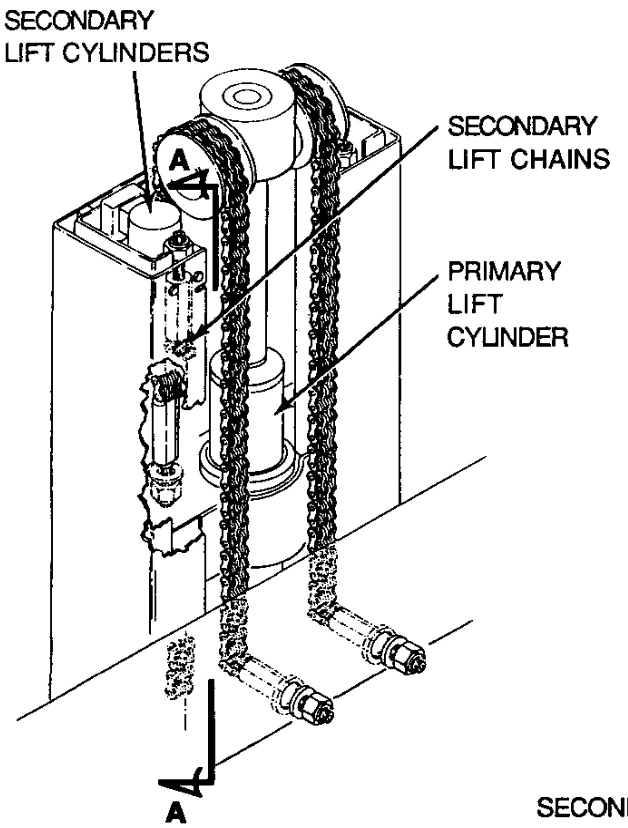
CAUTION: CHECK THAT CHAIN ANCHOR HAS NOT BEEN ADJUSTED TOO FAR FORWARD AND STRIKES THE CASTING WHICH SUPPORTS THE PRIMARY CYLINDER.

(k) Inspect all bearing blocks. If worn to the extent that bearing block screws scrub on a mating surface, replace them.

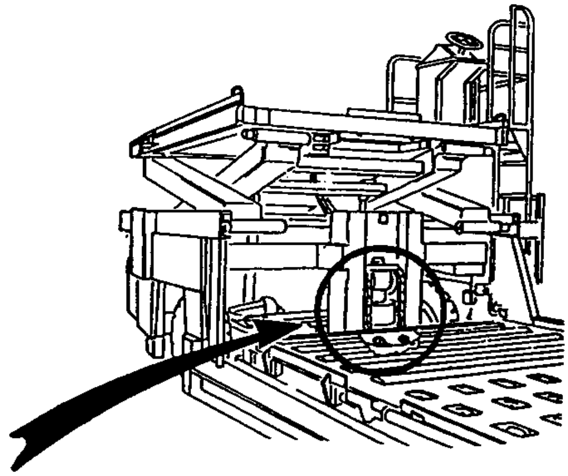
(l) Raise the bridge approximately one foot from full down. Raise the rear platform to interface with the bridge and observe the interface mechanism for correct operation.

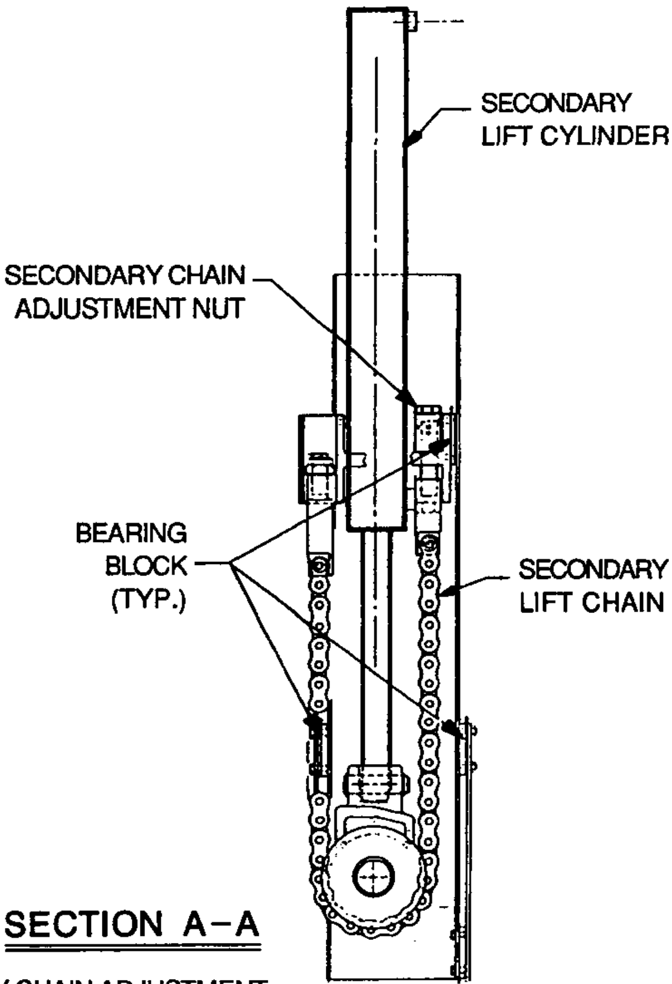
WARNING: BE PREPARED TO OVERRIDE THE REAR LIFT OR HIT THE EMERGENCY SHUTDOWN IN THE EVENT OF PLATFORM OVERTRAVEL.

(m) If necessary, readjust forward most proximity switch (4PRS-B) up or down to achieve correct platform interface. If platform stops below bridge, move switch (4PRS-B) down 3mm (1/8") to raise platform to interface.



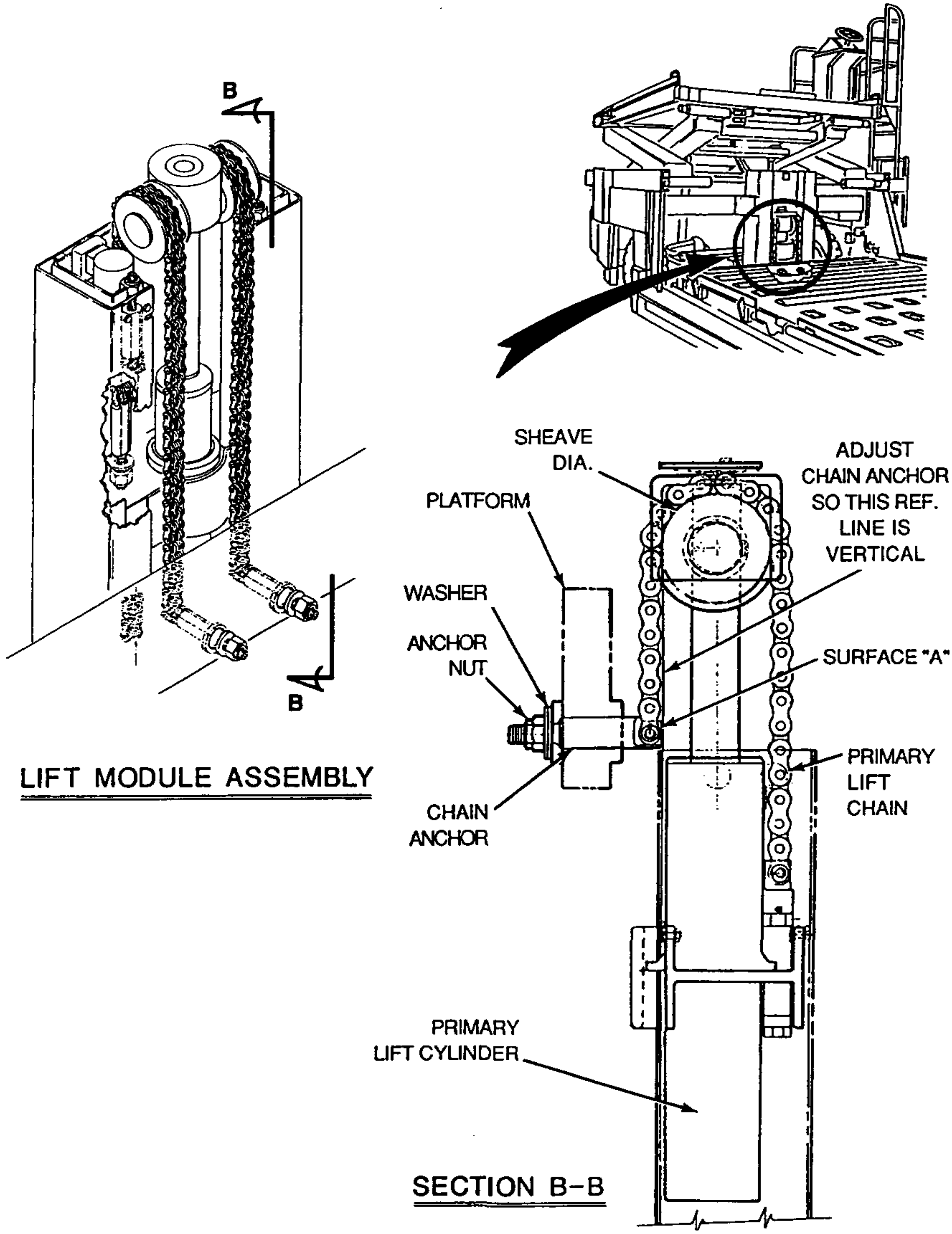
LIFT MODULE ASSEMBLY





SECTION A-A

SECONDARY CHAIN ADJUSTMENT
Figure 2



PRIMARY CHAIN ADJUSTMENT
Figure 3

F. Solenoid Adjustments (Fig. 4, 5)

Solenoid actuators have two (2) coils that provide the magnetic field that moves the plunger. The pull-in coil has a large wire and when energized, draws heavy current for the magnetic field required to move the plunger through its stroke. The hold coil will hold the plunger in the maximum stroke position when the pull-in coil is de-energized.

When electrical current is applied to the solenoid terminal, both the pull-in and hold coils are energized to provide a strong magnetic field to move the plunger and the current (amperes) is very high. At the end of the plunger travel, the plunger will actuate a switch that disconnects the pull-in and leaves the hold coil energized to retain the plunger at the maximum stroke position and the current (ampere) requirements are quite small.

Solenoid position and linkage adjustments become critical to provide maximum pull and full stroke to actuate the switch contacts to open. Should the switch fail to actuate, the heavy current will cause the pull-in coil to overheat and burn out destroying the solenoid.

Adjust solenoid linkage to provide a clearance between the lever maximum travel adjusting screw (stop screw) and the lever when the solenoid is energized and the plunger has moved full stroke. A .010 inch minimum gap is required. (Fig. 5A)

When the solenoid linkage has a spring coupling or spring cushion, the lever can strike the maximum travel screw (stop screw) providing that the spring cushions do not limit the plunger from making its full stroke and actuating the switch "OPEN". (Fig. 5B)

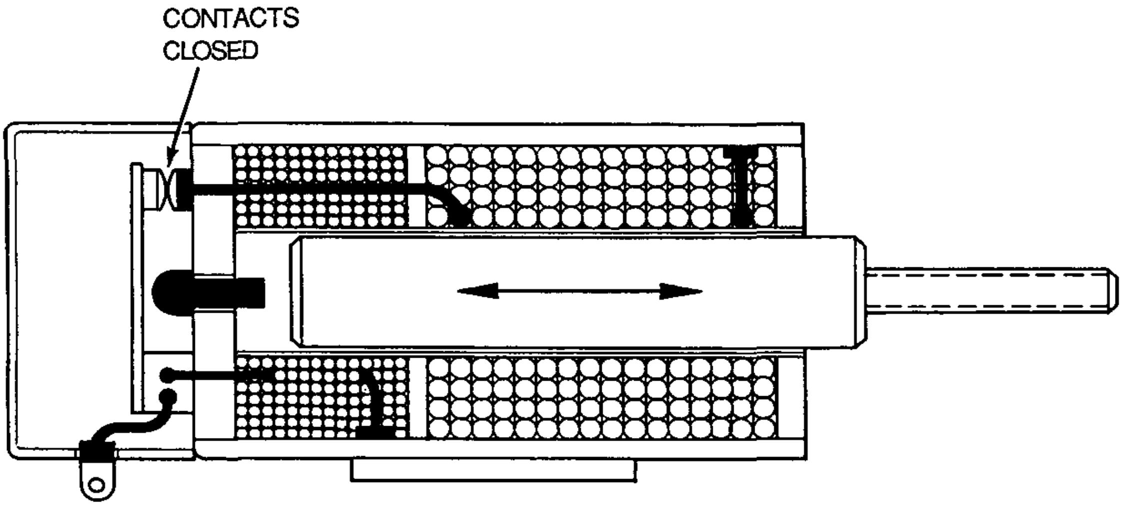
G. Velocity Governor Adjustment **(Ford 6-300 Engine Only)**

(1) ADJUSTING THE GOVERNOR (Fig. 6)

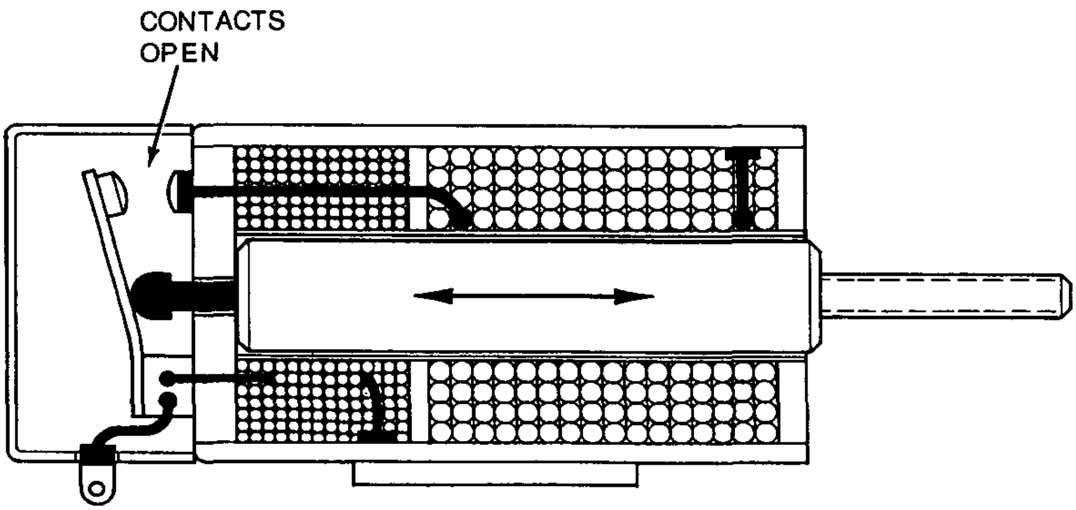
For higher speed, turn main adjusting screw clockwise; for lower speed, counter-clockwise. Always turn governor up to desired speed setting. If setting is too fast, turn back to below desired setting-then up to it.

When desired speed is reached, install seal.

The secondary adjusting screw is factory set to cover a wide range of engine speeds. (This does not apply to governors furnished as original equipment where setting is predetermined.) In setting the governor to desired road or engine speed **use main adjusting screw only.** If governor control is too sharp or not sharp enough, follow instructions below. Only in rare instances need the secondary adjustment be changed.

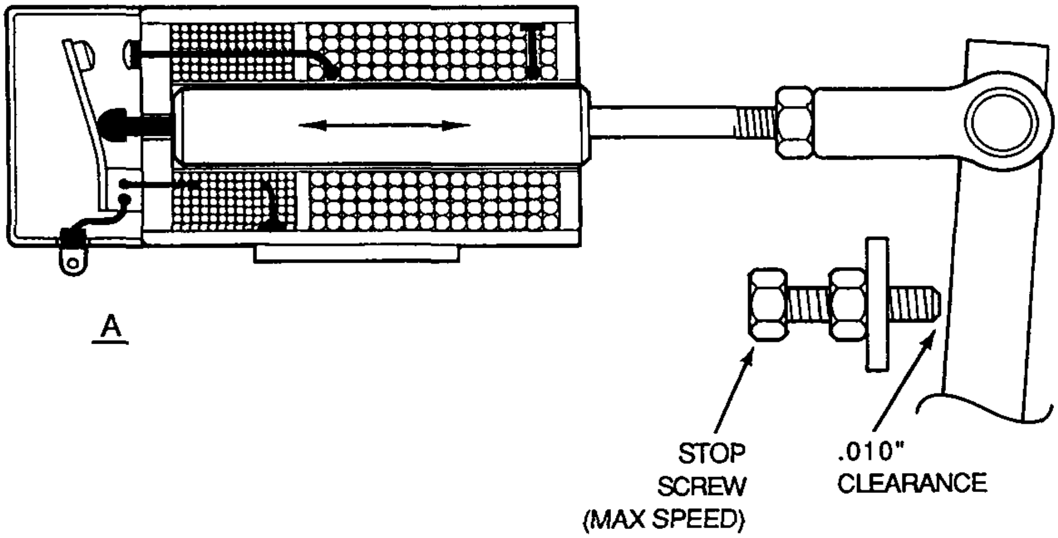


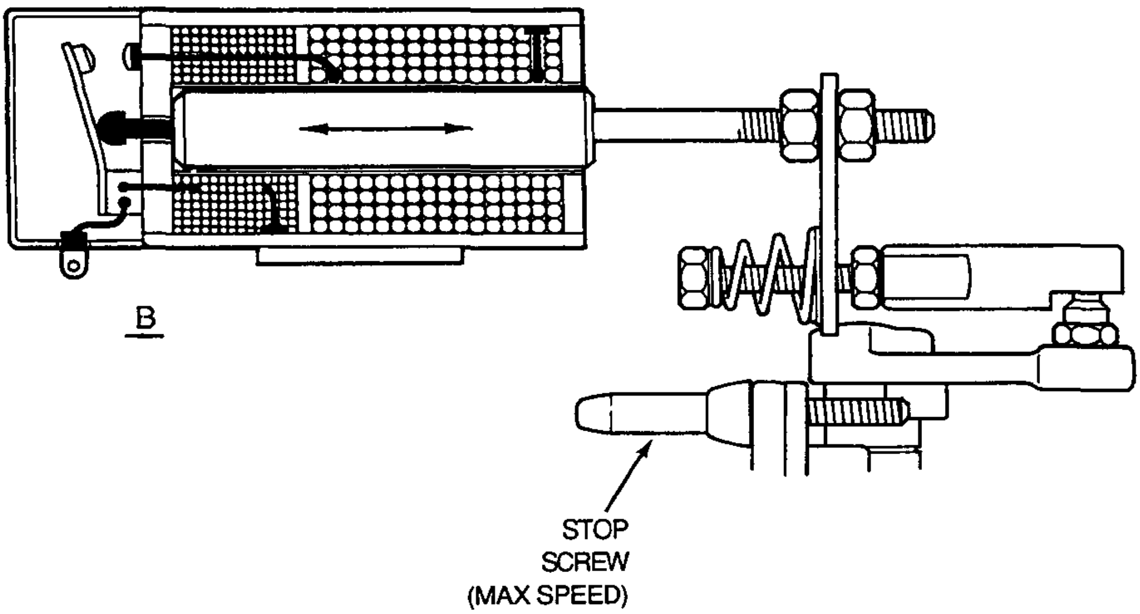
SOLENOID DE-ENERGIZED



SOLENOID ENERGIZED

SOLENOID CIRCUITS
Figure 4





SOLENOID ADJUSTMENTS (TYPICAL)
Figure 5

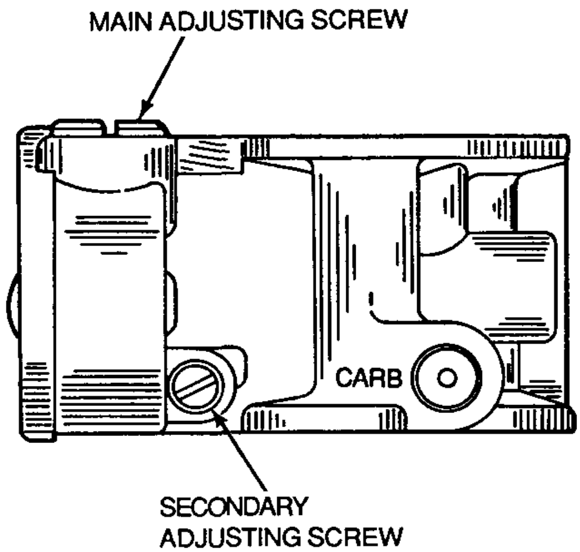
Drill welch plug covering secondary adjusting screw with a 1/16" drill. Insert a 1/16" rod in drilled hole and pry off welch plug.

IF GOVERNOR CONTROL IS TOO SHARP WHICH CAUSES SURGING OR HUNTING: Turn secondary adjusting screw clockwise 1/4 turn at a time. Turn main adjusting screw counter-clockwise approximately one turn for every 1/4 turn of secondary screw to bring speed adjustment back to normal.

IF GOVERNOR CONTROL IS NOT SHARP ENOUGH, WHICH CAUSES TOO GREAT A VARIATION IN SPEED BETWEEN LOAD AND NO LOAD: Turn secondary adjusting screw counter-clockwise 1/4 turn at a time. Turn main adjusting screw clockwise approximately one turn for each 1/4 turn of secondary screw to bring speed back to normal.

(2) HOW TO SEAL GOVERNOR

When final adjustment is made, drop brass washer (tab end in slot) into recess hole by adjusting screw. Put Welsh plug in hole (on top of brass washer) and compress Welsh plug into place to assure a tight fit.



VELOCITY GOVERNOR ADJUSTMENT
Figure 6

SECTION 3 HYDRAULIC & ELECTRICAL ADJUSTMENTS

1. HYDRAULIC SYSTEM

The hydraulic system is a closed center system with a load sensing control that automatically regulates pump displacement. When there is no system demand, the pump stands by at near zero flow and low pressure.

When making performance checks, hydraulic system pressure checks, or hydraulic system adjustments, the hydraulic oil must be at normal operating temperature.

Eye protection, safety glasses or a face shield, must always be worn for protection against injury when hydraulic systems are under pressure and adjustments are being made.

The loader drive wheels must always be chocked to prevent movement of the loader in either direction and the stabilizers extended by placing the mode switch in "OPERATE". With the stabilizers extended, the PARKING BRAKES are automatically applied.

All adjustments on the BRIDGE can be accomplished with the BRIDGE in the fully lowered position. The platform must have the maintenance stands installed to support the platform whenever personnel are required to go under the platform for maintenance or adjustment procedures.

A. Standby Pressure (Fig. 1, 2)

NOTE: An assistant is required for this procedure. Hydraulic oil must be at normal operating temperature.

WARNING: LOADER DRIVE WHEELS ARE TO BE CHOCKED TO PREVENT MOVEMENT IN EITHER DIRECTION. EYE PROTECTION MUST BE WORN WHEN MAKING ADJUSTMENTS.

(1) Remove bolt that secures power unit in the closed position and swing power unit open to gain access to pump and valves.

(2) Have assistant start power unit, retract stabilizers by placing switch in drive mode and set the parking brakes. VERIFY by observing the stabilizer indicator light is "OFF" and parking brake indicator light is "ON". ALL GUIDES MUST BE UP.

(3) Have assistant shutdown the power unit.

(4) Remove the 0-345 bar (0-5000 PSI) gauge from port "A" and install a 0-40 bar (0-600 PSI) gauge in gauge port "A".

(5) Have assistant start power unit and allow 2 to 3 minutes for system to stabilize.

<u>NOTE:</u> <u>Do not</u> operate any loader function with the 0-40 bar (0-600 PSI) gauge in gauge port "A". Pressure gauge <u>will</u> be damaged beyond repair.

(6) Observe pressure gauge for indicated pressure of:

19 bar (275 PSI) Isuzu engine
21 bar (300 PSI) all other engines

(7) To adjust standby pressure, remove protective cap on adjusting screw, loosen locknut and turn adjusting screw clockwise to increase pressure and counterclockwise to decrease pressure.

(8) Allow system to stabilize for 2 to 3 minutes after making an adjustment and securing locknut and verify that pressure remains at specified indicated pressure.

(9) Install protective cap on adjustment screw.

(10) Have assistant shutdown power unit.

(11) Remove low pressure gauge from gauge point "A" and reinstall 0-345 bar (0-5000 PSI) gauge.

(12) Clean up any hydraulic oil that has leaked during adjustment procedure.

(13) Swing power unit closed and secure with retention bolt.

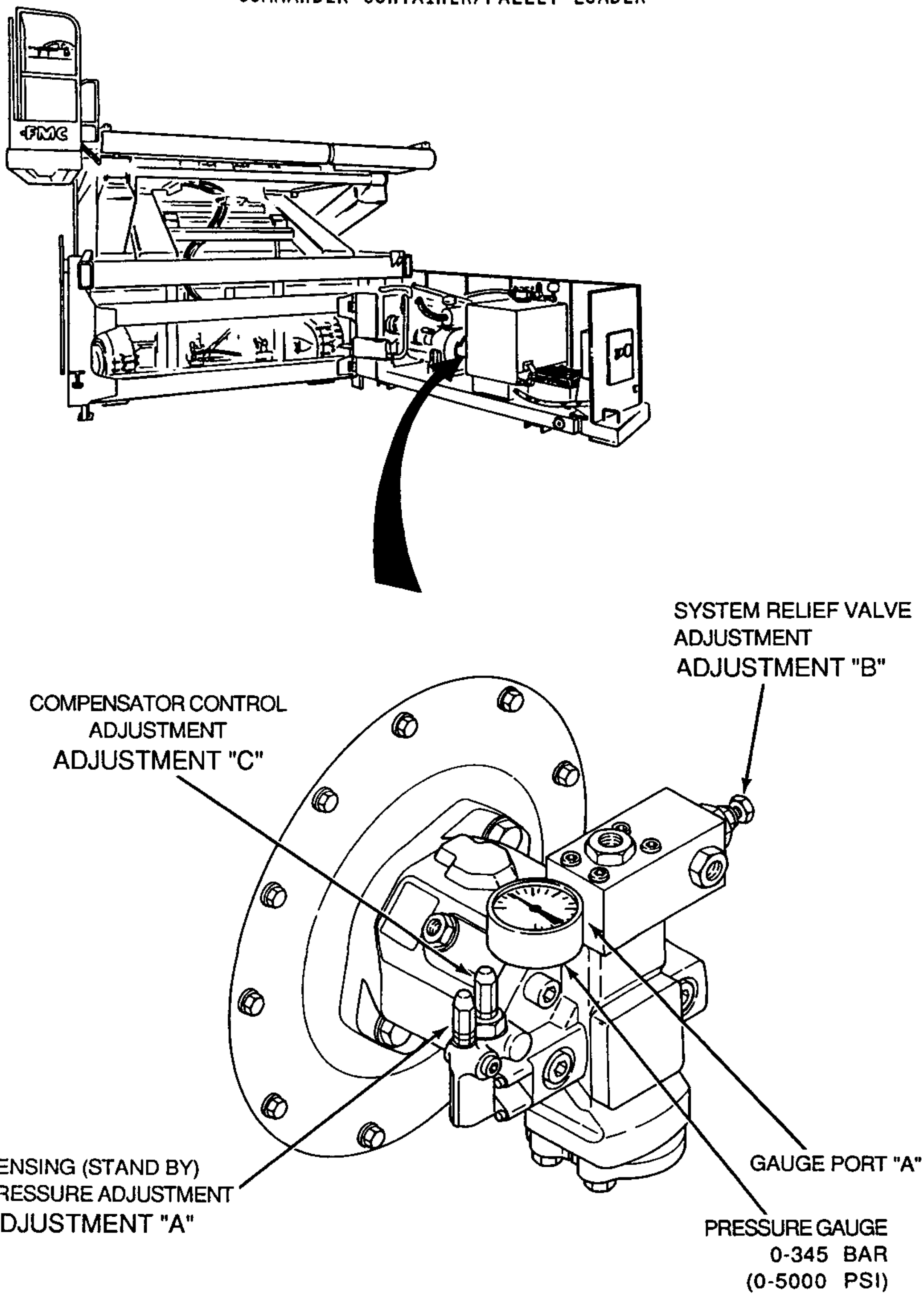
B. *System Relief Pressure (Fig. 1, 2)*

<u>NOTE:</u> An assistant is required for this procedure. Hydraulic oil must be at normal operating temperature.

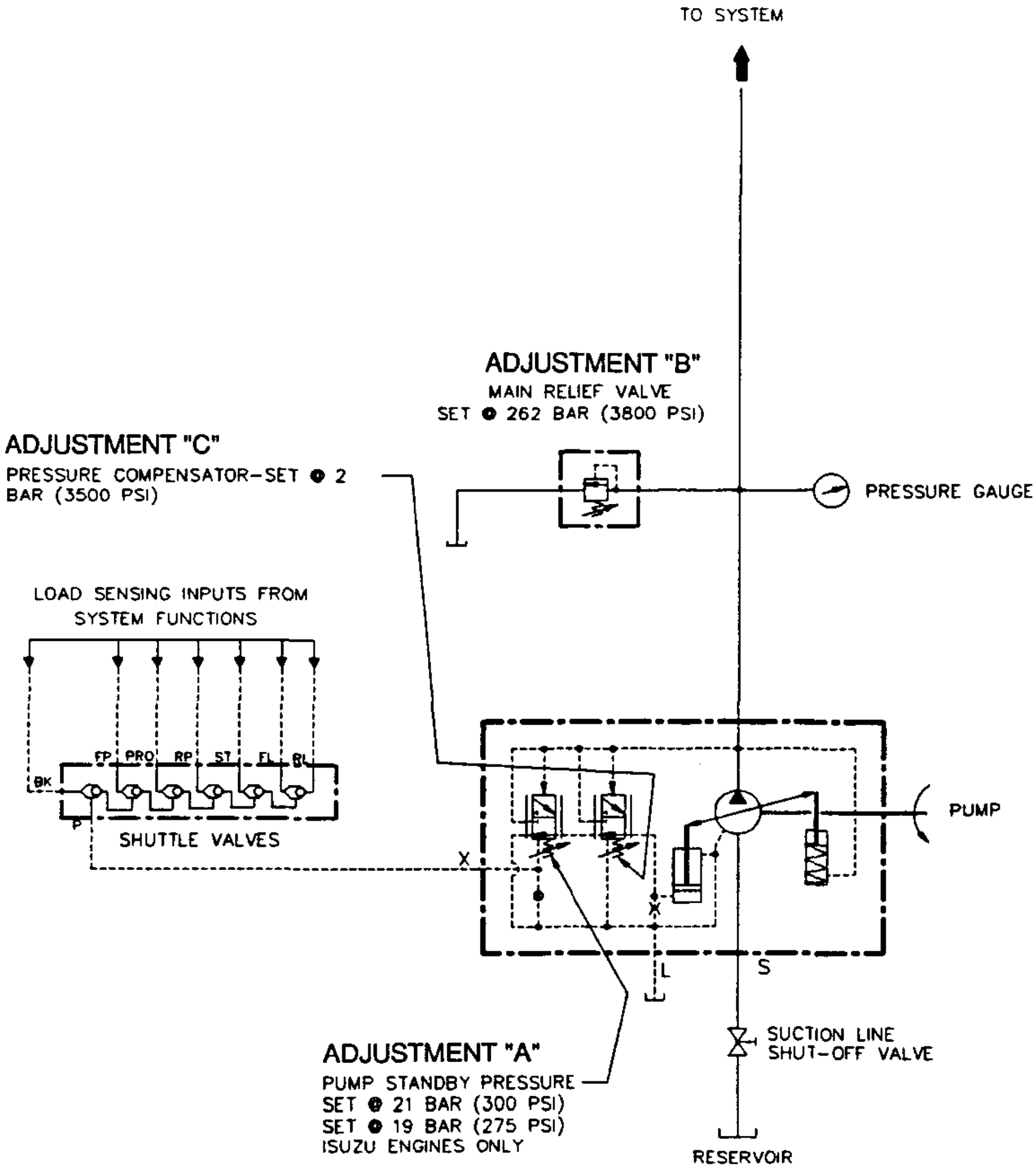
The engine will lug (slow down) during this adjustment procedure. (normal characteristic)

<u>WARNING:</u> LOADER DRIVE WHEELS ARE TO BE CHOCKED TO PREVENT MOVEMENT IN EITHER DIRECTION. EYE PROTECTION MUST BE WORN WHEN MAKING ADJUSTMENTS.

(1) Remove bolt that secures power unit in the closed position and swing power unit open to gain access to pump and valves.



HYDRAULIC PUMP ADJUSTMENTS
Figure 1



MAIN PUMP & CONTROL CIRCUIT

HYDRAULIC PUMP ADJUSTMENTS
Figure 2

(2) Loosen locknut on compensator control adjustment screw and turn adjustment screw clockwise one (1) turn.

(3) Have assistant start the power unit and place the mode switch in "DRIVE" to retract the stabilizers, and then actuate and HOLD bogy wheel switch in the "RAISE" position. Observe pressure gauge for an indicated reading of 262 bar (3800 PSI).

(4) If pressure reading of 262 bar (3800 PSI) is not indicated on gauge, loosen locknut on system relief valve adjusting screw and turn adjusting screw clockwise to increase pressure and counterclockwise to decrease pressure.

NOTE: System relief pressure must always be higher than compensator control pressure EXCEPT when making system relief pressure adjustment. When system relief pressure is LESS than compensator control pressure the pump will shift to full stroke for maximum flow at system relief pressure setting and will lug the engine to a complete stall.

(5) If 262 bar (3800 PSI) indicated reading cannot be obtained by turning system relief valve adjusting screw clockwise, turn compensator control adjusting screw clockwise one (1) additional turn and readjust system relief valve to obtain correct indicated pressure of 262 bar (3800 PSI).

(6) When system relief valve is correctly adjusted to 262 bar (3800 PSI) tighten locknut securely on relief valve adjusting screw.

(7) Reset compensator control to specification of 241 bar (3500 PSI) by turning adjusting screw clockwise to increase pressure and counterclockwise to decrease pressure.

NOTE: Bogy wheel switch MUST BE HELD IN "RAISE" POSITION when making system relief valve and compensator control valve pressure adjustments.

(8) Have assistant release bogy wheel switch and shutdown power unit.

(9) Clean up any oil that has leaked during adjustment procedures.

(10) Swing power unit closed and secure with retention bolt.

C. Compensator Control Setting (Fig. 1, 2)

WARNING: LOADER DRIVE WHEELS ARE TO BE CHOCKED TO PREVENT MOVEMENT IN EITHER DIRECTION. EYE PROTECTION MUST BE WORN WHEN MAKING ADJUSTMENTS.

NOTE: An assistant is required for this procedure. Hydraulic oil must be at normal operating temperature.

(1) Remove bolt that secures power unit in the closed position and swing open to gain access to pump and valves.

(2) Have assistant start the power unit and place the mode switch in "OPERATE" to extend the stabilizers, and then actuate and HOLD the bogy wheel switch in the "RAISE" position. Observe the pressure gauge for an indicated reading of 241 bar (3500 PSI).

(3) Remove protective cap and loosen locknut on adjusting screw, turn adjusting screw clockwise to increase pressure and counterclockwise to decrease pressure. Adjust compensator control to specification of 241 bar (3500 PSI).

(4) When compensator control pressure is at specified pressure of 241 bar (3500 PSI) tighten locknut securely on adjusting screw. Replace protective cap.

(5) Have assistant release bogy wheel switch and shutdown power unit.

(6) Clean up any oil that has leaked during adjustment procedure.

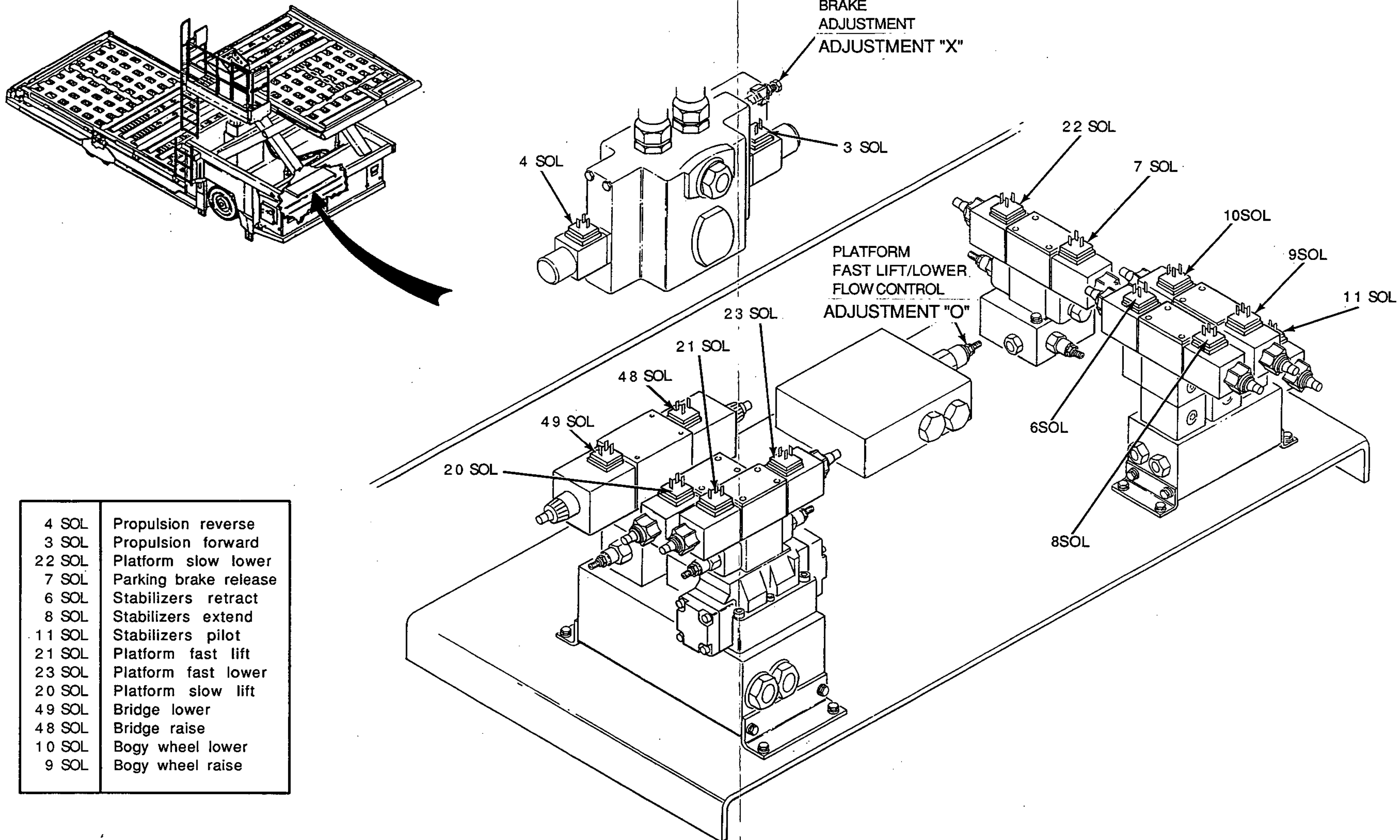
(7) Swing power unit closed and secure with retention bolt.

D. Bogy Wheel Extend/Retract Adjustments (Fig. 3, 4, 5 & 6)

NOTE: An assistant is required for this procedure. Hydraulic oil must be at normal operating temperature.

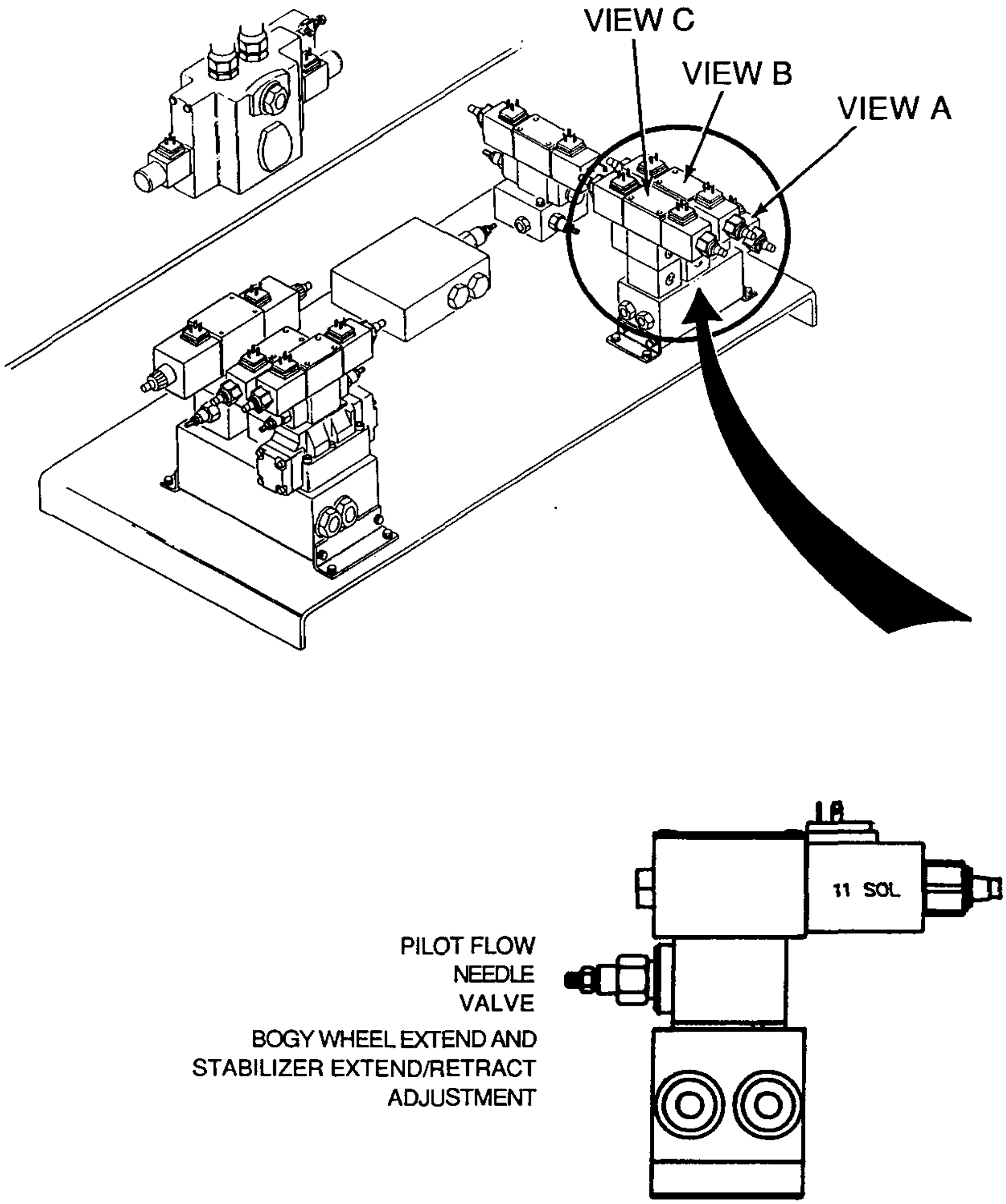
(1) Remove bolt that secures power unit in the closed position and swing power unit open to gain access to needle valve and flow control adjustments.

(2) Have assistant start power unit and extend bogy wheels. Bogy wheels are to extend (Raise Loader) fully in 2 to 5 seconds.



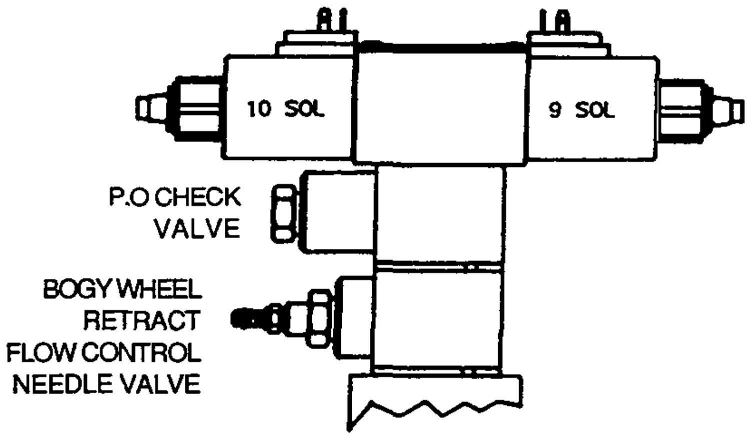
4 SOL	Propulsion reverse
3 SOL	Propulsion forward
22 SOL	Platform slow lower
7 SOL	Parking brake release
6 SOL	Stabilizers retract
8 SOL	Stabilizers extend
11 SOL	Stabilizers pilot
21 SOL	Platform fast lift
23 SOL	Platform fast lower
20 SOL	Platform slow lift
49 SOL	Bridge lower
48 SOL	Bridge raise
10 SOL	Bogy wheel lower
9 SOL	Bogy wheel raise

SOLENOID VALVE IDENTIFICATION CHART
Figure 3

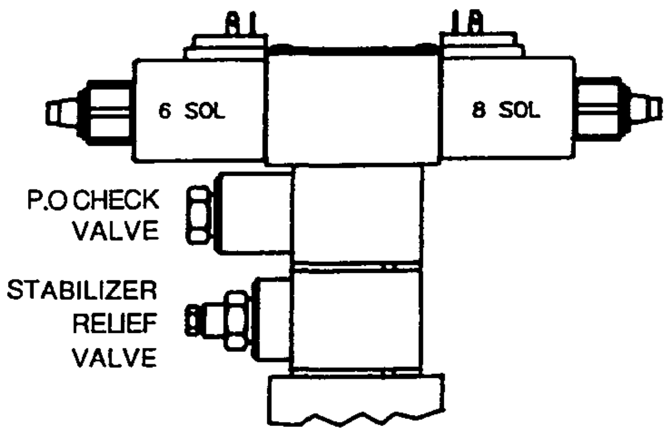


VIEW A
ADJUSTMENT "D"

BOGY WHEEL ADJUSTMENTS
Figure 4

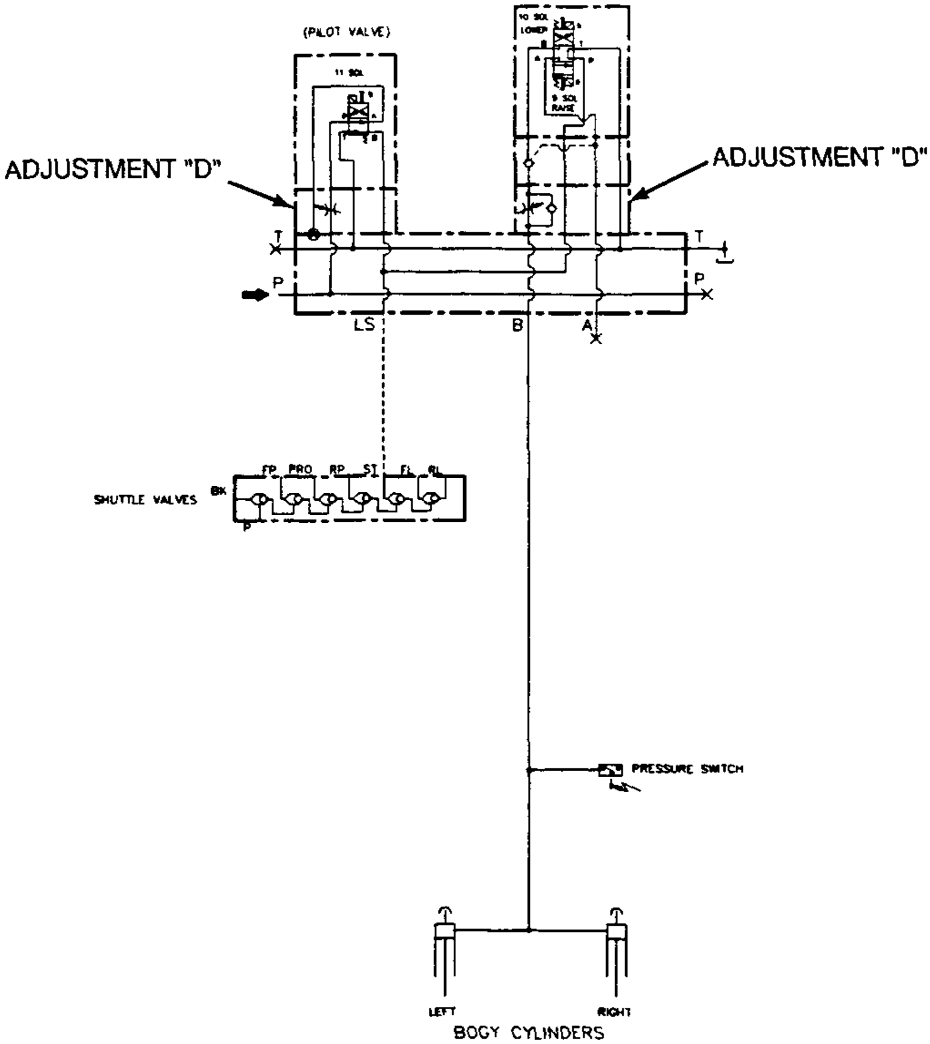


VIEW B
ADJUSTMENT "D"



VIEW C
ADJUSTMENT "F"

BOGY WHEEL ADJUSTMENTS,
STABILIZER ADJUSTMENT
Figure 5



BOGY CYLINDER CIRCUIT

BOGY WHEEL ADJUSTMENTS
Figure 6

(3) Adjust needle valve by loosening locknut on adjusting screw and turning adjusting screw clockwise to decrease flow (increase time) or counterclockwise to increase flow (decrease time) for extending bogy wheel cylinders fully. Needle valve is located below solenoid valve 11SOL.

NOTE: Needle valve adjustment can effect stabilizer operation. If needle valve is turned too far clockwise (decrease flow) stabilizers will be slow to extend and retract.

(4) Have assistant retract bogy wheel cylinders. Bogy wheels are to retract (lower loader) fully in 2 to 5 seconds.

(5) Adjust flow control needle valve by loosening locknut on adjusting screw and turning adjusting screw clockwise to decrease flow (increase time) or counterclockwise to increase flow (decrease time) for retracting bogy wheels fully. Needle valve is located below solenoid valve 9SOL.

(6) Shut power unit down.

(7) Clean up any hydraulic oil that may have leaked.

(8) Swing power unit closed and secure with retention bolt.

E. Parking Brake Release Pressure (Fig. 7, 8)

NOTE: An assistant is required for this procedure. Hydraulic oil must be at normal operating temperature.

WARNING: LOADER DRIVE WHEELS ARE TO BE CHOCKED TO PREVENT MOVEMENT IN EITHER DIRECTION. EYE PROTECTION MUST BE WORN WHEN MAKING ADJUSTMENTS.

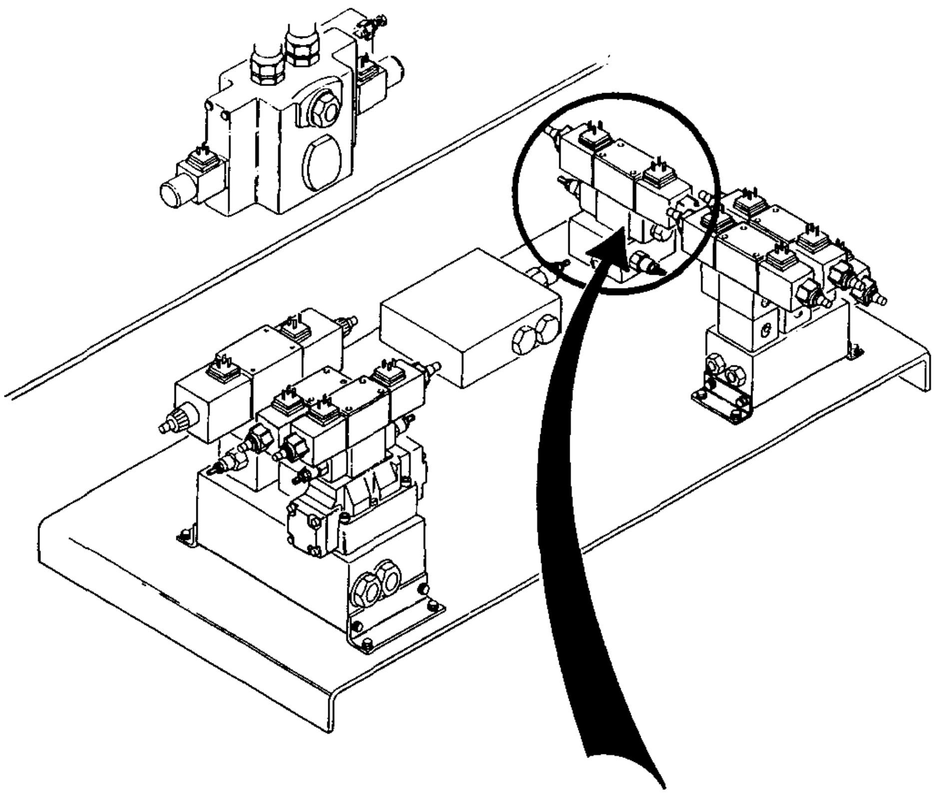
(1) Remove bolt that secures power unit in the closed position and swing power unit open to gain access to pump and valves.

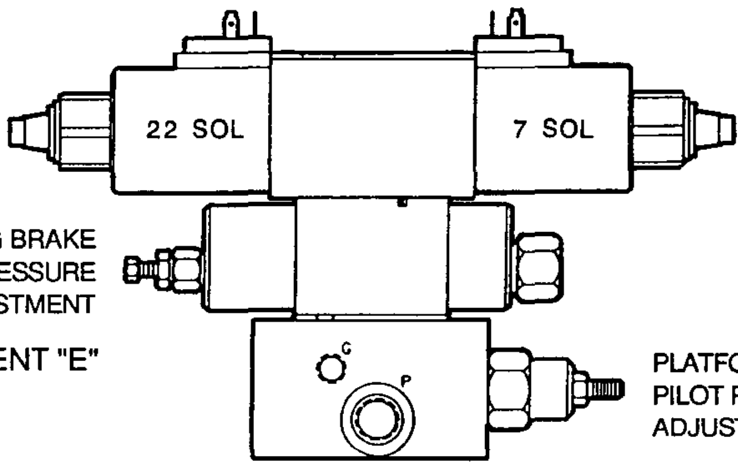
(2) Have assistant start engine and place mode switch in DRIVE and move parking brake switch to "OFF" position.

(3) Observe pressure gauge for indicated reading of 76 bar (1100 PSI).

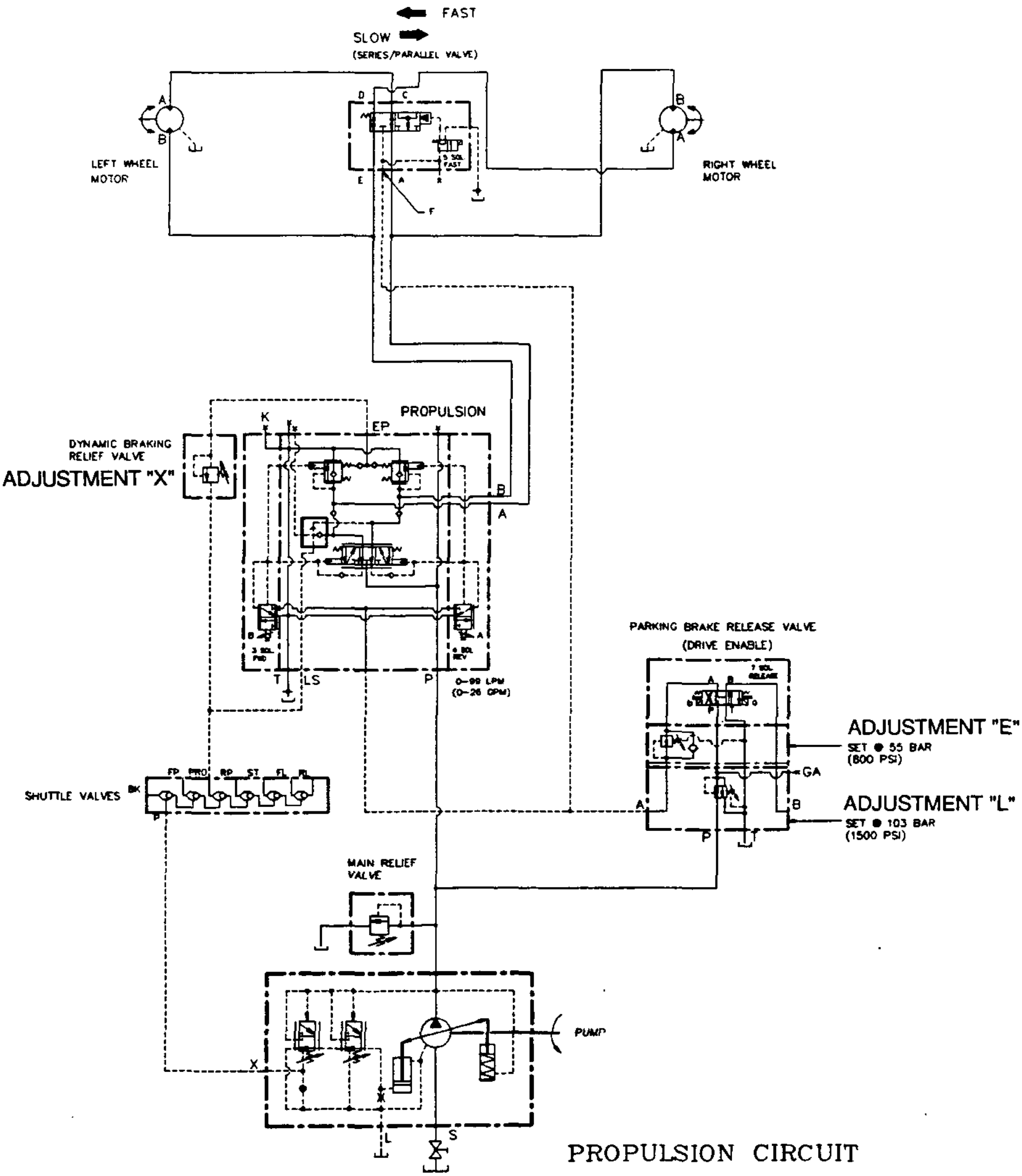
NOTE: A 76 bar (1100 PSI) indicated reading at gauge port "A" will be the combined pressure of the parking brake pressure reducing valve and standby pressure, i.e.:

55 bar (800 PSI) parking brake release pressure
21 bar (300 PSI) standby pressure
76 bar (1100 PSI) indicated pressure





PARKING BRAKE RELEASE PRESSURE ADJUSTMENT
PLATFORM DOWN PILOT PRESSURE ADJUSTMENT
Figure 7



PROPULSION CIRCUIT

PROPULSION CIRCUIT
Figure 8

(4) If pressure reading of 76 bar (1100 PSI) is not indicated on gauge, loosen locknut on pressure reducing valve adjusting screw and turn screw clockwise to increase pressure or counterclockwise to decrease pressure.

NOTE: Verify "PLATFORM" pilot "DOWN" pressure is correct if parking brake release pressure cannot be properly adjusted to specifications. (See Adjustment Procedure "L")

(5) When parking brake release pressure has been set to specifications, tighten locknut on adjusting screw securely.

(6) Verify parking brake release pressure setting by cycling parking brakes off and on several times.

(7) Clean up any oil that has leaked during adjustment procedure.

(8) Swing power unit closed and secure with retention bolt.

F. Stabilizer Adjustments (Fig. 5, 9, & 10)

NOTE: An assistant is required for this procedure. Hydraulic oil must be at normal operating temperature.

WARNING: LOADER DRIVE WHEELS ARE TO BE CHOCKED TO PREVENT MOVEMENT IN EITHER DIRECTION. EYE PROTECTION MUST BE WORN WHEN MAKING ADJUSTMENTS.

NOTE: Stabilizers must be retracted when making this measurement.

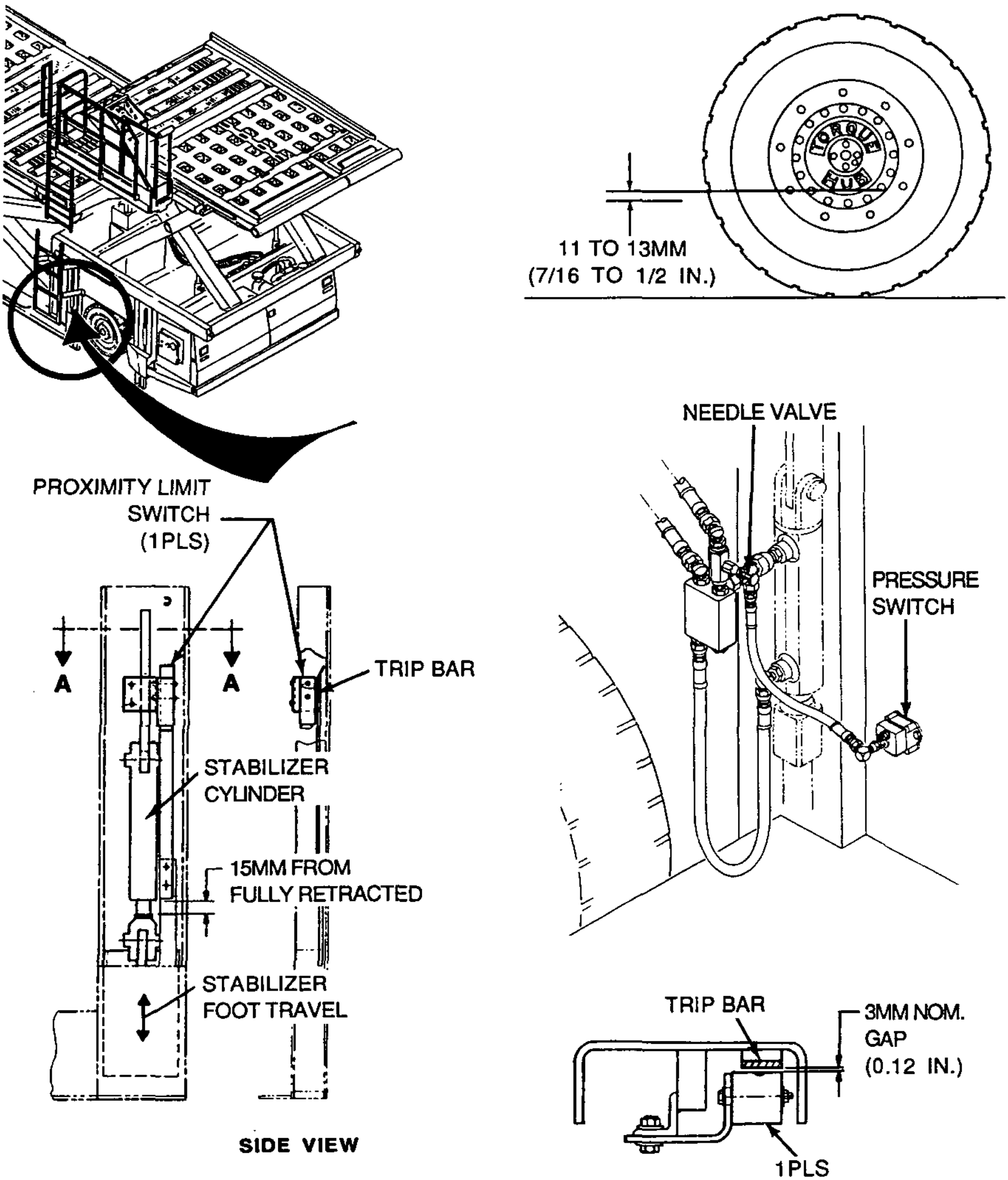
(1) Remove bolt that secures power unit in the closed position and swing power unit open to gain access to stabilizer relief valve.

(2) Loosen locknut on stabilizer flow control valve and turn adjusting screw counterclockwise fully. (Flow control is located on right side center stabilizer pilot operated check valve, Fig. 9).

(3) Loosen locknut on stabilizer pressure switch and turn pressure adjusting screw clockwise fully. (Fig. 9)

(4) Measure and record the distance from a marked point on the drive wheel torque hub to ground level. (Reference point) (Fig. 9)

(5) Have assistant start engine and cycle stabilizers several times and then set stabilizers by placing mode switch in the operate position.

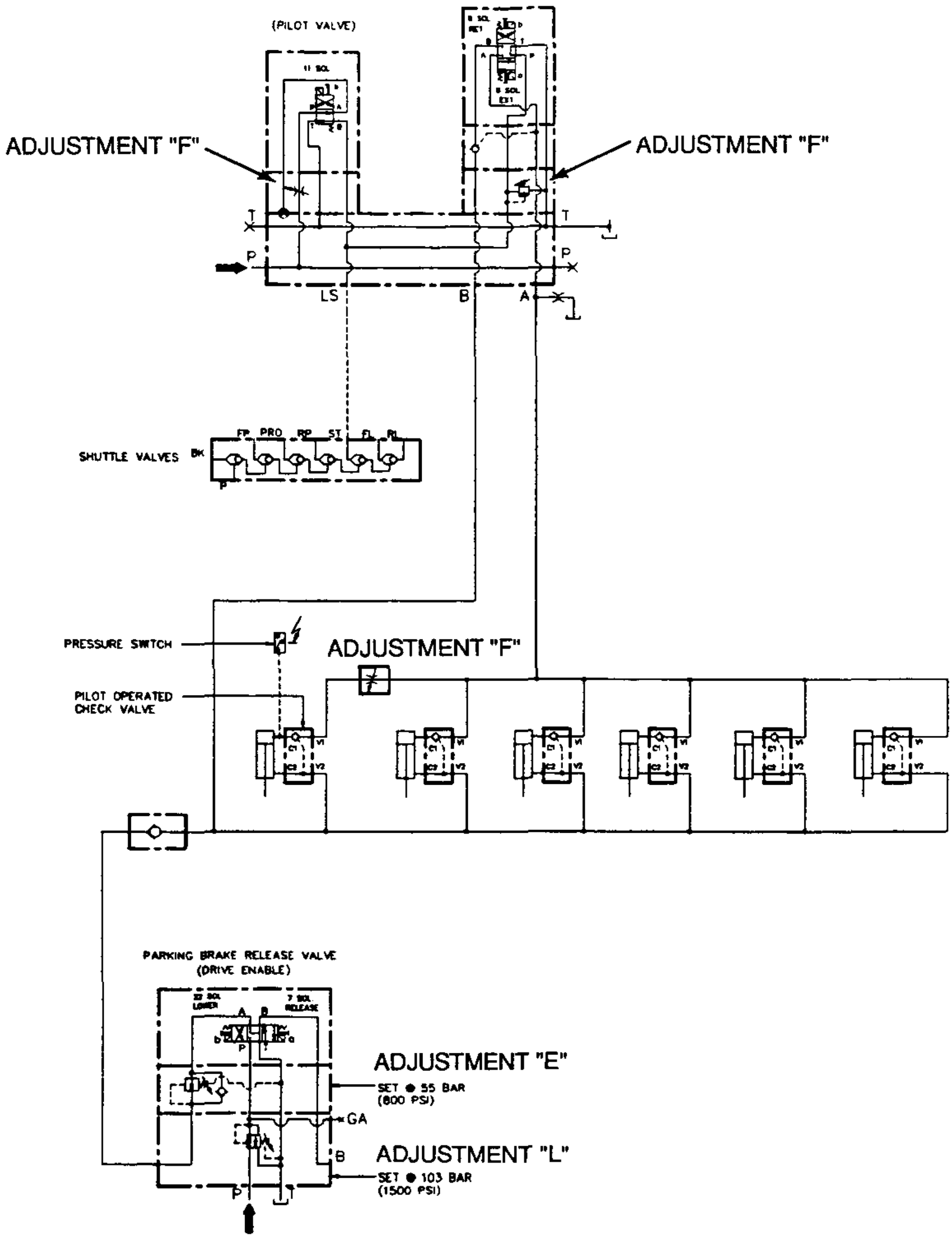


STABILIZER DETAIL

SECTION A-A

ADJUSTMENT "F"

STABILIZER ADJUSTMENTS
Figure 9



STABILIZER CONTROL CIRCUIT

STABILIZER CONTROL CIRCUIT
Figure 10

(6) Adjust stabilizer relief valve to obtain 16 to 19MM (5/8" to 3/4" raise on the torque hub. (Increase from the marked reference point). To adjust stabilizer relief valve, loosen locknut on the adjusting screw and turn adjusting screw clockwise to increase pressure and increase rise on the torque hub or counterclockwise to decrease pressure and lower torque hub.

(7) Tighten locknut securely after each adjustment and cycle stabilizers to verify adjustment.

(8) Turn adjusting screw on pressure switch counterclockwise fully and have assistant extend stabilizers by placing mode switch in the operate position.

(9) Adjust pressure switch to obtain 11 to 13MM (7/16" to 1/2") rise on the torque hub. (Increase from the marked reference point). To adjust pressure switch, turn adjusting screw clockwise to increase actuating pressure and increase rise on torque hub or counterclockwise to decrease actuating pressure and lower torque hub. Tighten adjusting screw locknut securely after each adjustment.

(10) Cycle stabilizers several times to verify adjustment of pressure switch.

(11) Adjust flow control valve on right center stabilizer to obtain a 2 to 3 second delay on extension and retraction from all other stabilizer cylinders. (Turn adjustment clockwise to increase delay or counterclockwise to decrease delay). RIGHT CENTER STABILIZER MUST BE THE LAST STABILIZER TO EXTEND AND RETRACT.

(12) Tighten locknut securely after adjustment has been accomplished.

G. Bridge Raise/Lower Flow Controls (STANDARD LOADERS) (Fig. 12, 13)

<u>NOTE:</u> An assistant is required for this procedure. Hydraulic oil must be at normal operating temperature

<u>WARNING:</u> LOADER DRIVE WHEELS ARE TO BE CHOCKED TO PREVENT MOVEMENT IN EITHER DIRECTION. EYE PROTECTION IS TO BE WORN WHEN MAKING ADJUSTMENTS.

(1) Remove bolt that secures power unit closed and swing power unit open for access to flow control adjustment.

(2) Have assistant start power unit and place mode switch in "OPERATE" to extend stabilizers, and then raise and lower bridge (full extension).

(3) Check time that is required to raise and lower bridge (full extension).

Bridge raise 29 to 34 seconds
Bridge lower 19 to 24 seconds

(4) To adjust raise/lower flow controls, loosen locknut on adjusting screw and turn adjusting screw clockwise to increase flow (decrease time) or counterclockwise to decrease flow (increase time).

(5) When adjustment is completed, tighten locknut securely on adjusting screw.

(6) Clean up any hydraulic oil that may have leaked.

(7) Swing power unit closed and secure with retention bolt.

H. Bridge Raise/Lower Flow Controls (MAIN DECK AND UNIVERSAL LOADERS) (Fig. 12, 13)

<u>NOTE:</u> An assistant is required for this procedure. Hydraulic oil must be at normal operating temperature.

<u>WARNING:</u> LOADER DRIVE WHEELS ARE TO BE CHOCKED TO PREVENT MOVEMENT IN EITHER DIRECTION. EYE PROTECTION MUST BE WORN WHEN MAKING ADJUSTMENTS.

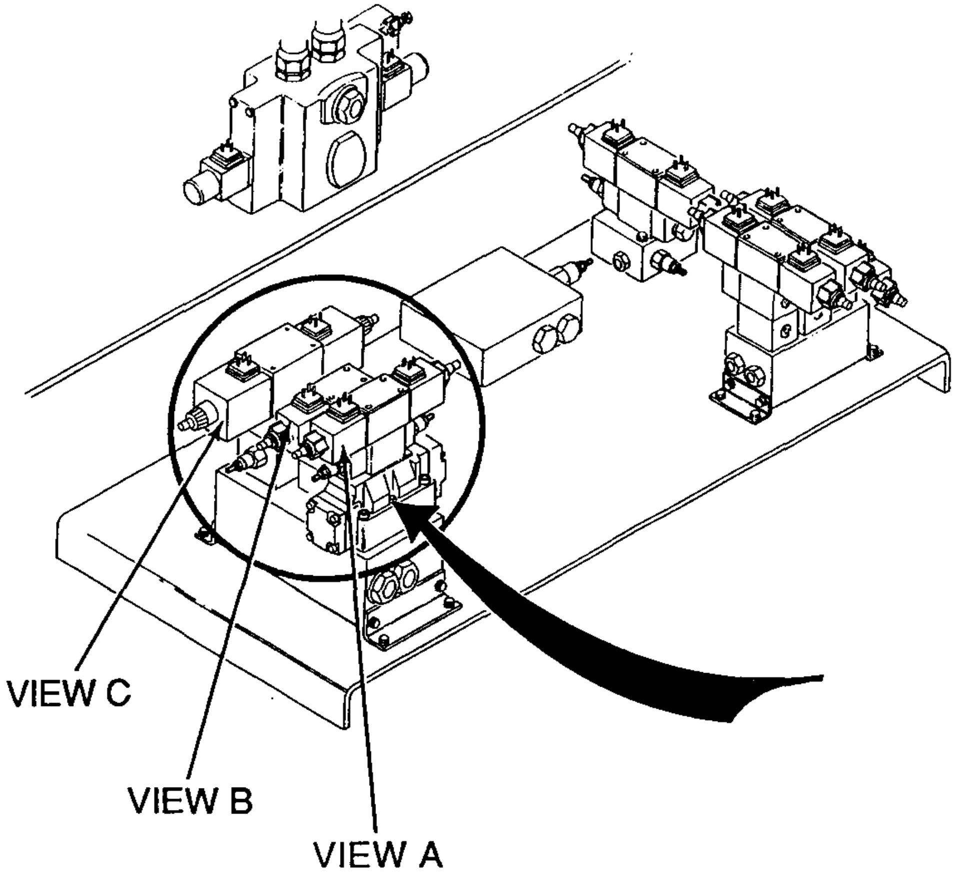
(1) Remove bolt that secures power unit closed and swing power unit open to gain access to flow control adjustments.

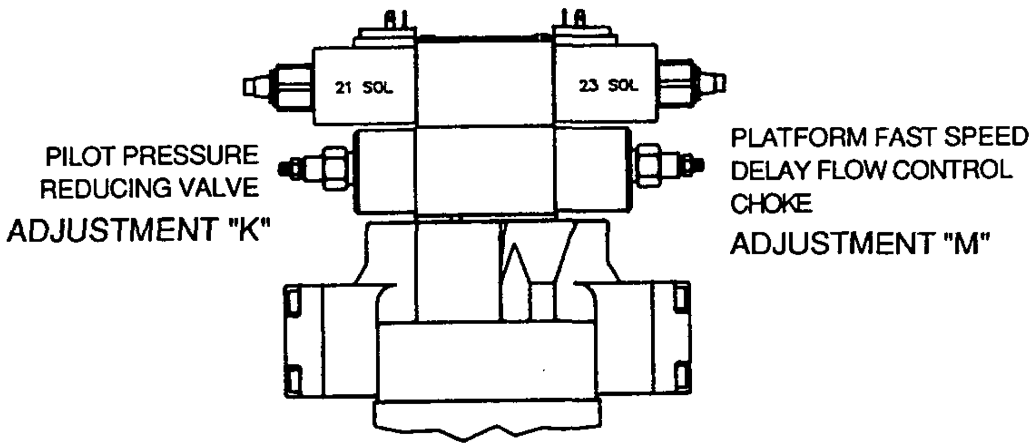
(2) Have assistant start power unit and place mode switch in "OPERATE" to extend stabilizers, then raise and lower bridge (full extension).

(3) Check time that is required to raise and lower bridge (full extension).

Bridge raise 49 to 53 seconds
Bridge lower 29 to 34 seconds

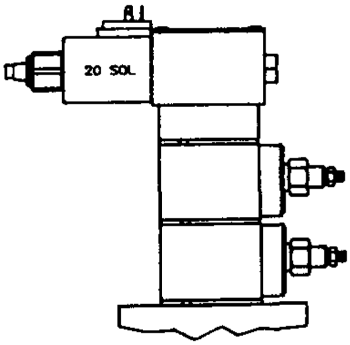
(4) To adjust bridge raise flow control, loosen locknut on adjusting screw and turn adjusting screw clockwise to decrease flow (increase time) or counterclockwise to increase flow (decrease time).



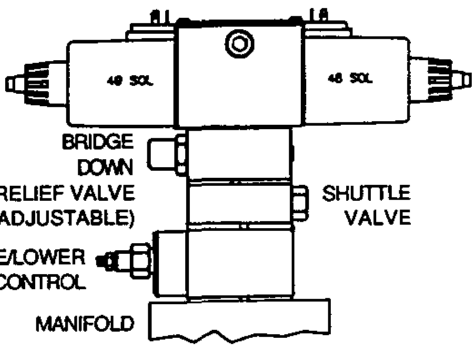


VIEW A

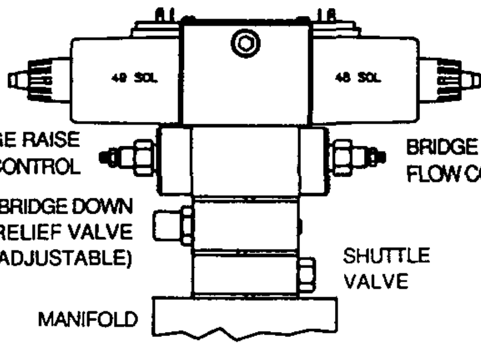
PILOT PRESSURE REDUCING VALVE
PLATFORM FAST SPEED DELAY FLOW CONTROL
Figure 11



VIEW B
ADJUSTMENT "N"

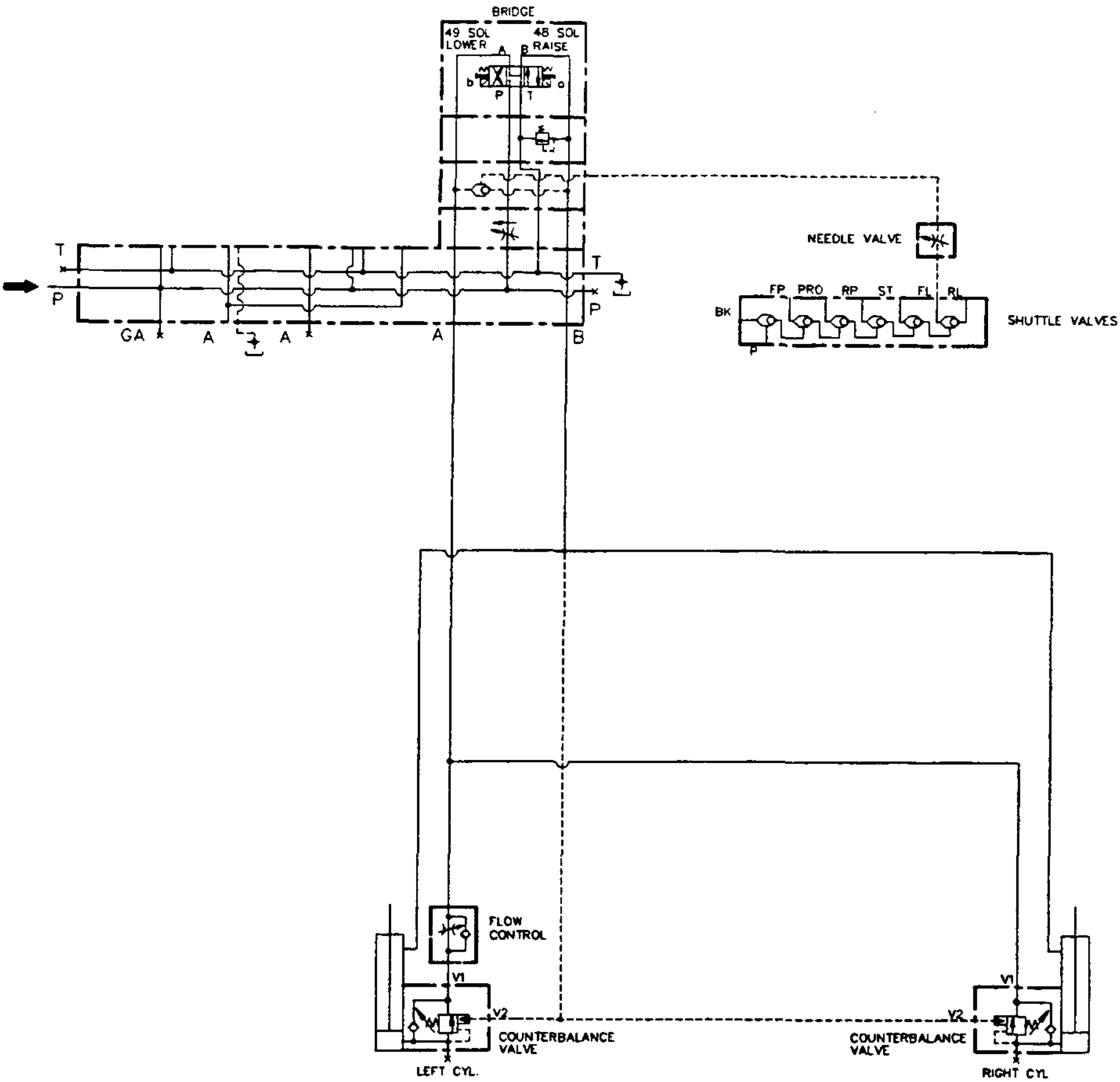


VIEW C
ADJUSTMENT "H"
(STANDARD LOADER)



VIEW C
ADJUSTMENT "H"
(OPTIONAL - MAIN DECK AND
UNIVERSAL LOADER)

PLATFORM SLOW RAISE/SLOW LOWER FLOW CONTROL
BRIDGE RAISE/LOWER FLOW CONTROL
Figure 12



BRIDGE RAISE/LOWER CIRCUIT
(STANDARD LOADER)

BRIDGE HYDRAULIC CIRCUIT
Figure 13

(5) To adjust bridge lower flow control. loosen locknut on adjusting screw and turn adjusting screw clockwise to decrease flow (increase time) or counterclockwise to increase flow (decrease time).

(6) When adjustments are completed, tighten locknuts securely on adjusting screws.

(7) Clean up any hydraulic oil that may have leaked.

(8) Swing power unit closed and secure with retention bolt.

I. Bridge Shuttle Valve, Needle Valve Adjustment (Fig. 14)

NOTE: An assistant is required for this procedure. Hydraulic oil must be at normal operating temperature.

(1) Remove bolt that secures power unit in the closed position and swing power unit open to gain access to needle valve. Needle valve will be located in the hydraulic line connected to port marked "FL" on the shuttle valve manifold.

(2) Loosen lock screw on adjusting screw and turn adjusting screw fully clockwise until needle is seated. (DO NOT OVERTIGHTEN). Turn needle valve counterclockwise exactly 1/4 turn and tighten lock screw securely on adjusting screw.

(3) Have assistant start power unit and place mode switch in "OPERATE" to extend stabilizers, raise bridge to full extension and then lower bridge. Bridge must raise and lower smoothly.

(4) Adjust needle valve if required, to obtain smooth operation of bridge when being raised and lowered.

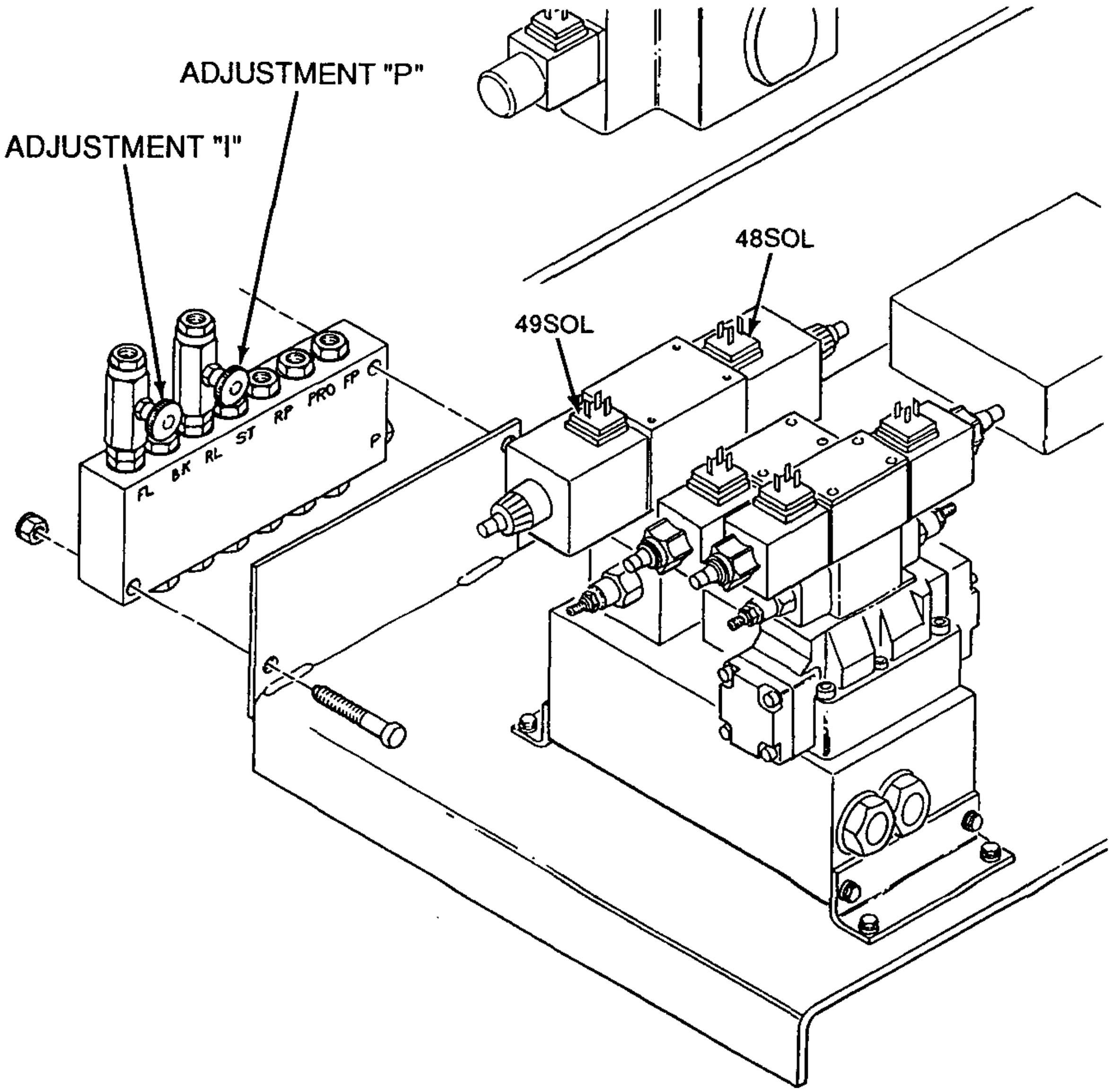
NOTE: This adjustment is critical and a small movement of the needle valve will make a change in bridge operation.

(5) Recheck adjustment of needle valve after smooth operation of the bridge is obtained. Bridge must raise immediately as the switch is actuated. (no delay) If there is a delay, needle valve has been turned too far clockwise and must be turned counterclockwise to remove any delay.

(6) Shut power unit down.

(7) Clean up any hydraulic oil that may have leaked.

(8) Swing power unit closed and secure with retention bolt.



BRIDGE SHUTTLE VALVE AND NEEDLE VALVE ADJUSTMENT
PLATFORM SHUTTLE VALVE AND NEEDLE VALVE ADJUSTMENT
Figure 14

J. Bridge Needle and Counterbalance Valves (Fig. 13, 15)

NOTE: An assistant is required for this procedure. Hydraulic oil must be at normal operating temperature.

WARNING: LOADER DRIVE WHEELS ARE TO BE CHOCKED TO PREVENT MOVEMENT IN EITHER DIRECTION. EYE PROTECTION MUST BE WORN WHEN MAKING ADJUSTMENTS.

(1) Remove bolt that secures power unit in the closed position and swing power unit open to gain access to needle and counterbalance valves at the base of the bridge lift cylinders.

(2) Have assistant start power unit and place mode switch in "OPERATE" to extend stabilizers, and then cycle bridge Up and DOWN several times.

(3) Have assistant raise bridge approximately half way and then raise platform fully to interface with the bridge and check bridge and platform for being level, side to side. Roll planes are to be level ± 9 to 12MM (3/8 to 1/2 inch) at the extreme left and right sides at interface. (Platform and bridge top frame surfaces can be used for measuring as an alternate to the roll planes).

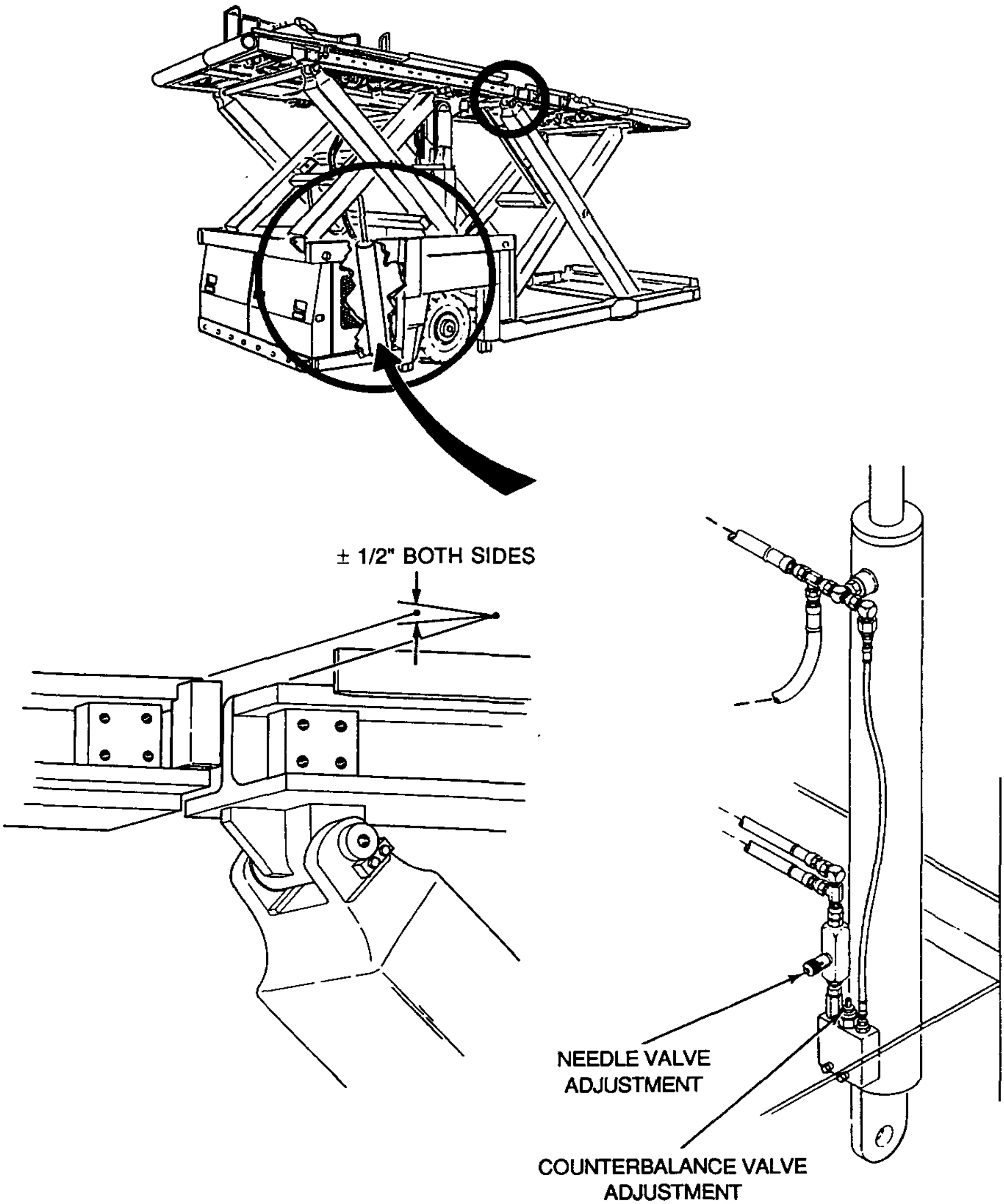
(4) Adjust needle valve on left side bridge cylinder to level bridge when bridge is being RAISED. Turn adjusting screw clockwise to slow the bridge down (on the left side) or counterclockwise to increase the bridge lift (on the left side).

NOTE: After each adjustment of the needle valve, lower the platform and bridge, then RAISE the bridge halfway. Raise the platform to interface and check level of the platform and bridge.

(5) Tighten lock screw securely after adjusting needle valve.

(6) Have assistant raise the bridge fully and then lower to platform interface and check that bridge is level with platform, side to side. Roll planes are to be level ± 9 to 12MM (3/8 to 1/2 inch). (Platform and bridge top frame surfaces can be used for measuring as an alternate to the roll planes)

NOTE: Platform is to be at approximately midpoint of bridge extension when checking level of the bridge and platform.



BRIDGE NEEDLE AND COUNTERBALANCE VALVE ADJUSTMENT
Figure 15

(7) Adjust bridge counterbalance valves to make bridge level with the platform, when the bridge is lowered, to specification of ± 9 to 12MM (3/8 to 1/2 inch) by loosening the adjusting screw lock screws and turning adjusting screws clockwise to decrease pressure or counterclockwise to increase pressure. Lock screws are to be securely tightened after each adjustment.

(8) Hydraulic pressures to lower bridge must be verified to be within specifications whenever bridge needle and counterbalance valves are adjusted.

(STANDARD LOADER)
Bridge lower pressure 83 to 90 bar (1200 to 1300 PSI)

(MAIN DECK LOADER)
Bridge lower pressure 96 to 103 bar (1400 to 1500 PSI)

(9) If bridge lower pressures are not within specifications, readjust counterbalance valves to increase pressure and level bridge with platform. BRIDGE LOWER HYDRAULIC PRESSURE MUST NEVER BE LESS THAN THE MINIMUM PRESSURE SPECIFIED.

Indicated pressure readings on gauge will include the standby pressure of 21 Bar (300 PSI) and this must be subtracted to obtain correct counterbalance pressure.

(STANDARD LOADER) 83 to 90 bar (1200 to 1300 PSI)
Indicated pressure 104 to 111 Bar (1500 to 1600 PSI)

(MAIN DECK LOADER 96 to 103 bar (1400 to 1500 PSI)
Indicated pressure 117 to 124 Bar (1700 to 1800 PSI)

(10) Have assistant shutdown power unit.

(11) Clean up any hydraulic oil that has leaked.

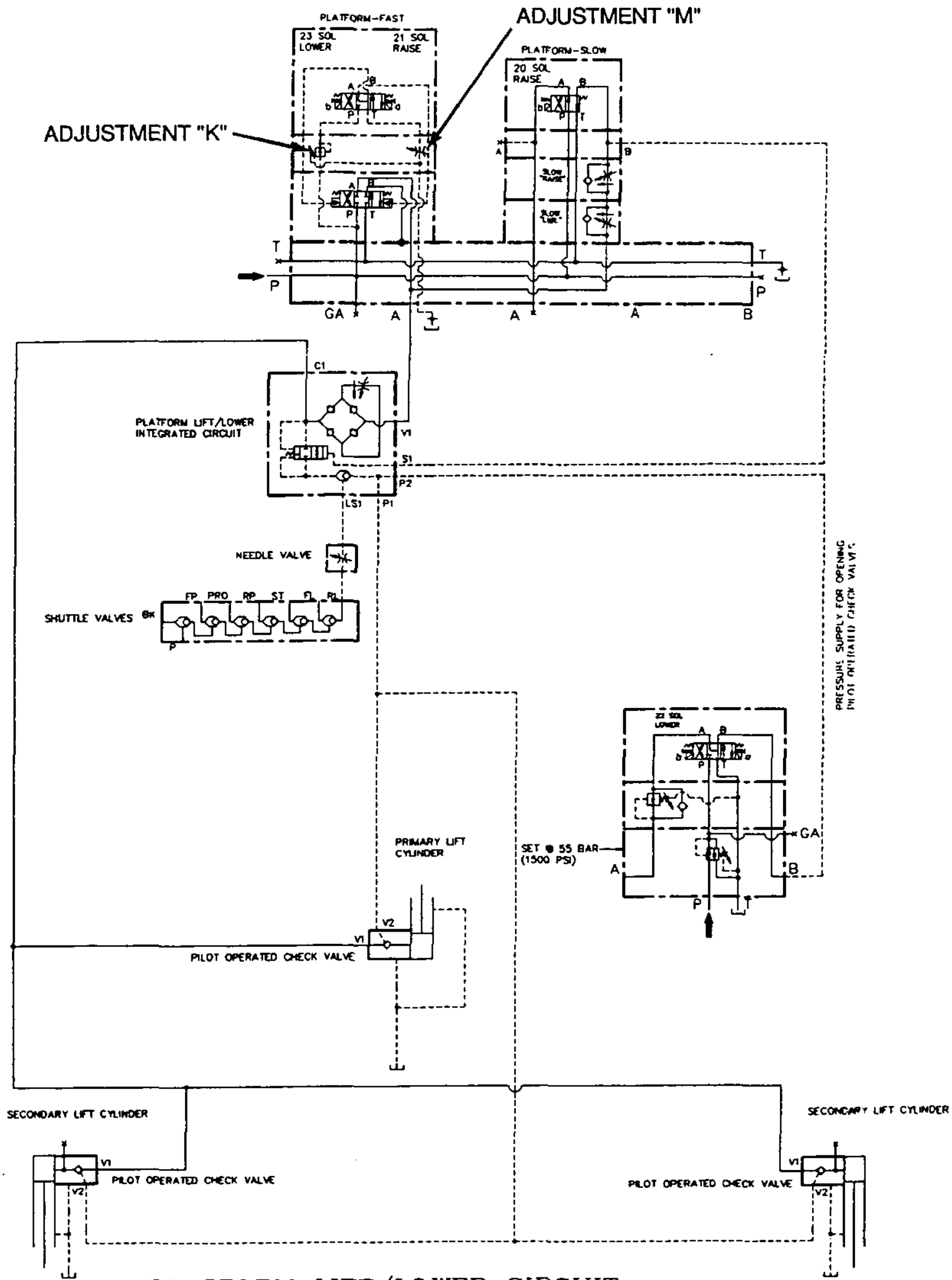
(12) Swing power unit closed and secure with retention bolt.

K. Pilot Pressure Reducing Valve (Fast Lift Valve) (Fig. 11, 16)

NOTE: This is a factory set adjustment and normally does not require a field adjustment.

(1) Remove bolt that secures power unit in the closed position and swing power unit open to gain access to platform pilot pressure reducing valve.

(2) With power unit shutdown, loosen locknut on adjusting screw and turn adjusting screw counterclockwise fully.



PLATFORM LIFT/LOWER CIRCUIT

PLATFORM LIFT/LOWER CIRCUIT
Figure 16

(3) Turn adjusting screw clockwise exactly two (2) full turns and securely tighten locknut on adjusting screw.

NOTE: If platform fast speed delay flow control (choke) cannot be set to specifications, increase pilot pressure by turning adjusting screw clockwise in 1/2 turn increments until fast lift valve shifts.

(4) Swing power unit to the closed position and secure with retention bolt.

L. Platform "Down" Pilot Pressure (Fig. 7, 16)

NOTE: An assistant is required for this procedure. Hydraulic oil must be at normal operating temperature.

WARNING: LOADER DRIVE WHEELS ARE TO BE CHOCKED TO PREVENT MOVEMENT IN EITHER DIRECTION. EYE PROTECTION MUST BE WORN WHEN MAKING ADJUSTMENTS.

(1) Remove bolt that secures power unit in the closed position and swing power unit open to gain access to pump and valves.

(2) Have assistant start the power unit and place the mode switch in "OPERATE" to extend the stabilizers, and then actuate and HOLD the platform switch in DOWN position. Observe the pressure gauge for an indicated reading of 124 bar (1800 PSI).

NOTE: A 124 bar (1800 PSI) indicated reading at gauge port "A" will be the combined pressure of the platform "LOWER" pressure reducing valve and standby pressure, i.e.:

103 bar (1500 PSI)	platform down pilot pressure
21 bar (300 PSI)	standby pressure
124 bar (1800 PSI)	indicated pressure

(3) If pressure reading of 124 bar (1800 PSI) is not indicated on gauge, loosen locknut on adjusting screw and turn adjusting screw clockwise to increase pressure or counterclockwise to decrease pressure.

(4) When platform "LOWER" pilot pressure has been set to specifications, tighten locknut on adjusting screw securely.

(5) Verify platform "LOWER" pilot pressure setting by activating switch several times.

(6) Have assistant shut down power unit.

(7) Clean up any oil that has leaked during adjustment procedure.

(8) Swing power unit closed and secure with retention bolt.

M. Platform Fast Speed Delay Flow Control (Choke) (Fig. 11, 16)

<u>NOTE:</u> An assistant is required for this procedure. Hydraulic oil must be at normal operating temperature.

<u>WARNING:</u> LOADER DRIVE WHEELS ARE TO BE CHOCKED TO PREVENT MOVEMENT IN EITHER DIRECTION. EYE PROTECTION MUST BE WORN WHEN MAKING ADJUSTMENTS.

(1) Remove bolt that secures power unit in the closed position and swing power unit open to gain access to the platform fast speed delay flow control.

(2) Have assistant start power unit, place the mode switch in "OPERATE" to extend the stabilizers, and then raise platform above 760MM (30 inches).

(3) Have assistant actuate switch for platform raise and check the time delay from when the platform first starts to move and when the fast lift valve shifts to high speed. Shift should occur in 2 to 3 seconds and must be a smooth shift.

(4) To adjust the fast speed delay flow control, loosen locknut on the adjusting screw and turn adjusting screw clockwise to increase the time delay and counterclockwise to decrease the time delay. Tighten locknut securely after adjustment has been made.

<u>NOTE:</u> If adjustment cannot be achieved, (VALVE DOES NOT SHIFT) check PILOT PRESSURE REDUCING VALVE ADJUSTMENT. Increase pilot pressure to achieve shift on the fast lift valve and adjust choke to obtain delay of 2 to 3 seconds.

(5) Recheck fast speed delay when automatic fast speed occurs. (Platform shifts from low speed to high speed at 760MM (30 inches) when being raised and at 100MM (4 inches) when platform is being lowered from bridge interface)

(6) Have assistant shutdown power unit.

(7) Clean up any oil that may have leaked during adjustment procedure.

(8) Swing power unit closed and secure with retention bolt.

N. Platform Slow Raise/Slow Lower Flow Control Needle Valve Adjustments (Fig. 12, 16)

<u>NOTE:</u> An assistant is required for this procedure. Hydraulic oil must be at normal operating temperature.

<u>WARNING:</u> LOADER DRIVE WHEELS ARE TO BE CHOCKED TO PREVENT MOVEMENT IN EITHER DIRECTION. EYE PROTECTION MUST BE WORN WHEN MAKING HYDRAULIC ADJUSTMENTS.

(1) Remove bolt that secures power unit in the closed position and swing power unit open to gain access to needle valve adjustments on flow control valves.

(2) Have assistant start power unit and raise and lower bridge full extension. Verify that bridge raises and lowers in the times specified in performance specifications.

(3) Raise bridge and platform to full extension and then lower bridge. Platform must lower evenly with the bridge.

(4) Adjust slow lower flow control needle valve for platform to match bridge lowering speed by loosening locknut on adjusting screw and turn adjusting screw clockwise to decrease platform speed or counterclockwise to increase platform speed. Tighten locknut securely on adjusting screw after each adjustment.

(5) Lower platform and bridge fully, and then raise bridge approximately 300MM (12 inches).

(6) Raise platform to interface with the bridge.

(7) Raise bridge and observe that platform raises at the same speed.

(8) Adjust slow raise flow control needle valve for platform to match bridge raise speed. Loosen locknut on adjusting screw and turn adjusting screw clockwise to decrease platform speed or counterclockwise to increase platform speed. Tighten locknut securely after each adjustment.

(9) Have assistant lower platform and bridge fully and shut down power unit.

(10) Clean up any hydraulic oil that may have leaked.

(11) Swing power unit closed and secure with retention bolt.

O. Platform Fast Lift/Lower Flow Control (Fig. 3)

NOTE: An assistant is required for this procedure. Hydraulic oil must be at normal operating temperature.

WARNING: LOADER DRIVE WHEELS ARE TO BE CHOCKED TO PREVENT MOVEMENT IN EITHER DIRECTION. EYE PROTECTION MUST BE WORN WHEN MAKING ADJUSTMENTS.

NOTE: This is a factory set adjustment and normally does not require a field adjustment.

(1) Remove bolt that secures power unit in the closed position and swing power unit open to gain access to the platform fast lift/lower flow control adjustment.

(2) Carefully turn adjusting screw clockwise until it seats (DO NOT OVERTIGHTEN) and tighten locknut on adjusting screw securely.

(3) Have assistant start power unit and place the mode switch in "OPERATE" to extend the stabilizers, and then raise the bridge and platform to full extension.

(4) Lower platform and check that time to lower is within specification of 10 to 15 seconds.

(5) Adjust PLATFORM fast raise/lower flow control, if platform does not lower within specification of 10-15 seconds.

(6) Loosen locknut on adjusting screw and turn adjusting screw 1/2 turn counterclockwise and tighten locknut.

NOTE: Turning adjusting screw counterclockwise will increase the time for the platform to lower.

(7) Recheck platform speed down after each adjustment of 1/2 turn until platform lowers in specified time of 10 to 15 seconds from full extension.

(8) Clean up any hydraulic oil that may have leaked.

(9) Swing power unit to the closed position and secure with retention bolt.

P. Platform Shuttle Valve (Needle Valve Adjustment) (Fig. 14)

NOTE: An assistant is required for this procedure. Hydraulic oil must be at normal operating temperature.

(1) Remove bolt that secures power unit in the closed position and swing power unit open to gain access to needle valve. Needle valve will be located in the hydraulic line connected to port marked "RL" on shuttle valve manifold.

(2) Loosen lock screw on adjusting screw and turn adjusting screw fully clockwise until needle is seated (DO NOT OVERTIGHTEN). Turn needle valve counterclockwise exactly 3/4 turn and tighten lock screw securely on adjusting screw.

(3) Have assistant start power unit and place mode switch in "OPERATE" to extend stabilizers, raise bridge and platform to full extension, and then raise platform. Platform must raise smoothly from full extension.

(4) Adjust needle valve if required, to obtain smooth operation of platform when being raised.

<u>NOTE:</u> This adjustment is critical and a small movement of the needle valve will make a change in platform operation.

(5) Shut power unit down.

(6) Clean up any hydraulic oil that may have leaked.

(7) Swing power unit closed and secure with retention bolt.

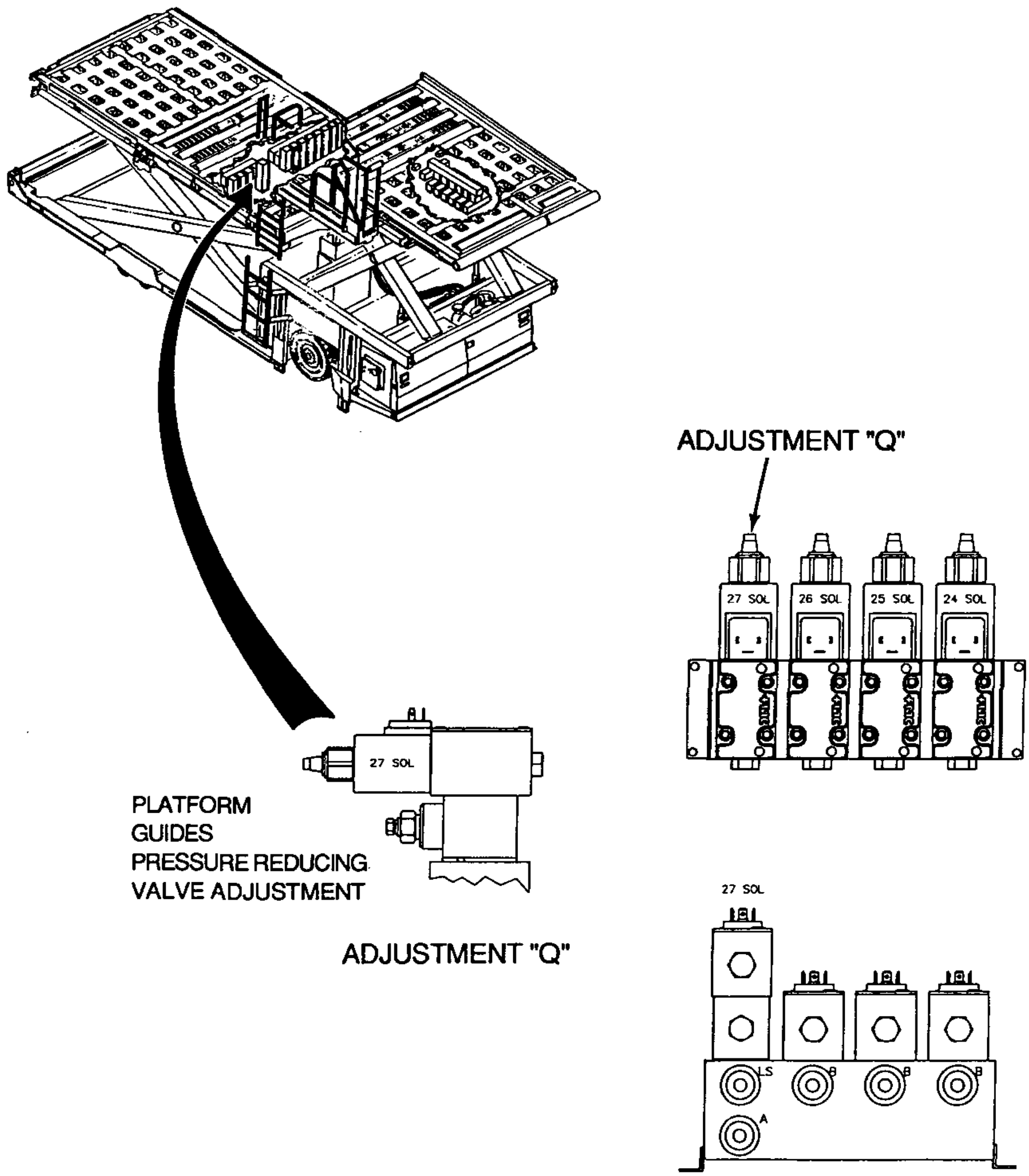
Q. Platform Guides Pressure Reducing Valve Adjustment (Fig. 17, 18)

<u>NOTE:</u> An assistant is required for this procedure. Hydraulic oil must be at normal operating temperature.

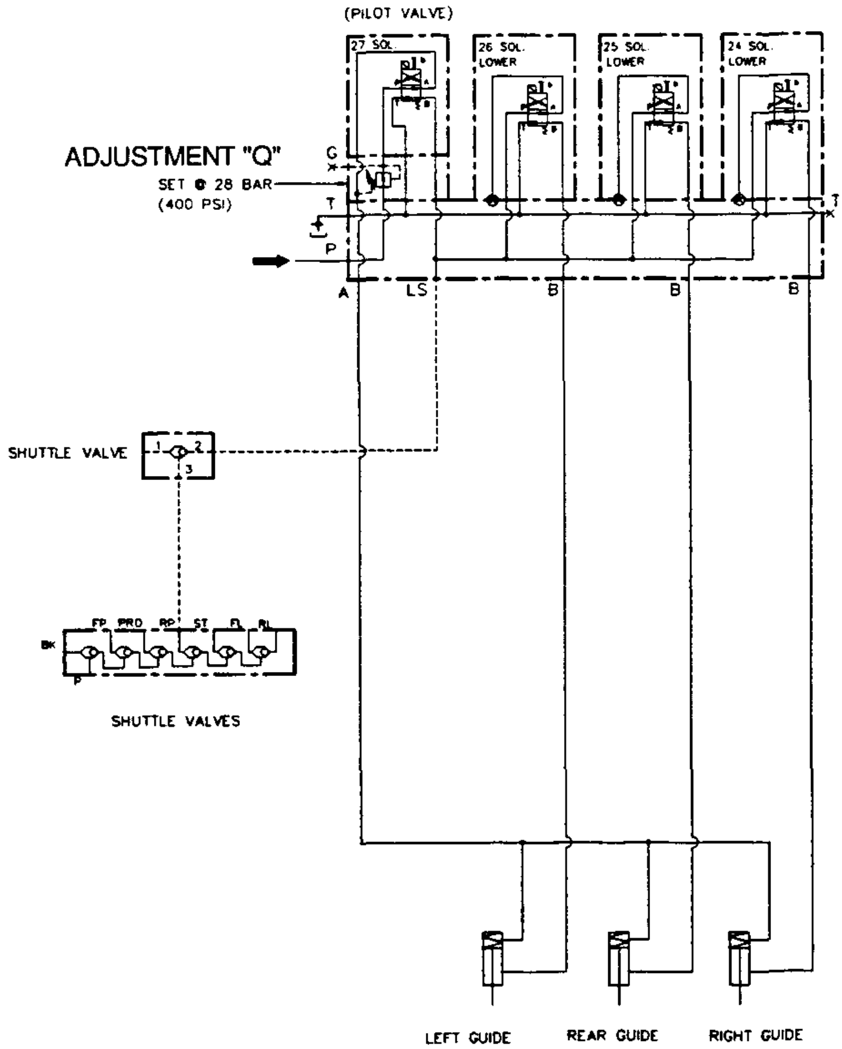
<u>WARNING:</u> LOADER DRIVE WHEELS ARE TO BE CHOCKED TO PREVENT MOVEMENT IN EITHER DIRECTION. EYE PROTECTION MUST BE WORN WHEN MAKING ADJUSTMENT.

(1) Have assistant start power unit and place the mode switch in "OPERATE" to extend the stabilizers, and then raise the platform. Move the maintenance stands into position and lower the platform fully against the maintenance stands.

(2) Open power unit access doors so that pressure gauge may be observed.



PLATFORM GUIDES PRESSURE REDUCING VALVE
Figure 17



PLATFORM GUIDES REDUCING VALVE ADJUSTMENT
Figure 18

(3) Have assistant manually actuate side guide solenoid valve (27 SOL) and observe for indicated pressure of 49 bar (700 PSI) on gauge.

NOTE: A 48 bar (700 PSI) indicated reading on gauge port "A" will be the combined pressure of the platform guides reducing valve and standby pressure, i.e:

28 bar (400 PSI)	reducing valve pressure
21 bar (300 PSI)	standby pressure
49 bar (700 PSI)	indicated pressure on gauge

(4) To adjust pressure reducing valve, loosen locknut on adjusting screw and turn adjusting screw clockwise to increase pressure or counterclockwise to decrease pressure. Tighten locknut securely after each adjustment.

(5) Clean up any hydraulic oil that may have leaked.

(6) Raise platform and stow maintenance stands, lower platform and close power unit access doors when adjustments are completed.

(7) Have assistant shutdown power unit.

R. Platform Convey Speed (Fig. 19, 20)

NOTE: An assistant is required for this procedure. Hydraulic oil must be at normal operating temperature.

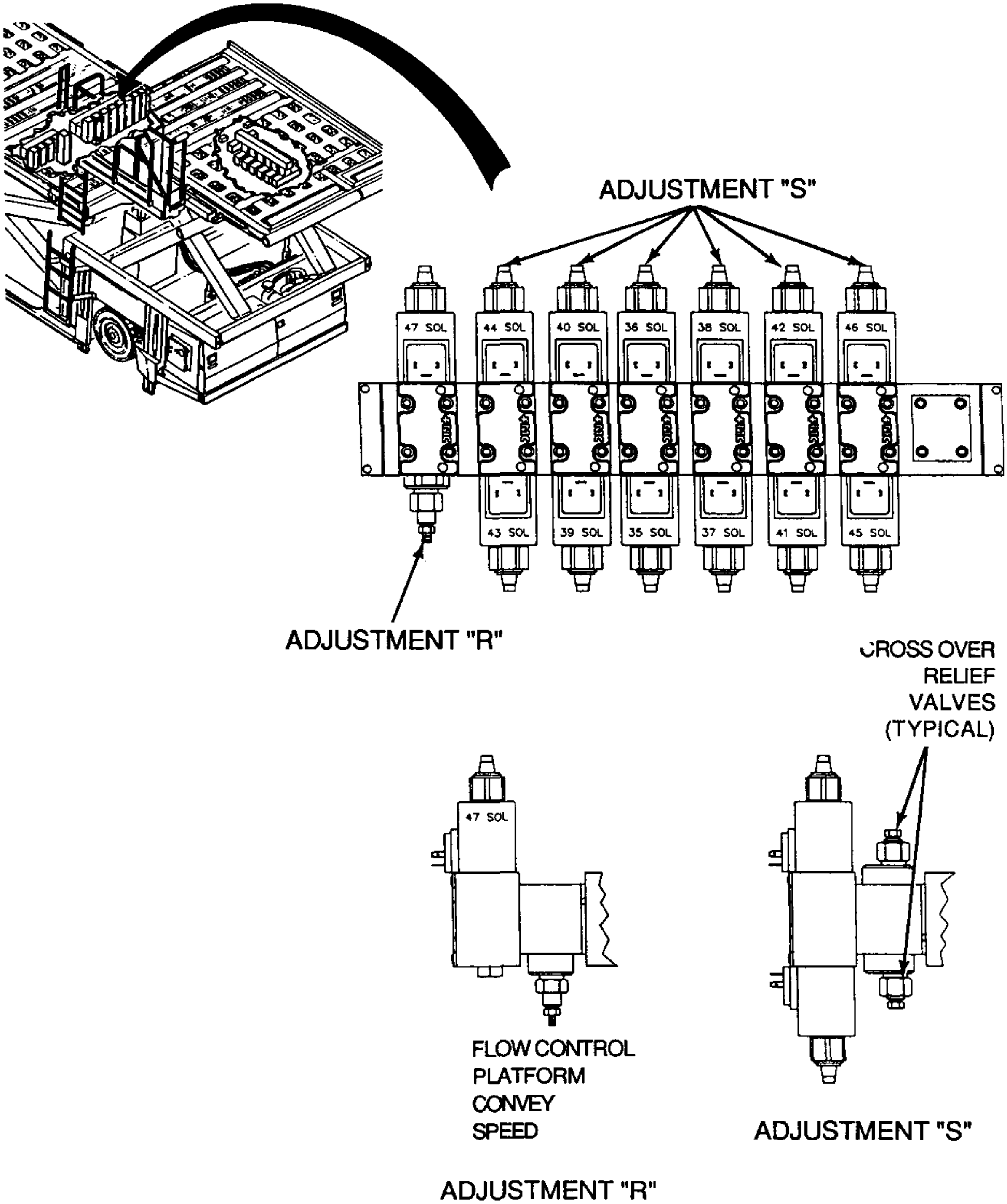
CAUTION: LOADER DRIVE WHEELS ARE TO BE CHOCKED TO PREVENT MOVEMENT IN EITHER DIRECTION. EYE PROTECTION MUST BE WORN WHEN MAKING HYDRAULIC ADJUSTMENTS.

(1) Have assistant start power unit and place mode switch in "OPERATE" to extend stabilizers and then raise rear platform. Move maintenance stands into position and then lower platform fully against maintenance stands.

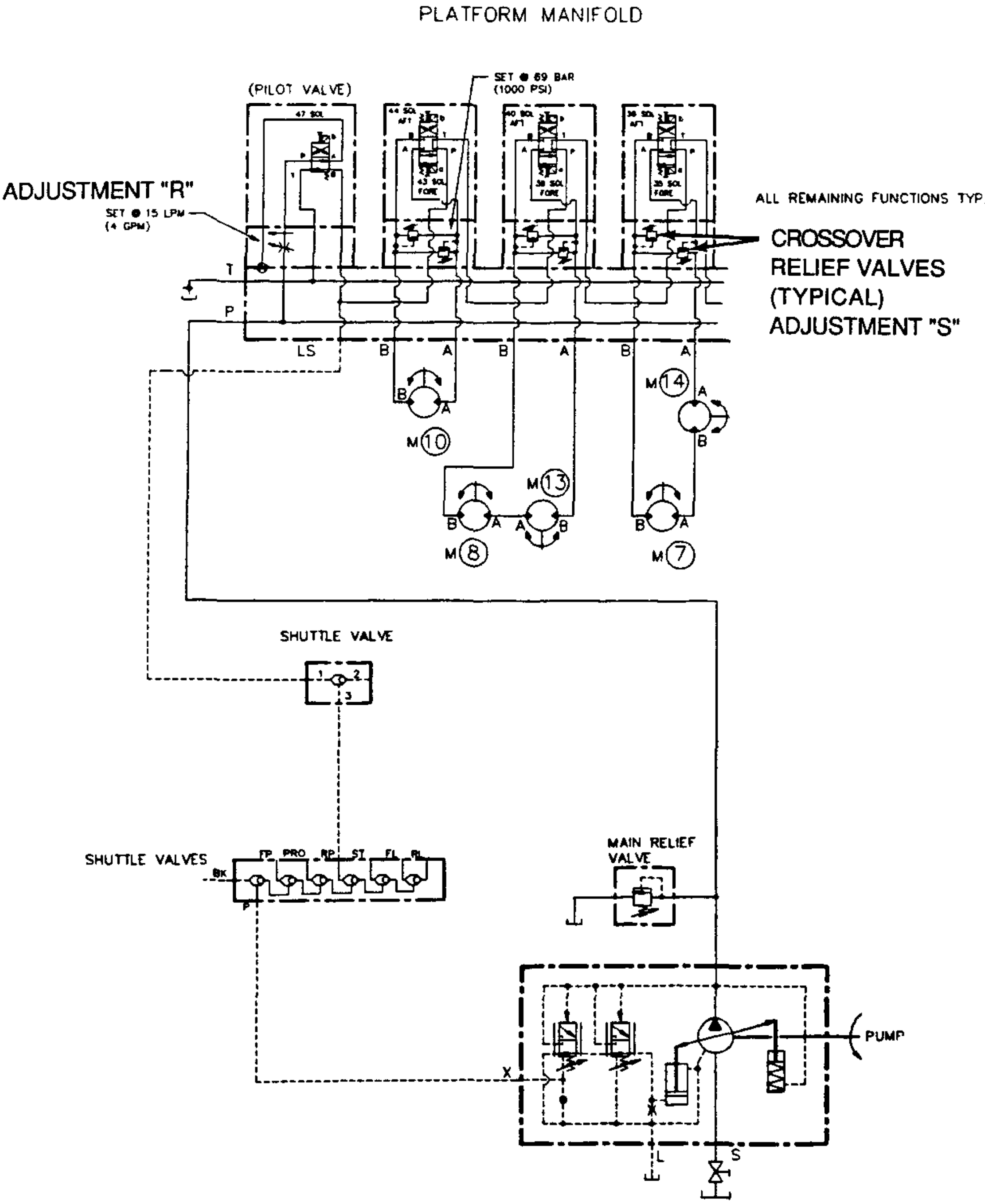
(2) Have assistant actuate platform convey switches and time rollers for specified revolutions per minute. (39-41 RPM) to obtain 60 feet per minute surface speed.

(3) To adjust roller speed, loosen locknut on flow control adjusting screw and turn adjusting screw clockwise to increase speed and counterclockwise to decrease speed. Tighten locknut securely after each adjustment.

NOTE: Flow control is located in manifold block opposite of 47SOL solenoid valve.



PLATFORM FLOW CONTROL AND
CROSSOVER RELIEF VALVES
Figure 19



PLATFORM CONVEY CIRCUIT

FLOW CONTROL CONVEY AND
CROSSOVER RELIEF VALVES
Figure 20

(4) Clean up hydraulic oil that may have leaked.

(5) Have assistant raise platform. Stow maintenance stands and then lower platform.

S. Platform Convey Crossover Relief Valves (Fig. 19, 20)

NOTE: An assistant is required for this procedure. Hydraulic oil must be at normal operating temperature.

WARNING: LOADER DRIVE WHEELS ARE TO BE CHOCKED TO PREVENT MOVEMENT IN EITHER DIRECTION. EYE PROTECTION MUST BE WORN WHEN MAKING HYDRAULIC ADJUSTMENTS.

(1) Have assistant start power unit and place mode switch in "OPERATE" position to extend stabilizers and then raise platform. Position maintenance stands to support platform and lower platform fully against maintenance stands. Have assistant shutdown power unit.

(2) Remove hydraulic hose from either "A" port or "B" port on valve assembly to be checked and cap adapter and plug hose.

(3) Have assistant start power unit.

(4) Manually actuate valve being checked and the pilot pressure solenoid valve (47SOL). Observe pressure gauge for indicated reading of 90 bar (1300 PSI).

NOTE: A 90 bar (1300 PSI) indicated reading at gauge port "A" will be the combined pressure of the crossover relief valve and standby pressure, i.e.:

69 bar (1000 PSI) Crossover relief pressure
21 bar (300 PSI) Standby pressure
90 bar (1300 PSI) Indicated pressure

(5) To adjust crossover relief valve pressure, loosen locknut on adjusting screw and turn adjusting screw clockwise to increase pressure and counterclockwise to decrease pressure. Tighten locknut on adjusting screw securely after each adjustment.

NOTE: Solenoid valve and pilot pressure valve must be manually held actuated to obtain indicated pressure when making adjustments.

(6) Check and adjust both relief valves in each valve section while hydraulic lines are capped.

(7) Have assistant shutdown power unit.

<u>NOTE:</u> This adjustment procedure applies to all valve sections with crossover relief valves in the convey system. Options available for the Commander loader determine the number of valves required and the position in the valve banks. Refer to composite hydraulic schematic for valve sections with crossover relief valves.

(8) Remove caps and plugs from hoses and adapters and reinstall hoses on adapters.

(9) Clean up any hydraulic oil that may have leaked.

(10) Have assistant start power unit and raise platform. Remove and stow maintenance stands, lower platform, and shutdown power unit.

T. Bridge Powered Guides Speed Adjustment (Fig. 21, 22)

<u>NOTE:</u> An assistant is required for this procedure. Hydraulic oil must be at normal operating temperature.

<u>WARNING:</u> LOADER DRIVE WHEELS ARE TO BE CHOCKED TO PREVENT MOVEMENT IN EITHER DIRECTION. EYE PROTECTION MUST BE WORN WHEN MAKING HYDRAULIC ADJUSTMENTS.

(1) Remove bolt that secures power unit in the closed position and swing power unit open to gain access to guide speed needle valve.

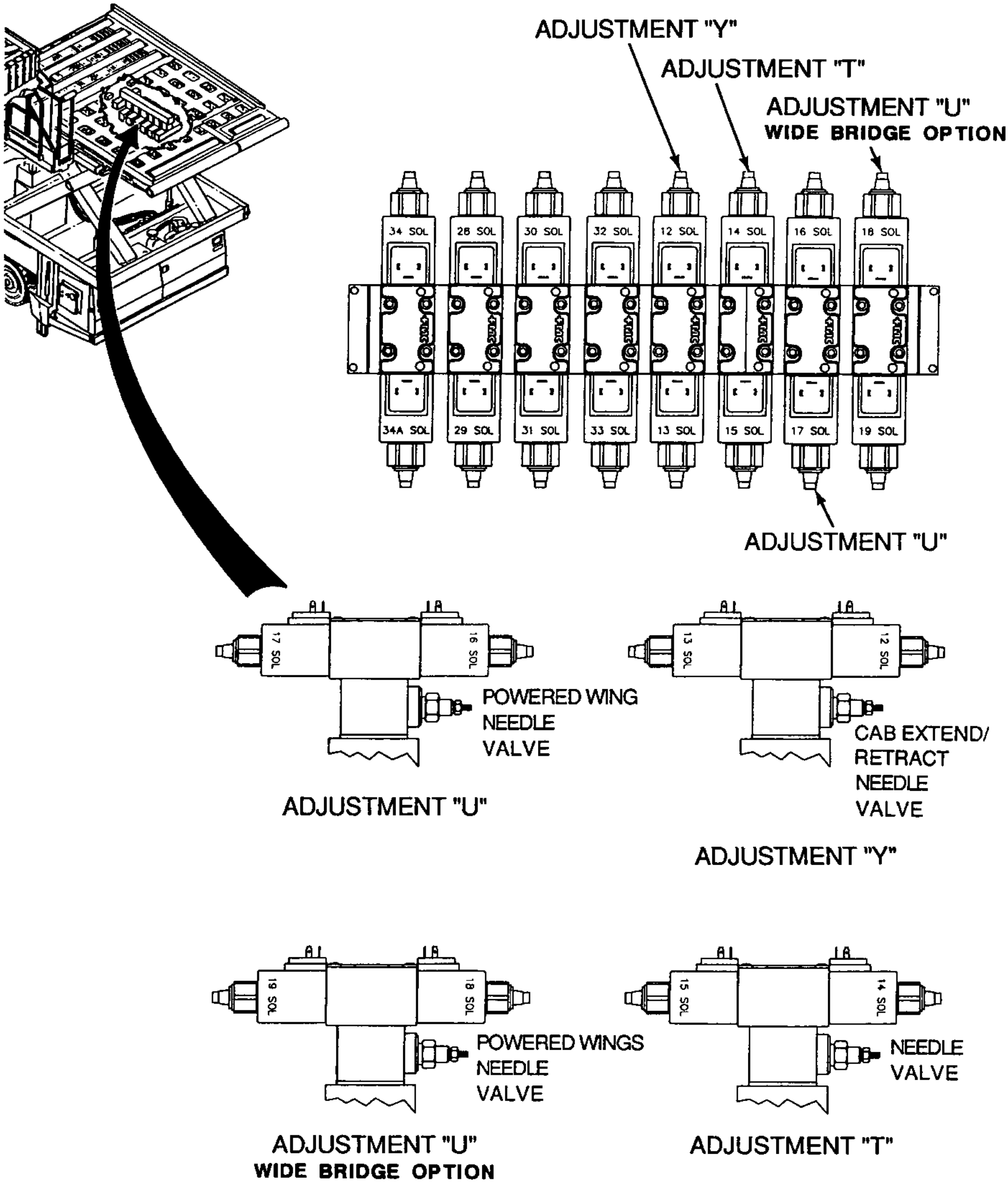
<u>NOTE:</u> Needle valve is located in manifold block below 14SOL solenoid valve.

(2) Have assistant start power unit and place mode switch in "OPERATE" position to extend stabilizers. Then shift guides from side to side. Specified time for full shift is 3 to 7 seconds.

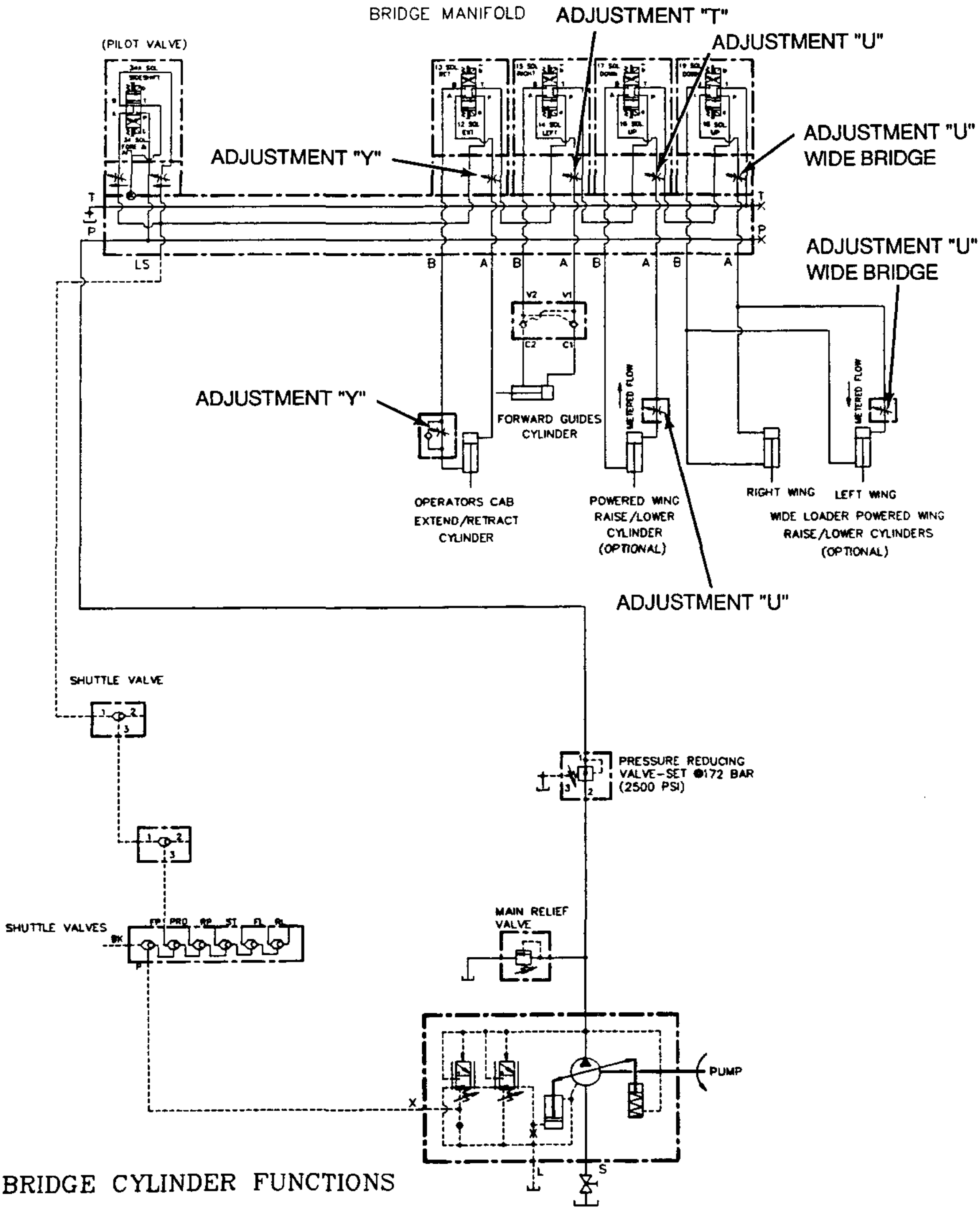
(3) To adjust shift speed, Loosen lock screw on needle valve and turn needle valve clockwise to decrease flow (increase time) or counterclockwise to increase flow (decrease time). Tighten locknut securely after each adjustment.

(4) Clean up hydraulic oil that may have leaked.

(5) Swing power unit closed and secure with retention bolt.

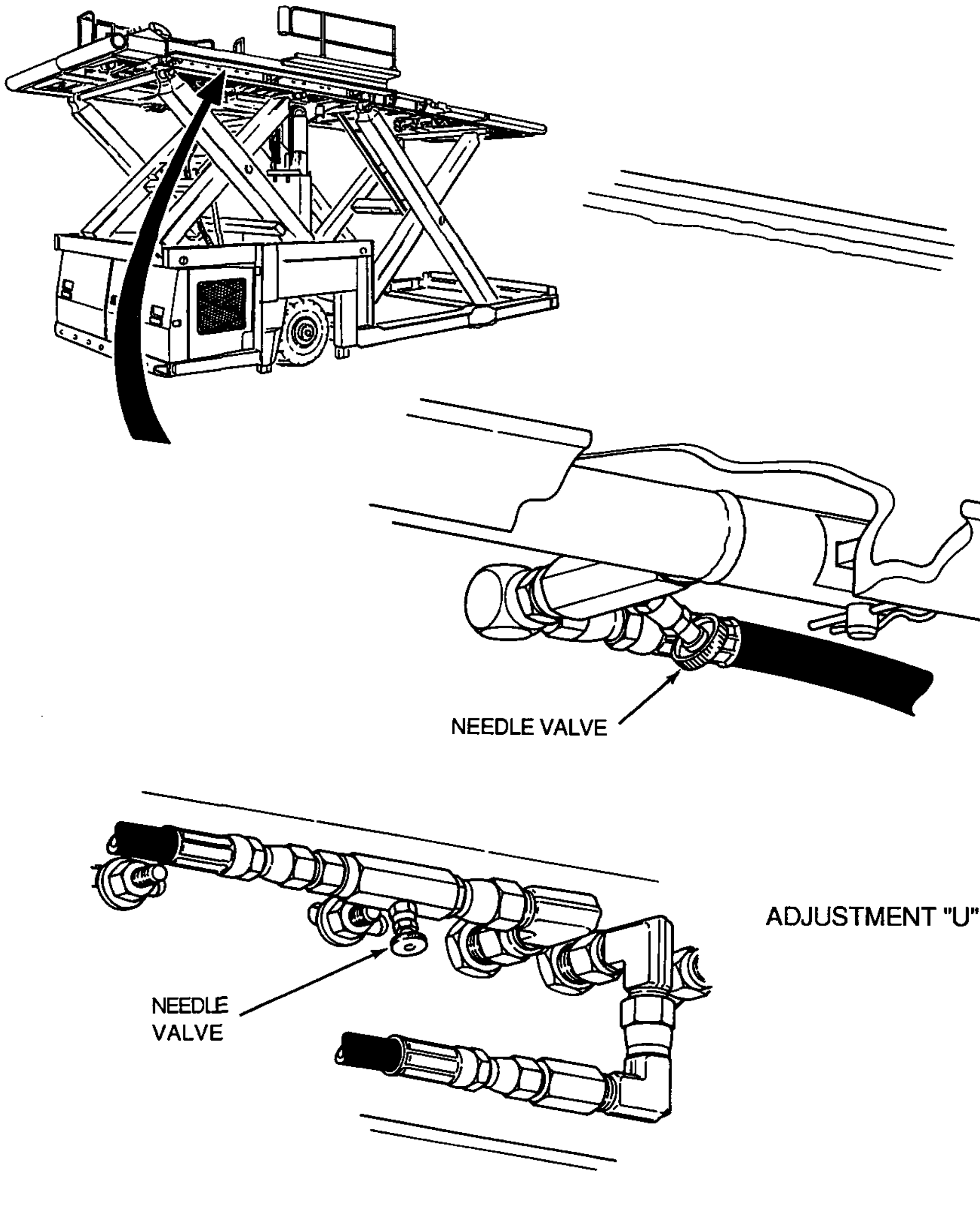


BRIDGE VALVE BANK ADJUSTMENTS
Figure 21



BRIDGE CYLINDER FUNCTIONS

BRIDGE VALVE BANK AND ADJUSTMENTS
Figure 22



POWER WING CYLINDER ADJUSTMENT
Figure 23

U. Bridge Powered Wing Speed Adjustment (Fig. 21, 22)

NOTE: An assistant is required for this procedure.
Hydraulic oil must be at normal operating temperature.

WARNING: LOADER DRIVE WHEELS ARE TO BE CHOCKED TO PREVENT MOVEMENT IN EITHER DIRECTION. EYE PROTECTION MUST BE WORN WHEN MAKING HYDRAULIC ADJUSTMENTS.

STANDARD BRIDGE

(1) Remove bolt that secures power unit in the closed position and swing power unit open to gain access to powered wing needle valves.

NOTE: Needle valve is located in manifold block below 16SOL solenoid valve.

(2) Have assistant start power unit and place mode switch in "OPERATE" position to extend stabilizers.

(3) Have assistant actuate powered wing switch to raise and lower powered wing. Wing is to fully raise or lower in specified time of 4 to 5 seconds.

(4) To adjust powered wing, raise and lower speeds, loosen lock screw on secondary needle valve and turn adjusting screw fully counterclockwise. (Secondary needle valve is located at cylinder.)

(5) Adjust primary needle valve by loosening lock screw on adjusting screw and turn adjusting screw clockwise to decrease flow (increase time) or counterclockwise increase flow (decrease time) until wing raises and lowers in specified time of 4 to 5 seconds. Tighten lock screw securely after each adjustment.

(6) After primary needle valve has been adjusted to specifications, adjust secondary needle valve by turning adjusting screw fully clockwise and then turn adjusting screw exactly 1/8 turn counterclockwise. Tighten lock screw securely on adjusting screw.

(7) Clean up any hydraulic oil that may have leaked.

(8) Swing power unit closed and secure with retention bolt.

WIDE BRIDGE POWERED WINGS ADJUSTMENT

NOTE: An assistant is required for this procedure. Hydraulic oil must be at normal operating temperature.

WARNING: LOADER WHEELS ARE TO BE CHOCKED TO PREVENT MOVEMENT IN EITHER DIRECTION. EYE PROTECTION MUST BE WORN WHEN MAKING HYDRAULIC ADJUSTMENTS.

(1) Remove bolt that secures power unit in the closed position and swing power unit open to gain access to powered wing needle valves.

(2) Have assistant actuate switch to raise and lower left and right side powered wings. Wings are to raise and lower in the specified time of 4 to 5 seconds. Left side powered wing must raise and lower fully AFTER right side wing.

(3) To adjust left and right side powered wings, loosen locknut and turn adjusting screw fully clockwise on left side powered wing hydraulic cylinder. (Fig. 23)

(4) Adjust needle valve to raise and lower right side wing in the specified time of 4 to 5 seconds. Tighten locknut securely after each adjustment. Needle valve is located in manifold block below 18SOL solenoid valve. (Fig. 21, 22)

(5) Turn adjusting screw on secondary needle valve counterclockwise until left side powered wing raises and lowers in specified time of 4 to 5 seconds. Tighten lock screw on adjusting screw.

NOTE: Left side powered wing must raise and lower fully after right side powered wing is full up and full down.

(6) Clean up any hydraulic oil that has leaked.

(7) Swing power unit closed and secure with retention bolt.

V. Bridge Convey Speeds

<u>NOTE:</u> An assistant is required for this procedure. Hydraulic oil must be at normal operating temperature.

<u>WARNING:</u> WHEELS MUST BE CHOCKED TO PREVENT MOVEMENT IN EITHER DIRECTION. EYE PROTECTION MUST BE WORN WHEN MAKING HYDRAULIC ADJUSTMENTS.

(1) Remove bolt that secures power unit in the closed position, and swing power unit open for access to flow control adjustments.

(2) Have assistant start power unit and move mode switch to "OPERATE" to extend stabilizers, and then actuate bridge convey switch. Time rollers for specified revolutions per minute (39-41 RPM) to obtain 60 feet per minute surface speed.

(3) To adjust roller speed, (fore and aft) loosen locknut on flow control adjusting screw and turn adjusting screw clockwise to increase speed or counterclockwise to decrease speed. Tighten locknut securely after each adjustment.

<u>NOTE:</u> Flow control adjustment is located in manifold block below 34SOL solenoid valve. (Fig. 24, 25)

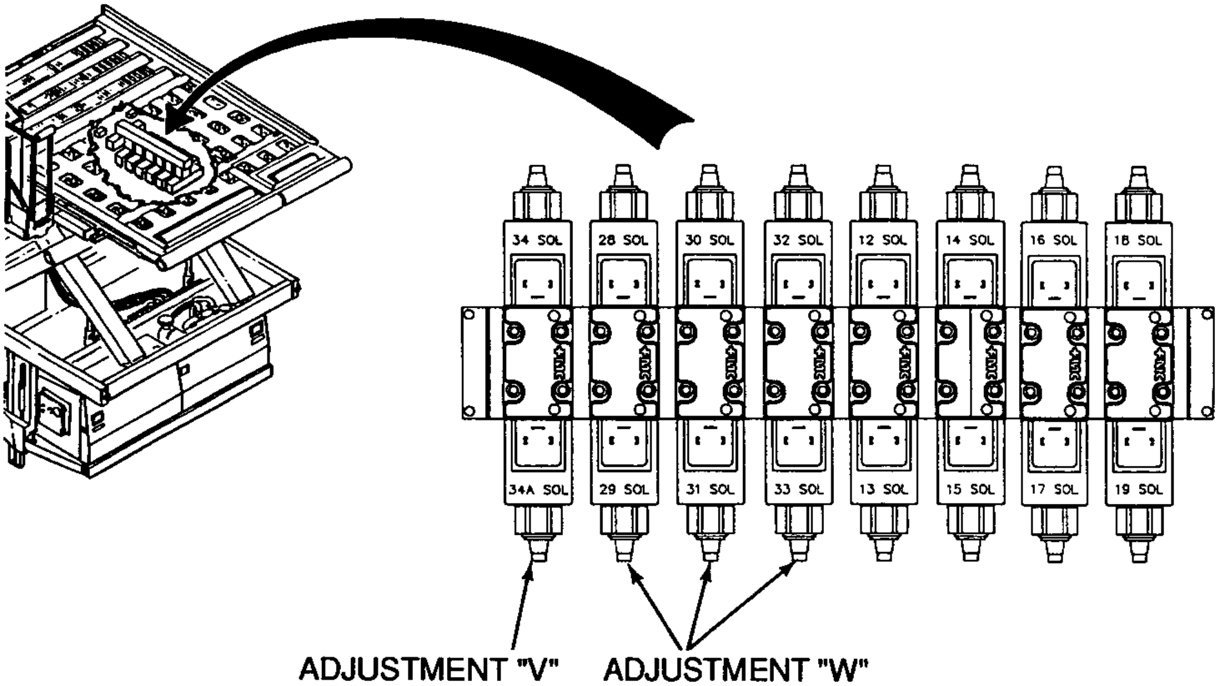
(4) To adjust roller speed for side transfer on bridge, loosen locknut on adjusting screw and turn adjusting screw clockwise to decrease speed or counterclockwise to increase speed. Tighten locknut securely after each adjustment.

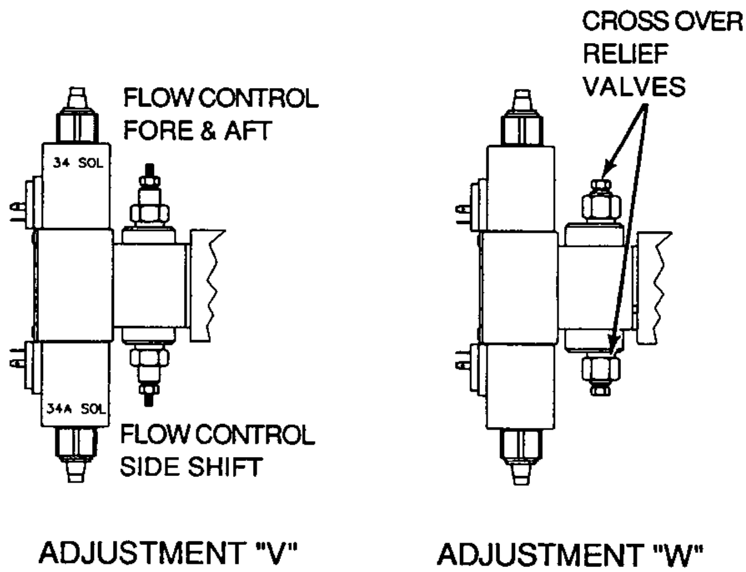
<u>NOTE:</u> Side transfer speed is 30 feet per minute (19-21 RPM).

Side transfer adjusting screw is located in manifold block below 34A solenoid valve. (Fig. 24, 25)

(5) Clean up any hydraulic oil that may have leaked.

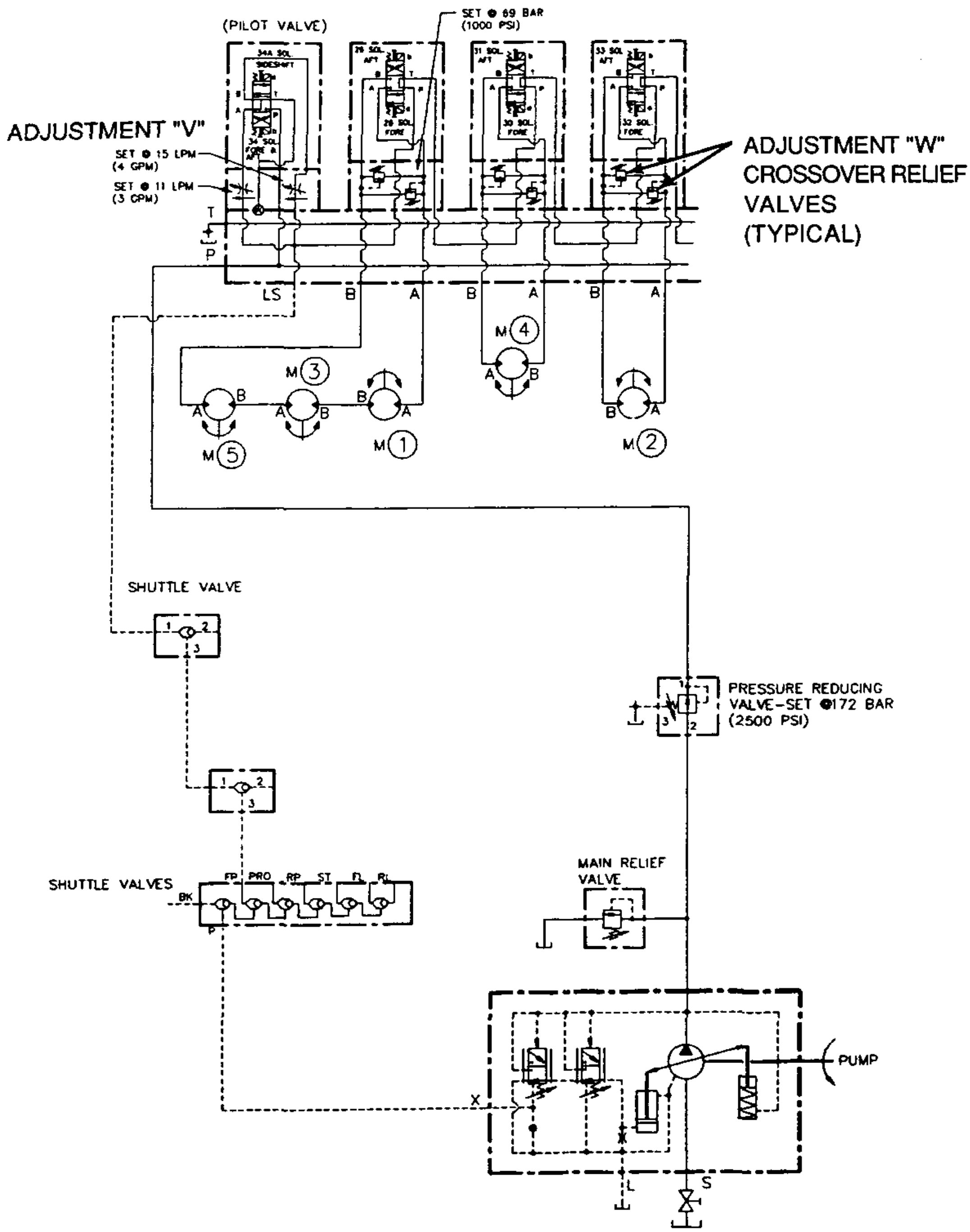
(6) Swing power unit closed and secure with retention bolt.





BRIDGE CONVEY ADJUSTMENTS
Figure 24

BRIDGE MANIFOLD



BRIDGE CONVEY CIRCUIT

BRIDGE CONVEY SPEED AND CROSSOVER RELIEF VALVES
Figure 25

W. Bridge Convey Crossover Relief Valves (Fig. 24, 25)

NOTE: An assistant is required for this procedure. Hydraulic oil must be at normal operating temperature.

WARNING: LOADER DRIVE WHEELS ARE TO BE CHOCKED TO PREVENT MOVEMENT IN EITHER DIRECTION. EYE PROTECTION MUST BE WORN WHEN MAKING HYDRAULIC ADJUSTMENTS.

(1) Remove bolt that secures power unit in the closed position and swing power unit open to gain access to crossover relief valve adjusting screws.

(2) Remove hydraulic hose from either "A" port or "B" port on valve assembly to be checked and cap adapter and plug hose.

(3) Have assistant start power unit and place mode switch in "OPERATE" to extend stabilizers.

(4) Manually actuate valve being checked and the pilot pressure solenoid valve (34A). Observe pressure gauge for indicated reading of 90 bar (1300 PSI).

NOTE: A 90 bar (1300 PSI) indicated reading at gauge port "A" will be the combined pressure of the crossover relief valve and standby pressure, i.e.:

69 bar (1000 PSI) Crossover relief pressure
21 bar (300 PSI) Standby pressure
90 bar (1300 PSI) Indicated pressure

(5) To adjust crossover relief valve pressure, loosen locknut on adjusting screw and turn adjusting screw clockwise to increase pressure or counterclockwise to decrease pressure. Tighten locknut on adjusting screw securely after each adjustment.

NOTE: Solenoid valve and pilot pressure valve must be manually held actuated to obtain indicated pressure when making adjustments.

(6) Check and adjust both relief valves in each valve sections while hydraulic lines are capped.

(7) Have assistant shutdown power unit.

(8) Remove caps and plugs from hose and adapter and reinstall hose.

(9) Clean up any hydraulic oil that may have leaked.

(10) Swing power unit closed and secure with retention bolt.

NOTE: This adjustment procedure applies to all valve sections with crossover relief valves in the convey system. Options available for the Commander loader determine the number of valves required and the position in the valve banks. Refer to composite hydraulic schematic for valve sections with crossover relief valves.

X. Dynamic Braking Adjustment (Fig. 3)

NOTE: An assistant is required for this procedure. Hydraulic oil must be at normal operating temperature.

Braking adjustment must be done on smooth, hard, dry and level surface.

(1) Mark a measured distance of 9 meters (30 feet) and 12 meters (40 feet) on surface where loader is to be checked and adjusted.

(2) Have assistant drive loader at maximum speed in RABBIT mode and release accelerator at beginning point of measured distance.

(3) Loader must come to a complete stop smoothly in 10.5 to 12 meters (35 to 40 feet).

(4) To make dynamic braking adjustment, have assistance set parking brakes and shutdown power unit.

(5) Remove bolt that secures power unit in the closed position and swing power unit open to gain access to dynamic braking adjustment.

(6) Loosen locknut on dynamic braking pressure adjusting screw and turn adjusting screw clockwise to decrease stopping distance or counterclockwise to increase stopping distance. Make adjustments in 1/2 turn increments until dynamic braking is set within specifications.

(7) Dynamic braking adjusting screw locknut is to be tightened securely after each adjustment.

(8) Swing power unit closed and secure with retention bolt after each adjustment has been made.

(9) Repeat steps 2 through 8 above until dynamic braking will stop the loader in the specified distance of 10.5 to 12 meters (35 to 40 feet).

Y. Cab Extend/Retract Speed Adjustment. (Fig. 21, 22)

NOTE: An assistant is required for this procedure. Hydraulic oil must be at normal operating temperature.

WARNING: LOADER DRIVE WHEELS ARE TO BE CHOCKED TO PREVENT MOVEMENT IN EITHER DIRECTION. EYE PROTECTION MUST BE WORN WHEN MAKING HYDRAULIC ADJUSTMENTS.

(1) Remove bolt that secures power unit in the closed position and swing power unit open for access to cab extension needle valve located in manifold block below 12SOL solenoid valve.

(2) Have assistant start power unit and place mode switch in "OPERATE" to extend stabilizers, and then fully extend operator's cab. Time to extend must be within specified time of 14 +1, -0 seconds, full travel.

(3) To adjust speed of cab extension, first check cab retract flow control needle valve adjustment.

(a) Loosen lock screw and turn needle valve fully clockwise until it seats, then turn needle valve exactly 1 1/2 turns counterclockwise and lock needle valve with lock screw.

(4) Recheck time for full cab extension and adjust cab extend needle valve to obtain full cab extension in specified time of 14 +1, -0 seconds, full travel.

(5) Recheck cab retract speed for full travel in specified time of 20 ± 2 seconds.

NOTE: Adjust cab extend speed needle valve ONLY to correct extend and retract speeds to specifications. DO NOT change preset setting on cab retract flow control needle valve.

(6) Clean up any hydraulic oil that may have leaked.

(7) Swing power unit closed and secure with retention bolt.

Z. Power Steering Pressure Reducing Valve Adjustment (Fig. 26, 27)

NOTE: An assistant is required for this procedure. Hydraulic oil must be at normal operating temperature.

WARNING: EYE PROTECTION MUST BE WORN WHEN MAKING ADJUSTMENTS.

(1) Remove bolt that secures power unit in the closed position and swing power unit open to gain access to power steering reducing valve adjustment.

(2) Have assistant start power unit and place mode switch in "OPERATE" to extend the stabilizers. Turn steering wheel fully in either direction, and continue turning in that direction while observing pressure gauge for an indicated reading of 193 bar (2800 PSI.

NOTE: A 193 bar (2800 PSI) indicated reading at gauge port "A" will be the combined pressure of the power steering reducing valve and standby pressure, i.e:

172 bar (2500 PSI)	power steering reducing valve
21 bar (300 PSI)	standby pressure
193 bar (2800 PSI)	indicated pressure on gauge

(3) To adjust power steering reducing valve, loosen locknut on adjusting screw and turn adjusting screw clockwise to increase pressure or counterclockwise to decrease pressure.

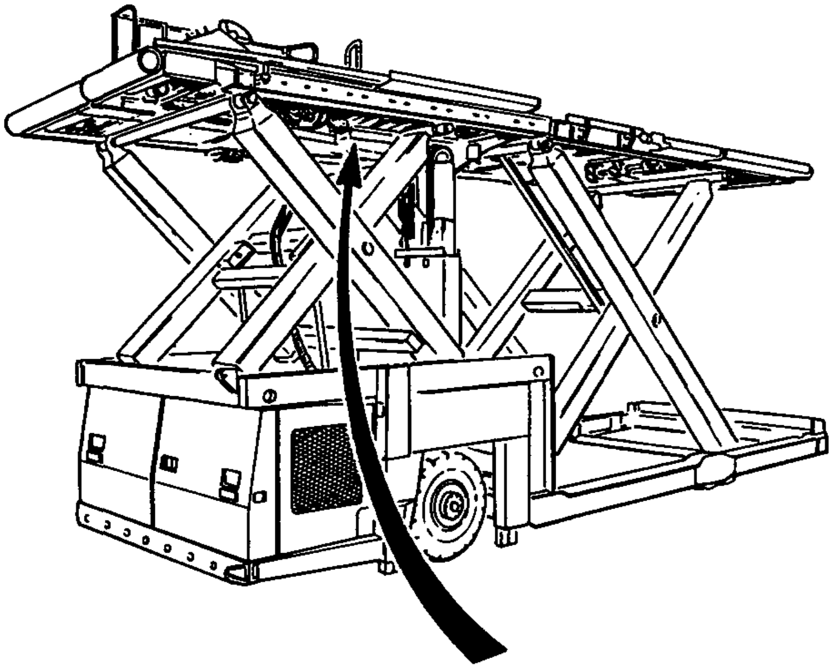
(4) When power steering reducing valve pressure has been set to specifications, tighten locknut on adjusting screw securely.

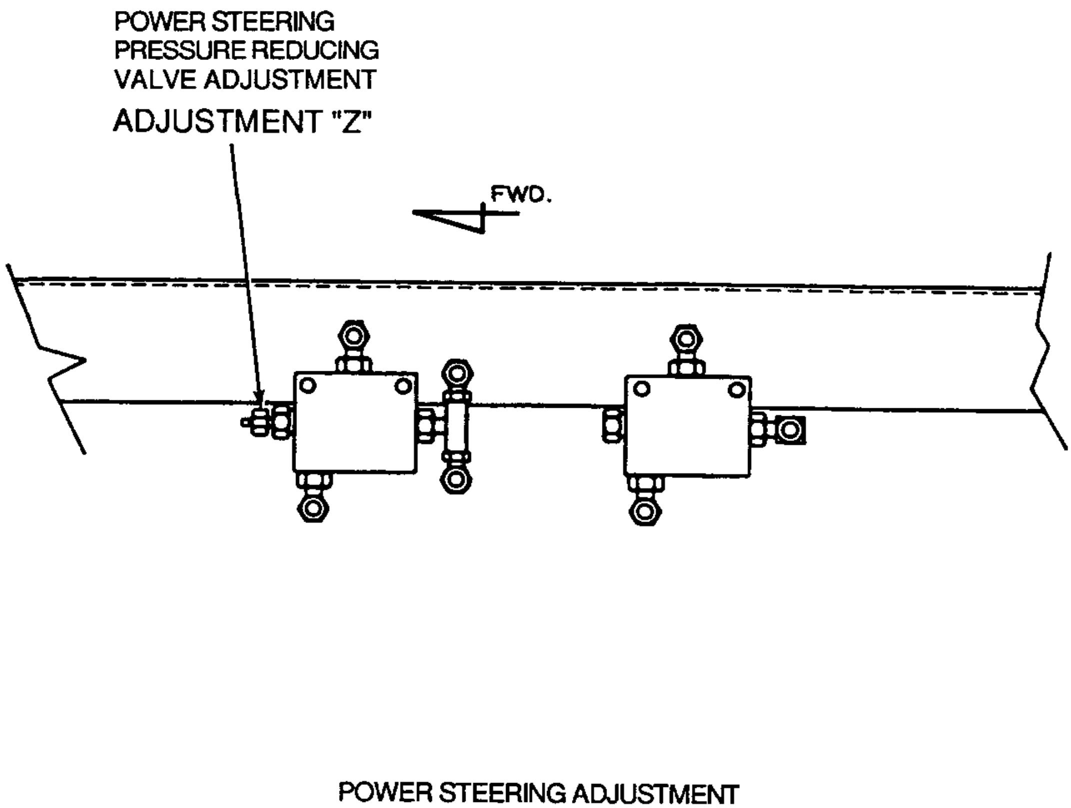
(5) Have assistant shutdown power unit.

(6) Clean up any hydraulic oil that may have leaked.

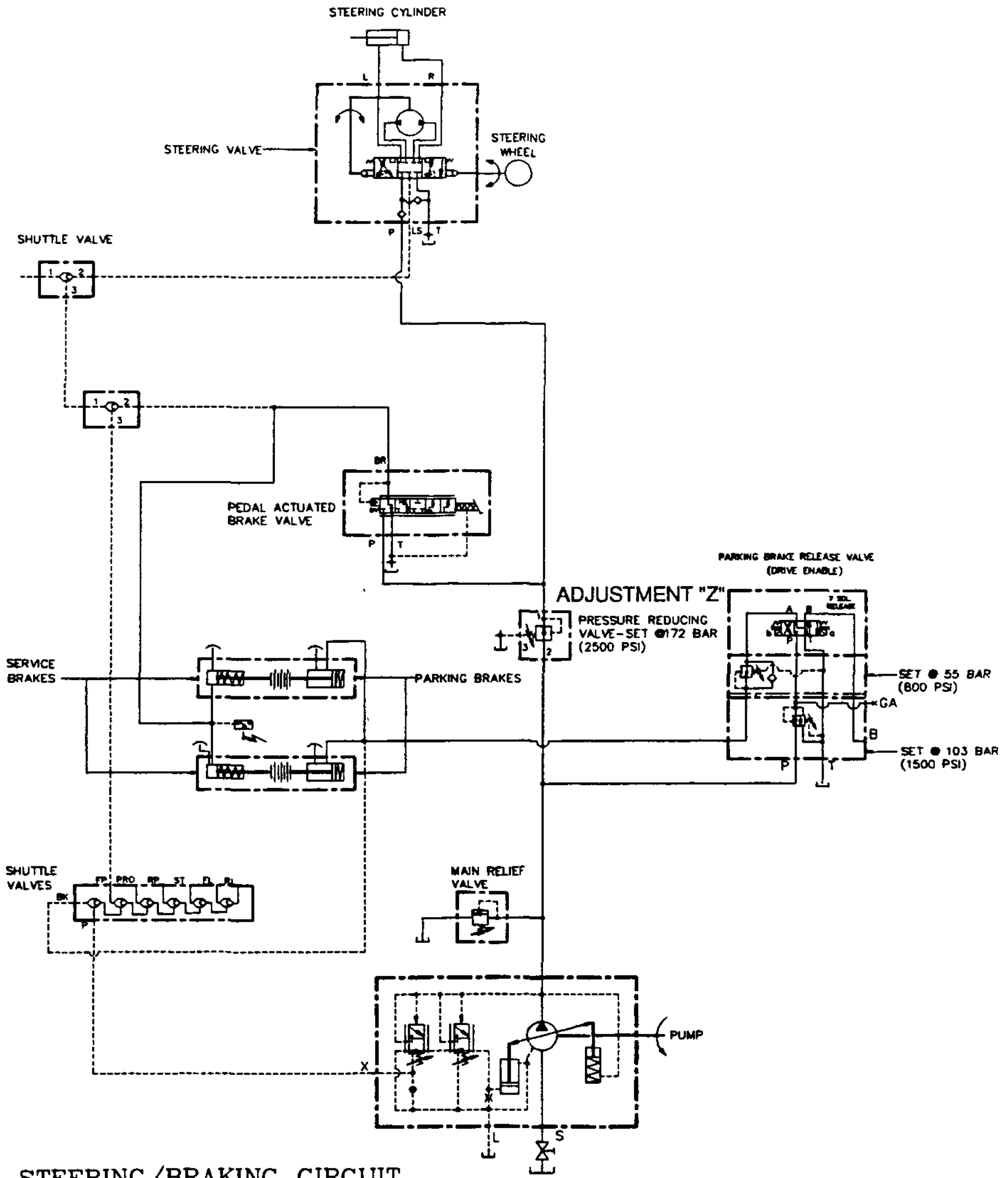
(7) Swing power unit closed and secure with retention bolt.

NOTE: Power steering reducing valve pressure of 172 bar (2500 PSI) will be the correct pressure setting for the service brakes.





POWER STEERING ADJUSTMENT
Figure 26



STEERING/BRAKING CIRCUIT

STEERING/BRAKING CIRCUIT
Figure 27

AA. Bridge Tilt Flow Control Adjustments (Option)

NOTE: An assistant is required for this procedure. Hydraulic oil must be at normal operating temperature.

WARNING: LOADER DRIVE WHEELS ARE TO BE CHOCKED TO PREVENT MOVEMENT IN EITHER DIRECTION. EYE PROTECTION MUST BE WORN WHEN MAKING HYDRAULIC ADJUSTMENTS.

(1) Remove bolt that secures power unit in the closed position and swing power unit open to gain access to flow control valves.

(2) Have assistant start power unit and move mode switch to "OPERATE" to extend stabilizers and then actuate bridge tilt switches. Bridge tilt cylinders must extend or retract fully in the specified time of 2 to 3 seconds.

(3) To adjust the raise speed (extend cylinders), loosen lock-screw on flow control valve in the line connected to the "P" port on valve manifold and turn adjusting screw clockwise to decrease flow (increase time) or counterclockwise to increase flow (decrease time) tighten lockscrew securely after each adjustment.

(4) To adjust the lower speed (retract cylinder), Loosen lock-screw on flow control valve in the line connected to the "T" port on valve manifold and turn adjusting screw clockwise to decrease flow (increase time) or counterclockwise to increase flow (decrease time). Tighten locknut securely after each adjustment.

(5) Shut power unit down.

(6) Clean up any hydraulic oil that may have leaked.

(7) Swing power unit closed and secure with retention bolt.

BB. Emergency Pump Relief Valve (Fig. 57)

NOTE: An assistant is required for this procedure. Hydraulic oil must be at normal operating temperature.

WARNING: EYE PROTECTION MUST BE WORN WHEN MAKING HYDRAULIC ADJUSTMENTS.

(1) Open power unit doors.

(2) Remove pressure hose from emergency hydraulic pump and plug hose to prevent contamination and loss of hydraulic oil.

(3) Install 0-345 bar (0-5000 PSI) pressure gauge on outlet port or hydraulic pump.

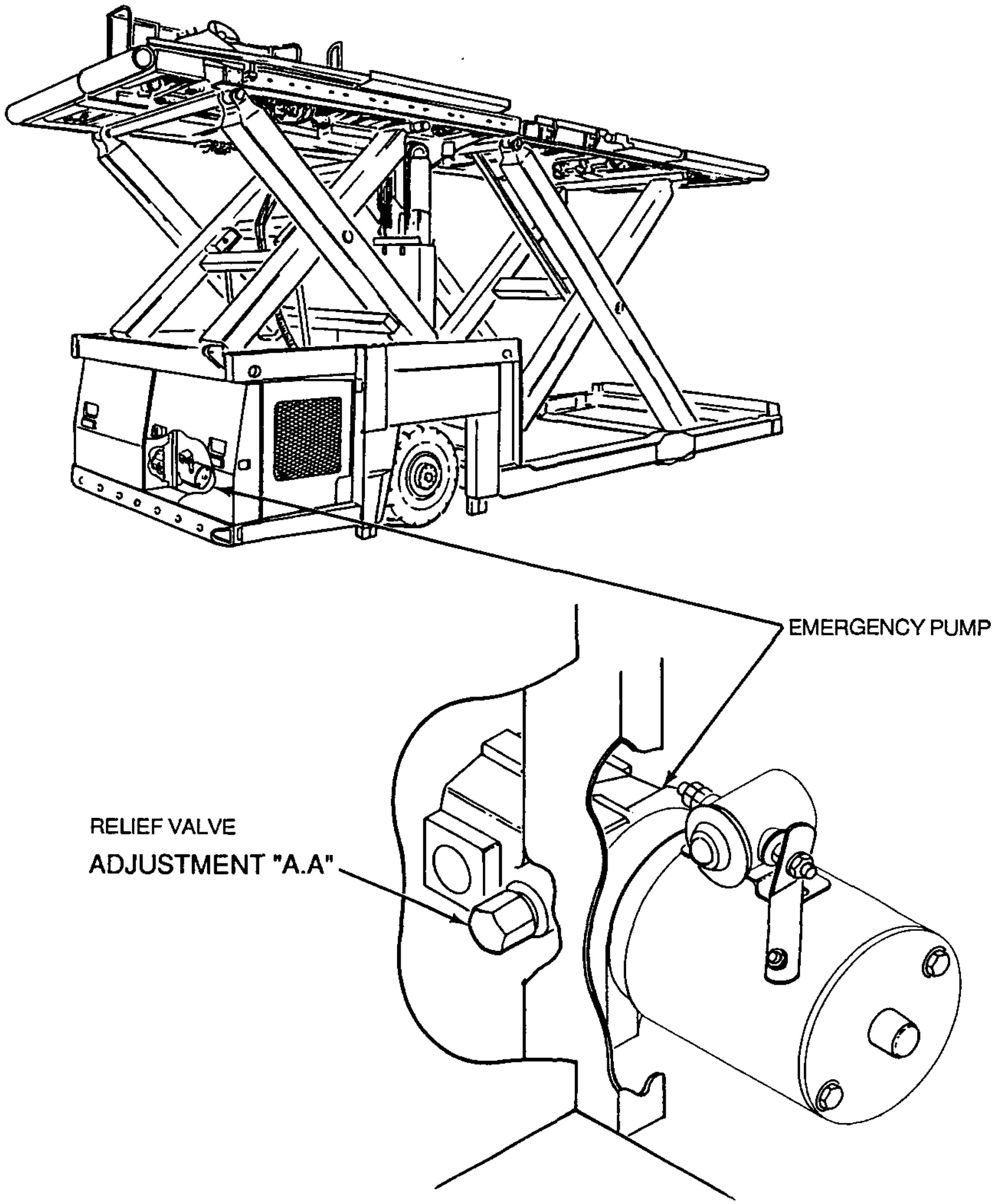
(4) Have assistant actuate emergency pump and observe gauge for 172 bar (2500 PSI) indicated pressure.

(5) Adjust pressure relief valve by removing cap and turning adjusting screw clockwise to increase pressure or counter-clockwise to decrease pressure. Tighten locknut when pressure has been adjusted to specifications.

(6) Remove gauge and plug, and reconnect the pressure hose.

(7) Clean up any hydraulic oil that has leaked.

(8) Close power unit doors.



EMERGENCY PUMP ADJUSTMENT
Figure 28

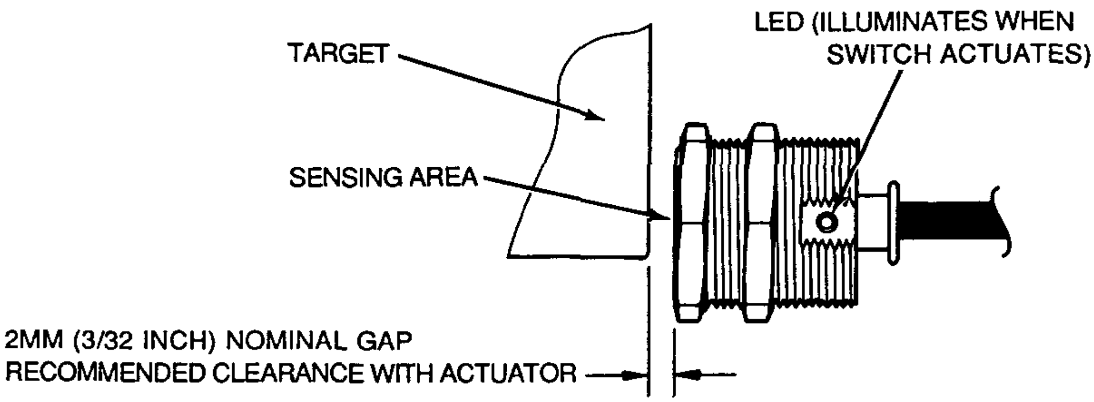
2. SWITCH ADJUSTMENT PROCEDURE

A. PROXIMITY SWITCH ADJUSTMENTS

WARNING: LOADER POWER UNIT MUST BE SHUTDOWN WHEN MAKING ANY SWITCH ADJUSTMENT TO PREVENT AN UNCONTROLLED MOVEMENT THAT COULD POSSIBLY RESULT IN DEATH OR INJURY TO PERSONNEL OR DAMAGE TO THE LOADER.

(1) INDUCTIVE PROXIMITY SWITCH

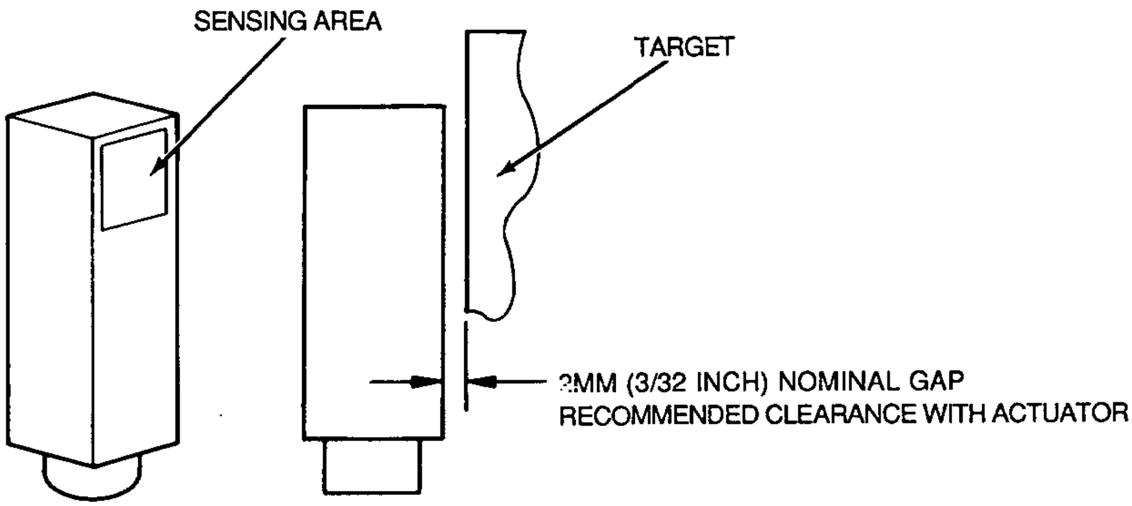
The proximity switch is a generic term which means it is a device capable of acting as an electronic switch when in the presence or close proximity of an object. The important distinction that differentiates it from a mechanical switch is that it does not require physical contact with anything else to operate.



PROXIMITY SWITCH ADJUSTMENT
Figure 29

(2) GO® PROXIMITY SWITCH

Magnetically actuated mechanical switch. Switch will actuate when metal target (actuator) enters the sensing area of the switch.



PROXIMITY SWITCH ADJUSTMENT
Figure 30

3. ELECTRICAL SYSTEM

A. 1 PLS Proximity Switch (Stabilizers Up) (Fig. 31)

(1) Start power unit and retract stabilizers fully by placing mode switch in drive position, then shut power unit down.

(2) Loosen locknuts on switch bracket and adjust proximity switch directly in front of actuating bar and tighten locknuts securely.

NOTE: The switch sensing area must have 3MM (.12 inches) ± 1MM clearance to actuating bar.

(3) Loosen locknuts and adjust actuating bar up or down for proximity switch to actuate when stabilizer is 15MM (9/16") +0, -2MM (3/32") from full retraction.

(4) Start power unit and verify adjustment by actuating stabilizers. Readjust actuating bar as required to achieve switch actuation when stabilizer is within 15MM (9/16" +0, -2MM (3/32") from full retraction.

B. 2PLS Proximity Switch (Bridge Down) (Fig. 32)

(1) Start power unit and lower bridge fully, then shut power unit down.

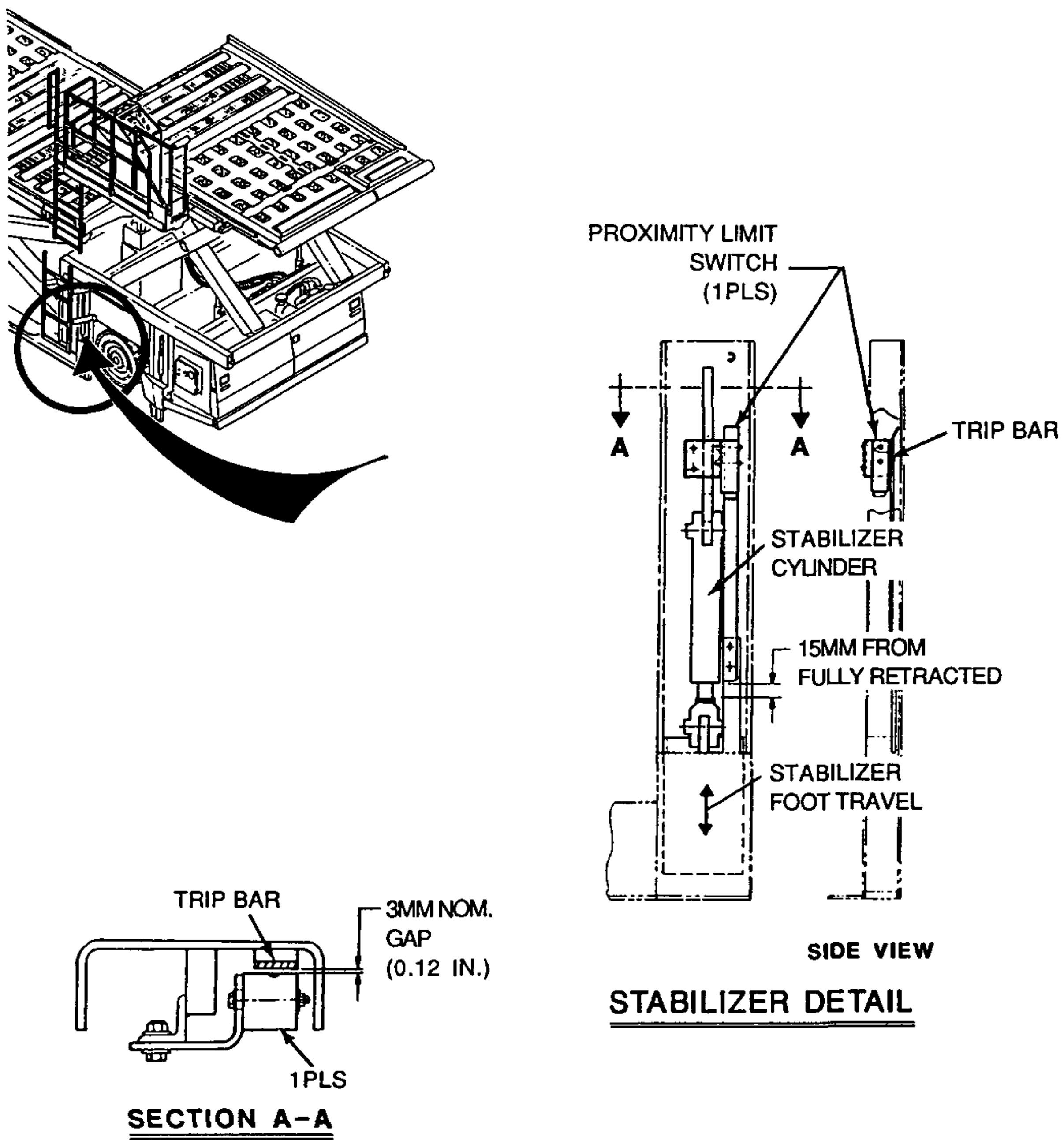
(2) Loosen locknuts and position switch to actuate when bridge is fully lowered and tighten locknuts securely.

(3) Verify switch adjustment by starting power unit and raise bridge 150MM (6 inches) maximum.

Actuate powered wing switch to raise powered wings. Wings must not raise with bridge elevated 150MM (6 inches).

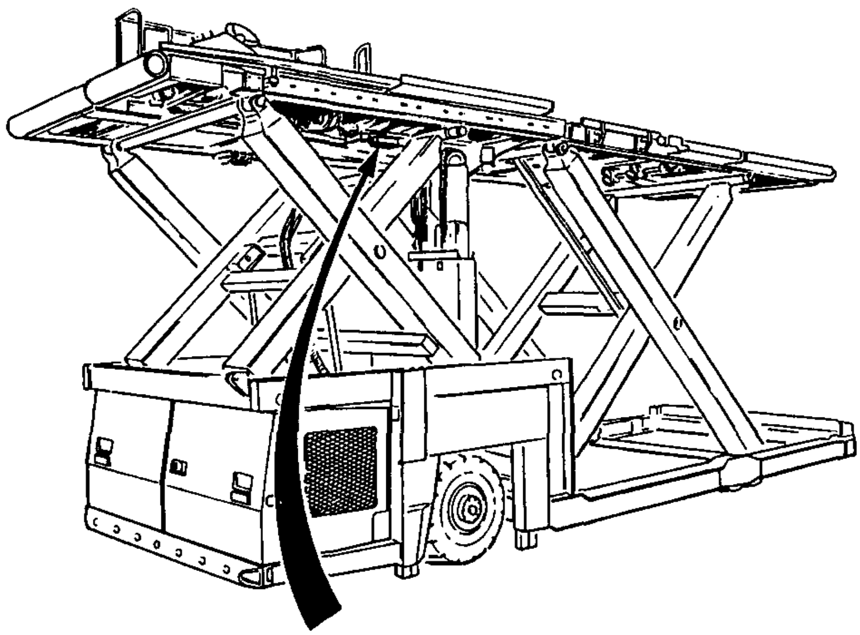
(4) Readjust switch as required to actuate only when bridge is fully down.

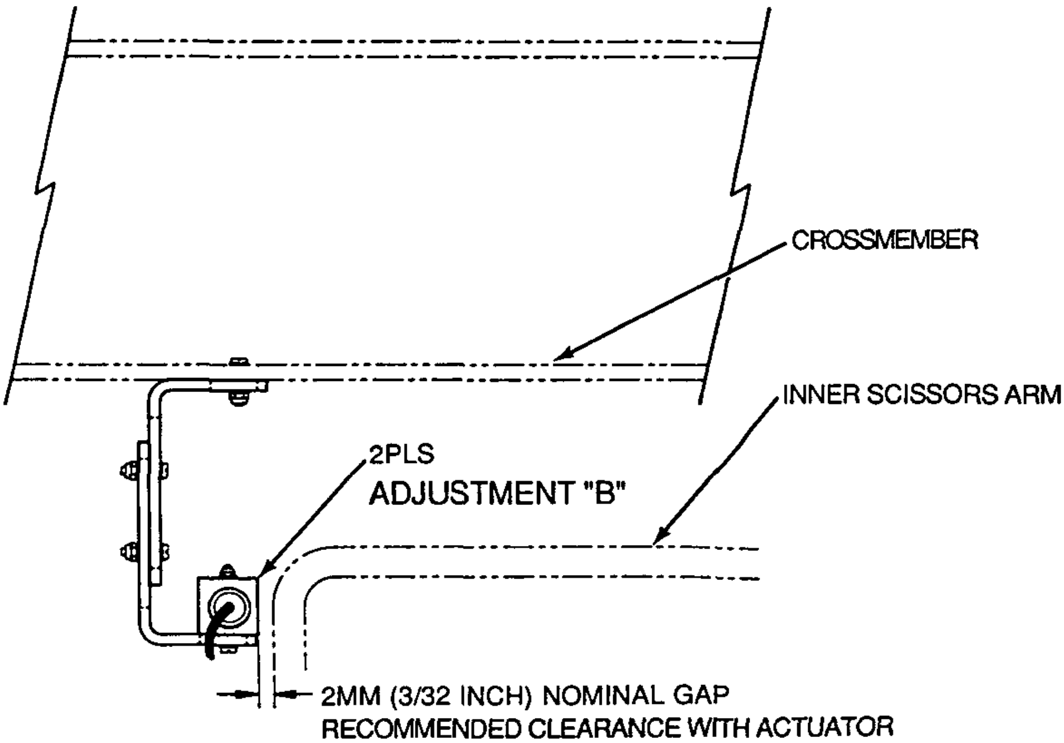
NOTE: 2PLS proximity switch will also actuate bridge up/reverse alarm (option).



ADJUSTMENT "A"

STABILIZER PROXIMITY SWITCH
Figure 31





BRIDGE DOWN PROXIMITY SWITCH
Figure 32

C. PD-PLS Proximity Switch (Propel Lockout with Platform UP) (Fig. 33)

NOTE: An assistant is required for this procedure.

(1) Start power unit, place mode switch in "OPERATE" position and lower platform to full down position.

(2) Shut power unit down and then turn ignition switch to the "ON" position. (DO NOT start power unit)

(3) Place mode switch in "DRIVE" position.

(4) Open main panel door to observe status panel lights.

(5) Loosen locknuts on proximity switch adjustable bracket and position proximity switch to sense platform in the full down position.

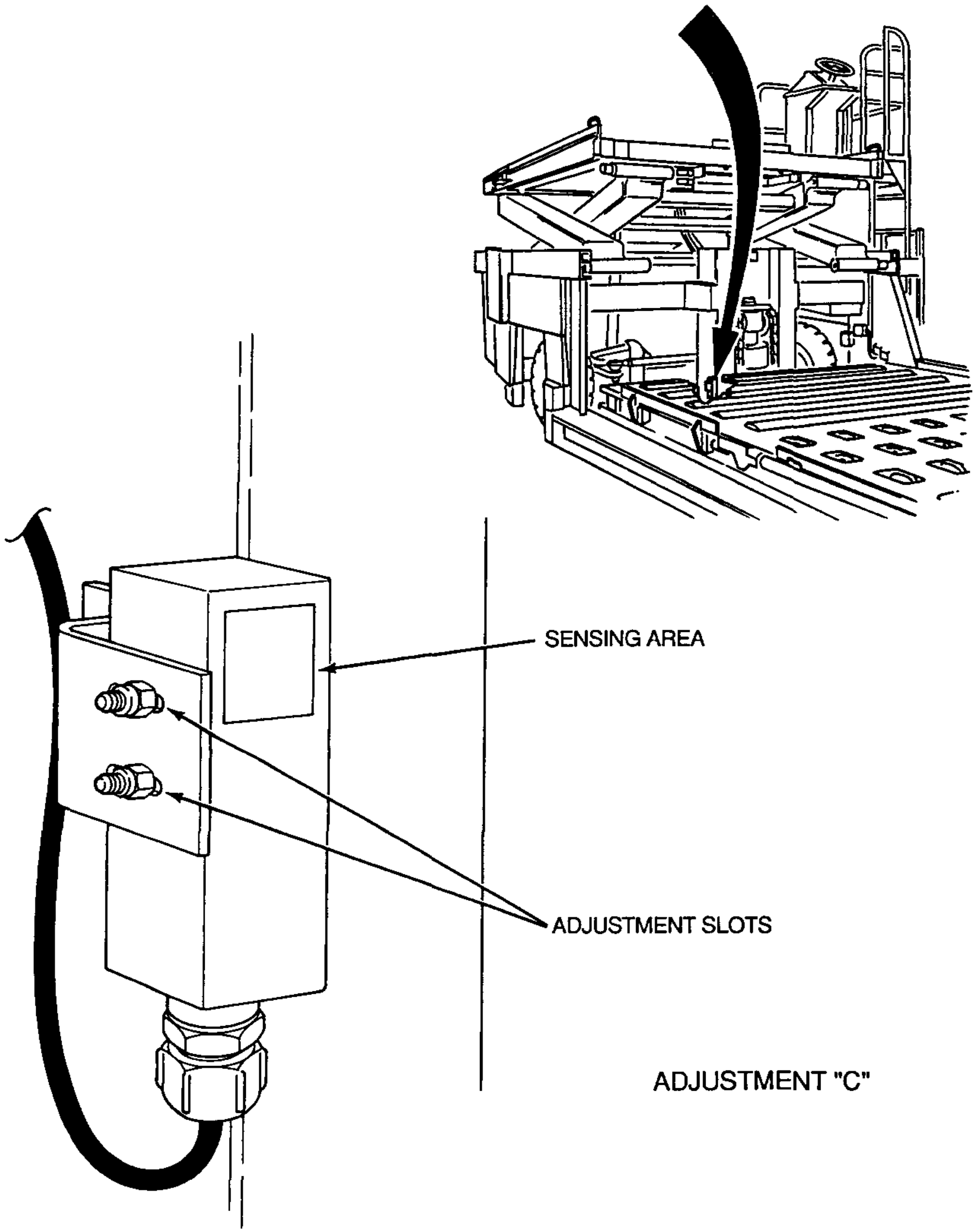
NOTE: When proximity switch senses platform and actuates, light 6SLT will illuminate.

(6) Tighten locknuts on proximity switch bracket securely after adjusting.

(7) Verify adjustment by starting power unit. Move mode switch to "OPERATE". Raise platform approximately 50MM (2 inches) then move mode switch to "DRIVE". Stabilizers must not retract.

(8) Place mode switch in "OPERATE" and lower platform to full down position and then place mode switch to "DRIVE". Stabilizers must retract.

(9) Shut power unit down and close main panel door.



PLATFORM DOWN PROXIMITY SWITCH
Figure 33

D. 1PRS, 1PRS-A, 2PRS, 3PRS and 3PRS-A Proximity Switch. (Guides Proximity Switches) (Fig. 34)

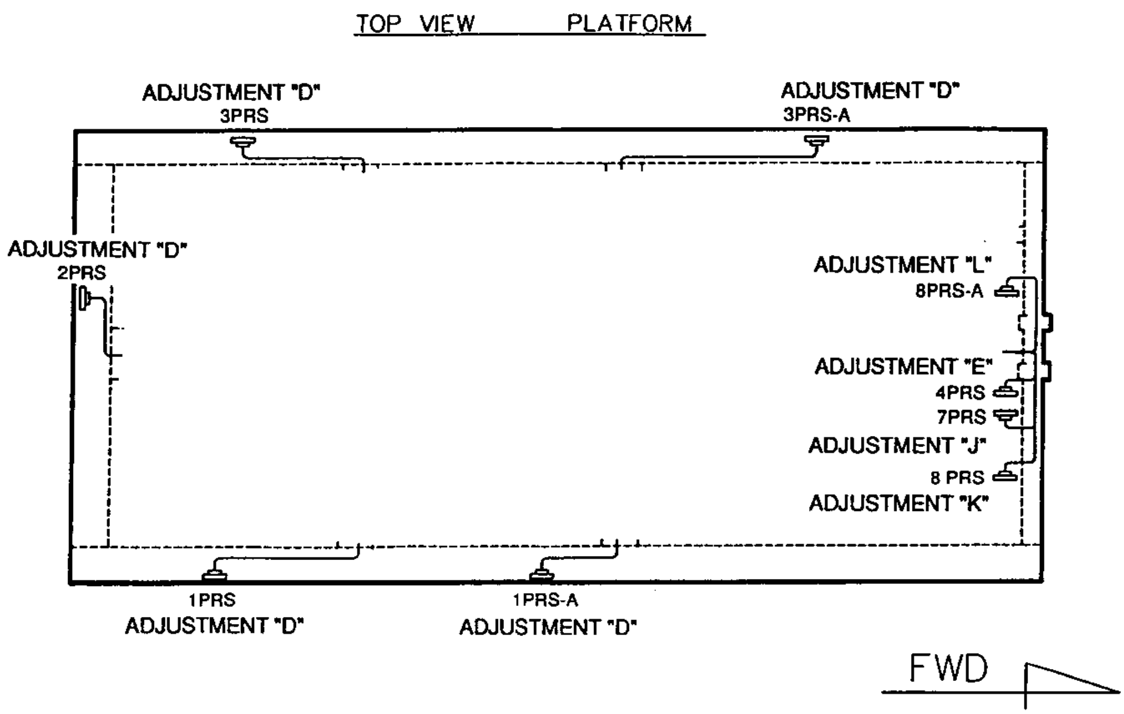
NOTE: Each guide on the platform will actuate a proximity switch located in the guide support when the guide is in the lowered position.

1PRS	Right Guide, Lowered
1PRS-A	Right Front Guide, Lowered
2PRS	Rear Guide, Lowered
3PRS	Left Guide, Lowered
3PRS-A	Left Front Guide, Lowered

(1) Position switch in guide support with the face (sensing surface) 2 to 3MM (3/32 to 1/8 inch) from being flush with end of tapped hole.

NOTE: Switch must not protrude through mounting hole or switch will be damaged when the guide is lowered.

(2) Tighten locknut on proximity switch securely when switch is properly positioned in guide support.



PROXIMITY SWITCH LOCATION
Figure 34

E. 4PRS Proximity Switch, Platform Below 610MM (24 inches) (Fig. 34)

(1) Remove walk deck on forward section of platform to gain access to 4PRS proximity switch.

(2) Start power unit and raise platform exactly 610MM (24 inches) and shut power unit down.

(3) Turn ignition switch to "ON" position and place mode switch in "OPERATE". DO NOT start power unit.

(4) Position proximity switch in slotted bracket until LED indicator light (on side of proximity switch) just actuates on when sensing the actuating arm. Tighten locknut securely after adjustment.

NOTE: Maintain specified clearance of 2 to 3MM (3/32 to 1/8 inch) between actuating arm and face of proximity switch.

(5) Turn ignition switch "OFF" and replace walk deck.

F. 4PRS-A Proximity Switch, Platform Within 100MM (4 Inches) of Bridge (Fig. 35)

(1) Position switch in mounting hole with the face (sensing surface)
2 to 3MM (3/32 to 1/8 inch) from being flush with end of tapped hole.

NOTE: Switch must not protrude through mounting hole or it will be damaged by the actuating ring.

G. 4PRS-B Proximity Switch (Platform/Bridge Interface) (Fig. 36)

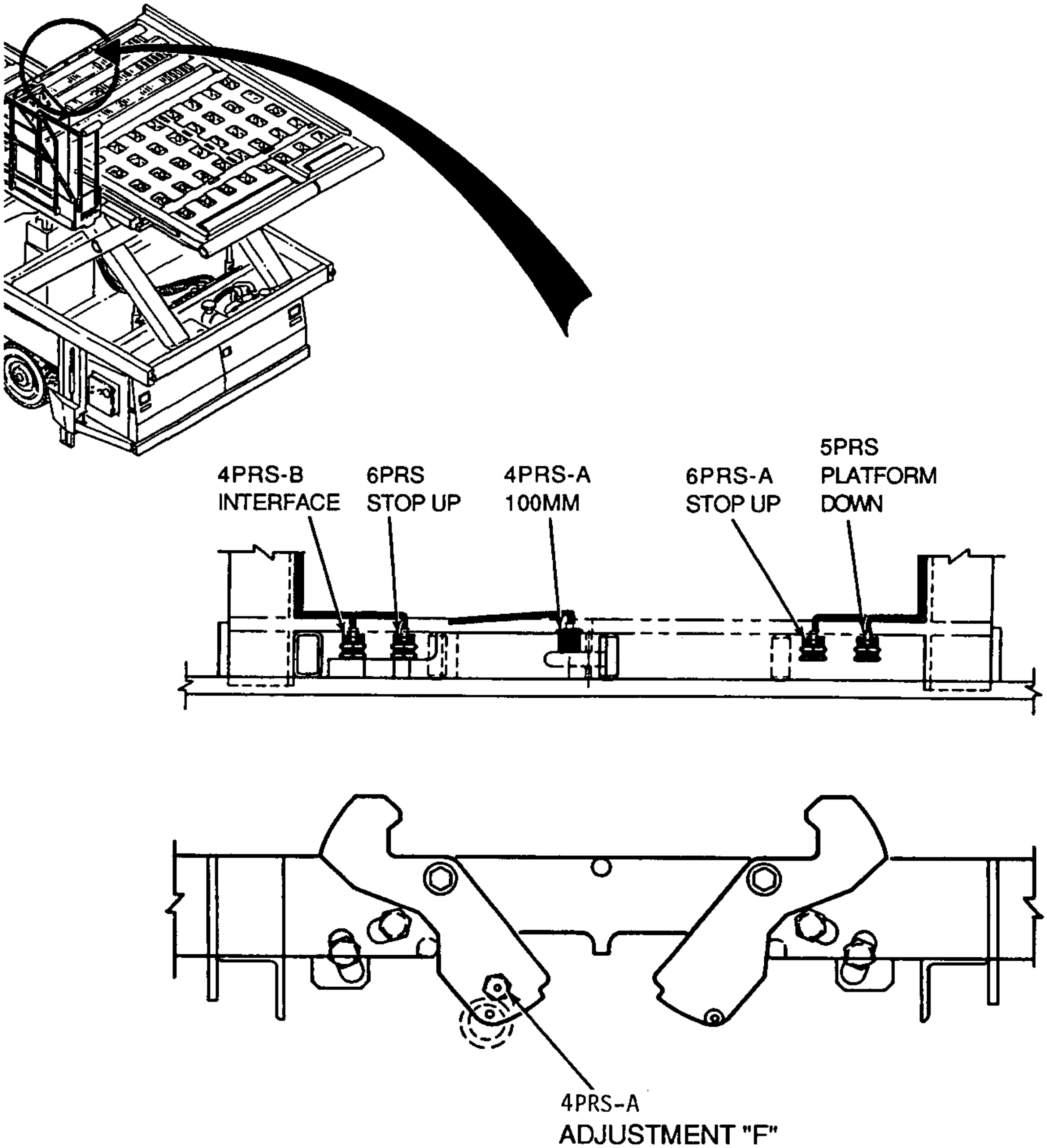
(1) Turn ignition switch "ON" and place mode switch in "OPERATE". DO NOT START POWER UNIT.

(2) Lower left side stop on bridge until top is level with bridge frame and secure while making adjustment.

(3) Position proximity switch 4PRS-B in adjustment slot for LED to just illuminate and tighten locknuts on proximity switch. (LED located on side of proximity switch).

NOTE: Clearance between bridge stop and proximity switch face must be maintained at 2 to 3MM (3/32 to 1/8 inch)

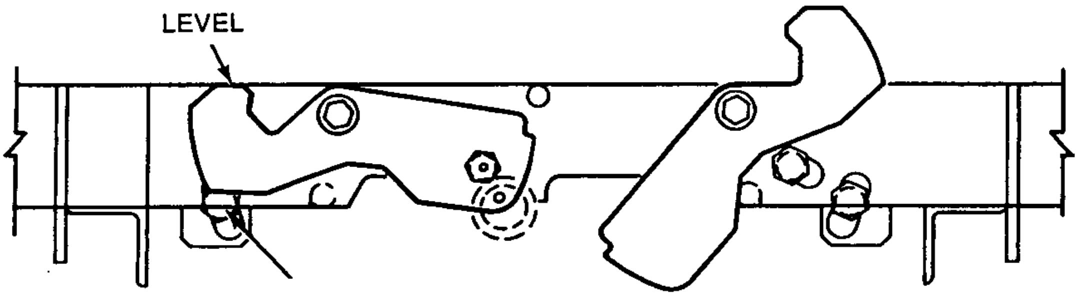
(4) Release bridge left side stop.



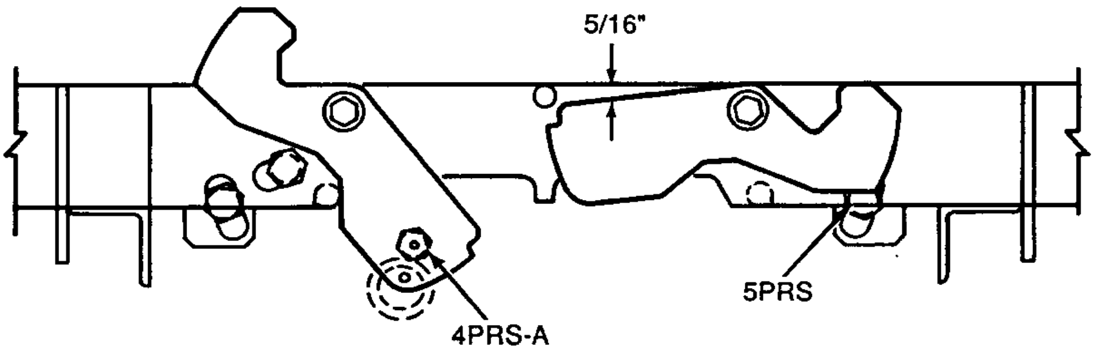
REAR STOP INSTALLATION

VIEW FROM REAR

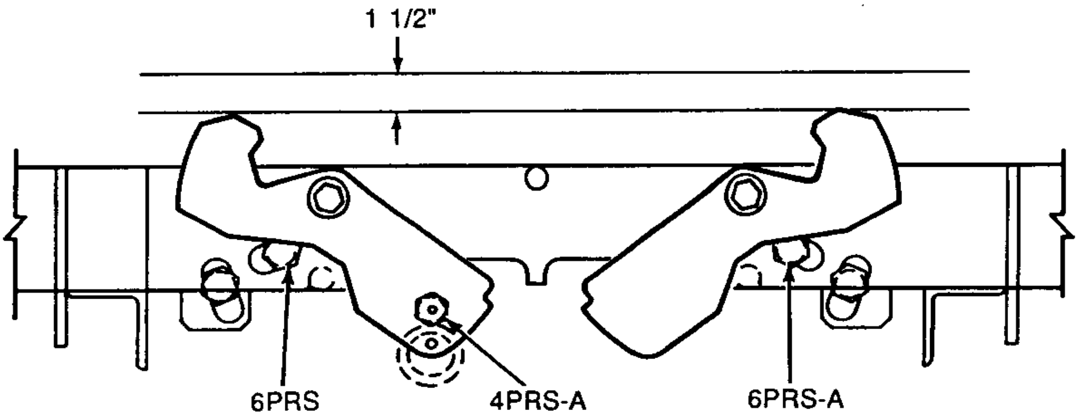
INTERFACE PROXIMITY SWITCHES
Figure 35



ADJUSTMENT "G"



ADJUSTMENT "H"



ADJUSTMENT "I"

INTERFACE PROXIMITY SWITCH ADJUSTMENTS
Figure 36

(5) Start power unit and raise bridge 300MM (12 inches) or more, and then raise platform fully to interface with bridge.

(6) Platform and bridge roll plane is to be level, ± 9 to 12MM (3/8 to 1/2 inch) when platform interfaces with bridge.

(7) If platform and bridge are not level within specification of ± 9 to 12MM (3/8 to 1/2 inch), readjust proximity switch.

(8) Lower platform and bridge fully down and shut power unit down.

(9) Move proximity switch UP in adjusting slot to lower platform and DOWN in adjusting slot to raise platform at interface.

(10) Recheck switch adjustment. (Repeat steps 5-6-7 and 8),

H. 5PRS Proximity Switch Platform 25MM (1 inch) Above Bridge (Fig. 36)

(1) Turn ignition switch "ON" and place mode switch in "OPERATE". DO NOT START POWER UNIT.

(2) Lower right side stop on bridge to obtain a measurement of 8MM (5/16 inch) and secure while making adjustment.

(3) Position proximity switch 5PRS in adjustment slot for LED to just illuminate and tighten locknuts on proximity switch. (LED on side of proximity siwtch)

<u>NOTE:</u> Clearance between bridge stop and proximity switch face must be maintained at 2 to 3MM (3/32 to 1/8 inch)

(4) Remove proximity switch 4PRS-B from adjusting slot and secure to prevent damage or from sensing metal when adjusting proximity switch 5PRS.

(5) Release bridge right side stop.

(6) Start power unit and raise bridge 300MM (12 inches) or more.

(7) Raise platform. Platform must raise 25MM (1 inch) above bridge. When proximity switch 5PRS actuates, platform will stop raising and start to lower.

(8) If platform does not raise and actuate proximity switch at 25MM (1 inch), readjust proximity switch.

(9) Lower platform and bridge fully down and shut power unit down.

(10) Move proximity switch UP in adjusting slot to lower platform and DOWN in adjusting slot to raise platform when proximity switch actuates.

(11) Recheck switch adjustment (Repeat steps 5-6-7 and 8).

(12) Reinstall proximity switch 4PRS-B that was removed in step 4 and adjust to specifications.

NOTE: Exercise care when raising platform to actuate proximity switch that platform does not exceed 25MM (1 inch) and allow lift assembly to strike bridge.

I. 6PRS and 6PRS-A Proximity Switches (Bridge Stops Lowered) (Fig. 36)

(1) Turn ignition switch "ON" and place mode switch in 'OPERATE". DO NOT START POWER UNIT.

(2) Lower left and right bridge stops 38MM (1 1/2") ± 3MM (1/8 inch) and secure while making adjustments.

(3) Loosen locknuts on proximity switches and move switches in adjusting slots for LED to just illuminate, and tighten locknuts. (LED on side of proximity switch)

NOTE: Clearance between bridge stop and proximity switch face must be maintained at 2 to 3MM (3/32 to 1/8 inch)

(4) Release bridge stops.

(5) Verify that proximity switches actuate at 38MM (1 1/2") ± 3MM (1/8 inch) by depressing stops and watch for LED's to illuminate.

J. 7PRS Proximity Switch, Platform Below 760MM (30 inches) (Fig. 34)

NOTE: An assistant is required for this procedure.

(1) Open main panel door to observe status panel indicator lights.

(2) Remove walk deck on forward section of platform to gain access to 7PRS proximity switch.

(3) Have assistant start power unit and raise platform exactly 760MM (30 inches) and shut power unit down.

(4) Turn ignition switch to "ON" position and place mode switch in "OPERATE". (DO NOT start power unit).

(5) Loosen locknut on proximity switch 7PRS and move switch in slotted adjusting bracket until switch just deactuates. Tighten locknut securely after each adjustment.

NOTE: Observe status panel indicator lights. Light 15RLT-A will illuminate when proximity switch 7PRS is actuated.

NOTE: Clearance between proximity switch sensing face and actuating arm must be maintained at 2 to 3MM (3/32 to 1/8 inches) to prevent damage to switch.

(6) Start power unit and lower platform, then shut down power unit.

(7) Close main panel door and replace walk deck on platform.

K. 8PRS Proximity Switch (Truck Transfer Height Option), Platform Below 1525MM (60 inches) (Fig. 34)

NOTE: An assistant is required for this procedure.

(1) Open main panel door to observe status panel indicator lights.

(2) Remove walk deck on forward section of platform to gain access to 8PRS proximity switch.

(3) Have assistant raise platform 1525MM (60 inches) from ground level with bogy wheels fully retracted and shut power unit down.

(4) Turn ignition switch "ON" and place mode switch in "OPERATE" position.

(5) Loosen locknut on proximity switch 8PRS and move switch in adjustment slot until indicator light on side of switch just turns off. Tighten locknut securely after each adjustment.

NOTE: Clearance between proximity switch sensing face and actuating arm must be maintained at 2 to 3MM (3/32 to 1/8 inches) to prevent damage to switch.

(6) Start power unit and lower platform and then shut power unit down.

(7) Close main panel door and replace walk deck on platform.

NOTE: This option available for 65" truck transfer height, and will require platform to be raised to 1650MM (65 inch) level when adjusting proximity switch.

L. 8PRS-A Platform Above 1800MM (71 inches) (Platform Cylinder Sequencing) (Fig. 34)

8PRS-B Platform below 1700MM (67 inches)

8PRS-A

NOTE: An assistant is required for this procedure.

(1) Remove walk deck on forward section of platform to gain access to proximity switch 8PRS-A.

(2) Have assistant start power unit and raise platform exactly 1800MM (71 inches) and shut power unit down.

(3) Turn ignition switch "ON" and place mode switch in "OPERATE" position. DO NOT start power unit.

(4) Loosen locknut on proximity switch 8PRS-A and move switch in adjusting slot until LED indicating light on side of switch illuminates. Tighten locknut securely after each adjustment.

NOTE: Clearance between proximity switch sensing face and actuating arm must be maintained at 2 to 3MM (3/32 to 1/8 inches) to prevent damage to switch.

(5) Have assistant start power unit and raise bridge to full extension.

(6) Raise platform to full extension (interface with bridge), and check indicator light on proximity switch 8PRS-A. Indicator light must be illuminated (switch actuated) when platform is above 1800MM (71 inches).

(7) Lower platform fully and raise platform to interface. Platform MUST NOT hesitate or stop at the 1800MM (71 inches) level when proximity switch 8PRS-A actuates.

NOTE: Proximity switch 8PRS-A is actuated when primary lift cylinder is fully extended. Additional adjustment may be required to actuate switch below 1800MM (71 inches) to obtain a smooth transfer at 1800MM (71 inches) when primary lift cylinder reaches full extension.

(8) Lower platform fully and shut down power unit.

(9) Replace walk deck on platform.

8PRS-B Switch Adjustment

NOTE: 8PRS-B Proximity switch is located at the top center of the platform lift mechanism weldment.

(1) Adjust proximity switch in the threaded hole until sensing face is flush with the weldment and tighten locknut securely.

NOTE: Proximity switch **MUST NOT** protrude through the tapped hole in the weldment to prevent damage to the switch by the lift mechanism.

M. 9PRS, 9PRS-A, 10PRS and 11PRS Proximity Switches (Auto-Track) (Fig. 37)

(1) Adjust all 4 proximity switches in switch holder plate 2 to 3MM from end of tapped holes and tighten locknuts securely.

NOTE: Proximity switches **MUST NOT** protrude through tapped holes or switches will be damaged by actuating bar.

(2) Place straight edge on top of univeyor deck and extended over face plate weldment.

NOTE: Straight edge must lie on top of a minimum of two (2) univeyor HeliRolls and must not touch forward rollers.

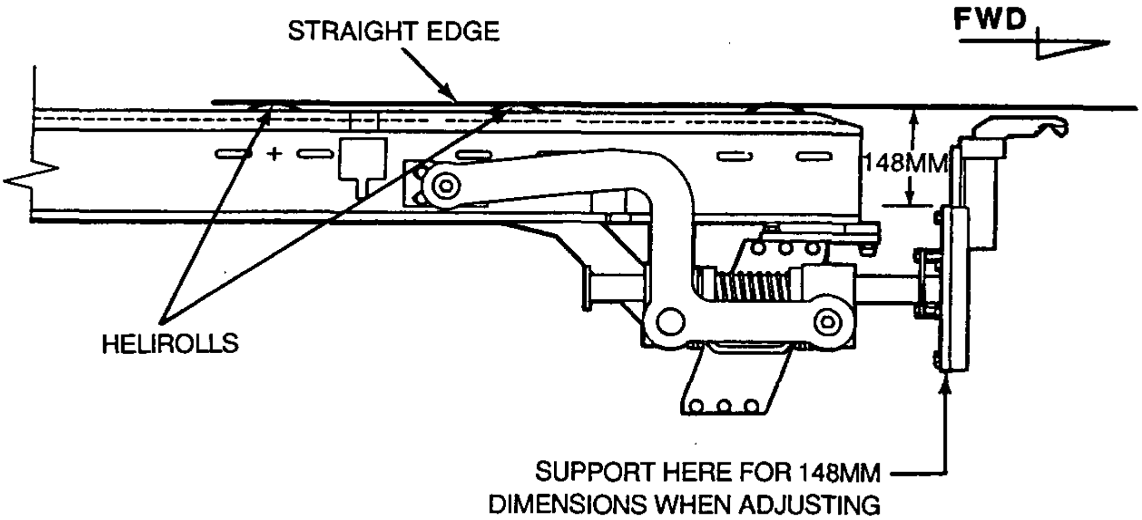
(3) Raise face plate weldment to obtain a 148MM (5.82 inches) measured distance from top of face plate weldment to bottom of straight edge.

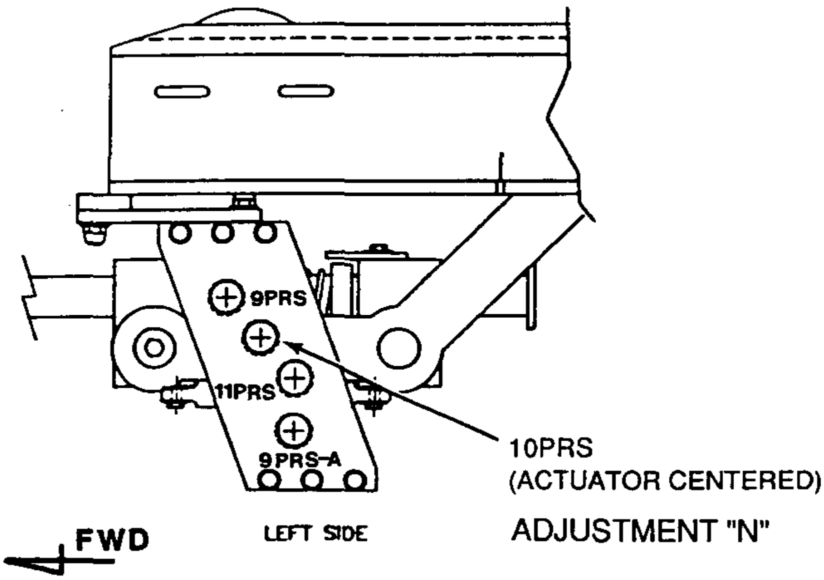
NOTE: Support face plate weldment to maintain measured distance when making adjustment.

(4) Loosen locknuts (3) on switch holder plate and position switch holder plate so actuating arm is centered equal distance on proximity switch 10PRS. (No. 2 position from top). Tighten locknuts securely after adjusting.

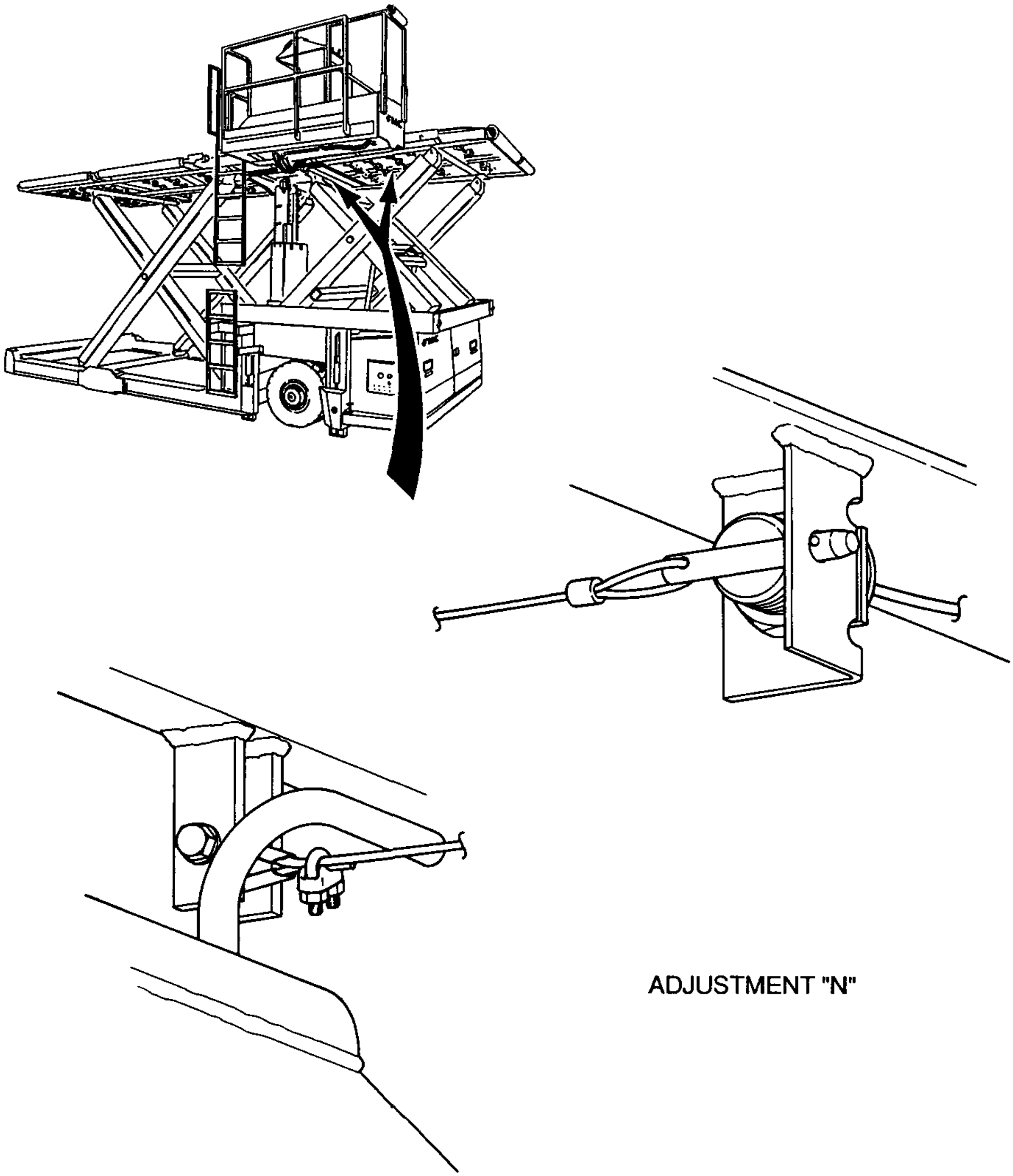
NOTE: This one adjustment will position all 4 proximity switches, 9PRS, 10PRS, 11PRS, and 9PRS-A correctly.

(5) Remove support for holding face plate weldment and the straight edge on bridge.





AUTO FOLLOWING PROXIMITY SWITCHES
Figure 37



ADJUSTMENT "N"

OVERTRAVEL SHUTDOWN SWITCH
Figure 38

N. OS-PRS Proximity Switch, Bridge Off of Track (Overtravel Shutdown) (Fig. 38)

(1) Adjust actuating cable to remove all excess slack without pulling actuating pin from retaining bracket.

(2) Start engine and place mode switch in "OPERATE" to extend stabilizers.

(3) Pull on cable to remove actuating pin. Power unit must shut down when actuating pin is removed.

O. 4PS Pressure Switch, Stabilizer Down (Fig. 39)

(1) Refer to stabilizer adjustment procedure "O" under Hydraulic Adjustments.

P. 5PS Pressure Switch, Bogy Wheels Extended (Fig. 40)

NOTE: An assistant is required for this procedure.

WARNING: LOADER WHEELS ARE TO BE CHOCKED TO PREVENT MOVEMENT IN EITHER DIRECTION. EYE PROTECTION MUST BE WORN WHEN MAKING ADJUSTMENTS.

(1) Remove bolt that secures power unit in the closed position and swing power unit open to gain access to pressure switch.

(2) Loosen locknut and turn adjusting screw fully clockwise.

(3) Have assistant start power unit and partially extend bogy wheels.

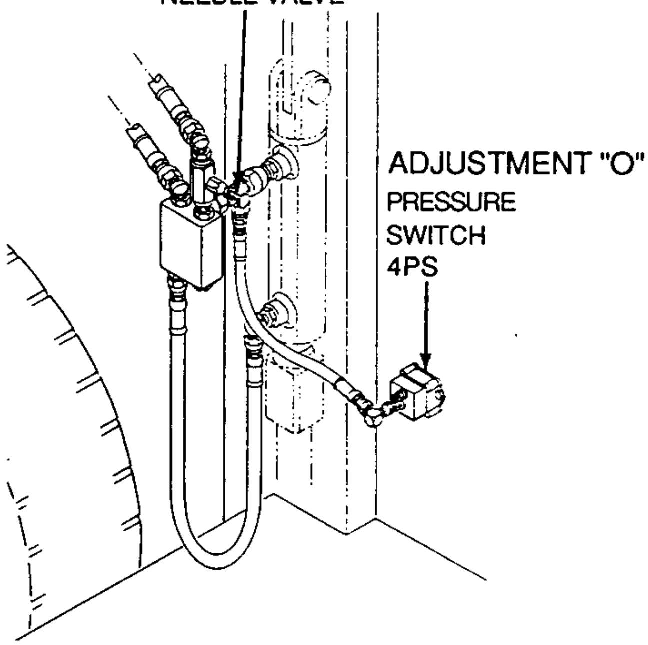
(4) Turn adjusting screw clockwise until indicator light on operator's panel is illuminated, then turn adjusting screw one (1) additional turn clockwise. Tighten locknut securely.

(5) Verify switch adjustment by extending and retracting bogy wheels.

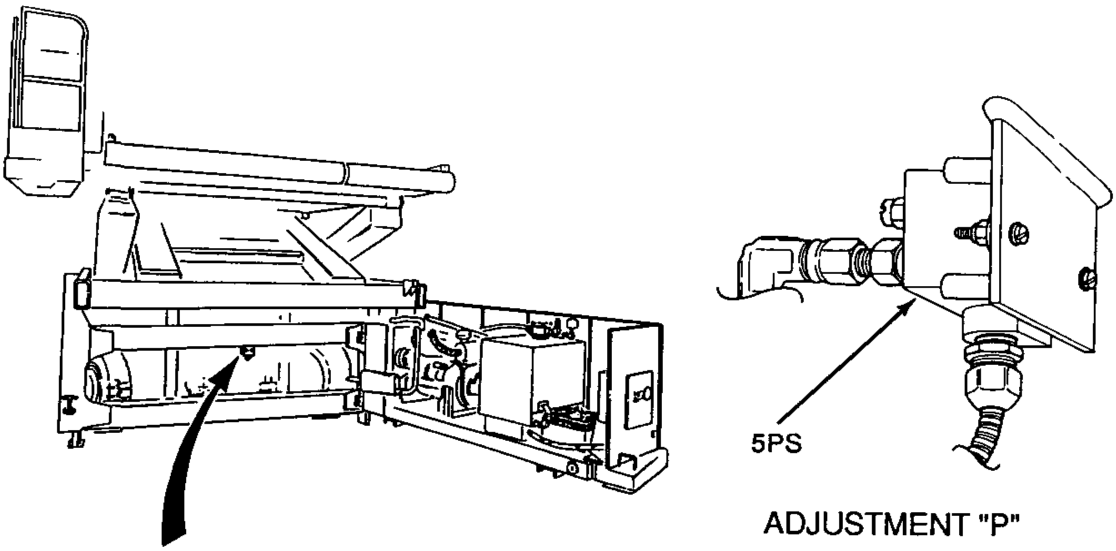
NOTE: Bogy wheel indicator light MUST be illuminated whenever bogy wheels are extended and indicator light MUST be "OFF" ONLY with bogy wheels fully retracted.

(8) Shut power unit down

(9) Swing power unit closed and secure with retention bolt.



STABILIZER PRESSURE SWITCH
Figure 39



BOGY WHEEL PRESSURE SWITCH
Figure 40

Q. Accelerator Pedal Adjustments (Fig. 41) - **Step (1) and (2) are not required after serial number CR90307.**

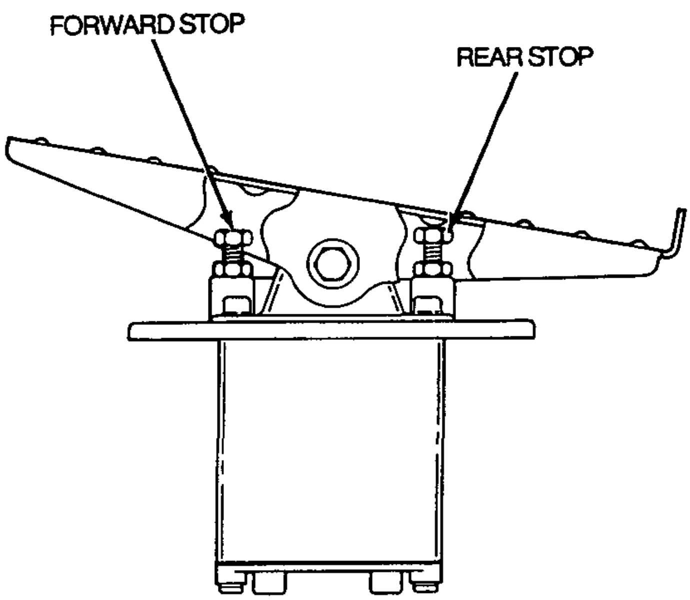
(1) Forward stop screw adjustment

(a) Loosen locknut on adjustment screw and turn the adjusting screw clockwise until it bottoms (all the way in).

(b) Depress the foot treadle by hand fully (maximum travel) and hold in this position.

(c) Carefully turn the adjusting screw counterclockwise (out) until it just touches the stop on the treadle. Release foot treadle.

(d) Turn the adjusting screw one (1) additional turn counterclockwise (out) and tighten locknut securely.



ACCELERATOR PEDAL
Figure 41

(2) Rear stop screw adjustment

(a) Start power unit and place mode switch in "DRIVE" to retract stabilizers and shut power unit down.

(b) Turn ignition switch to "ON" position. DO NOT start power unit.

(c) Place directional switch in "FORWARD".

(d) Position speed select switch in "TURTLE" (low speed).

(e) Loosen locknut on rear stop adjusting screw and turn adjusting screw clockwise until it bottoms (all the way in).

(f) Carefully turn rear stop adjusting screw counterclockwise (out) until the "HIGH A" LED indicating light just illuminates on the propel board assembly.

NOTE: This will require an assistant to observe the LED indicating light on the propel board located in the main panel.

(g) Turn adjusting screw clockwise in one quarter (1/4) turn, 1 1/2 flats on hex head adjusting screw, and tighten locknut securely. High "A" and High "B" indicating lights must NOT be illuminated after locknut is tightened.

NOTE: This is a critical adjustment and requires that all adjustment steps must be complied with.

R. Propel Board Preliminary Adjustment (Fig. 42)

NOTE: An assistant is required for this procedure.

(1) Open main panel door to obtain access to propel board. (Propel board is located on sidewall of main panel).

(2) Connect an accurate voltmeter to propel board terminal strip.

(a) Black (-) lead to terminal marked "GND"
(b) Red (+) lead to terminal marked "51B"

(3) Turn "RAMP" trim pot 20 turns counterclockwise.

(4) Have assistant start power unit and place mode switch in "DRIVE" to retract stabilizers and then shut power unit down.

(5) Turn ignition switch "ON". DO NOT start power unit.

(6) Place directional control switch in "FORWARD".

(7) Have assistant select "TURTLE" (low) speed and depress accelerator pedal fully against stop.

(8) Adjust "HI A" trim pot to 13.0 ± 0.5 volts. Release accelerator pedal.

(9) Have assistant select "SNAIL" (creep) speed and depress accelerator pedal fully against stop.

(10) Adjust "HI B" trim pot to 10.5 ± 0.5 volts. Release accelerator pedal.

(11) Have assistant slowly depress accelerator pedal until "HI B" LED indicator light just turns on.

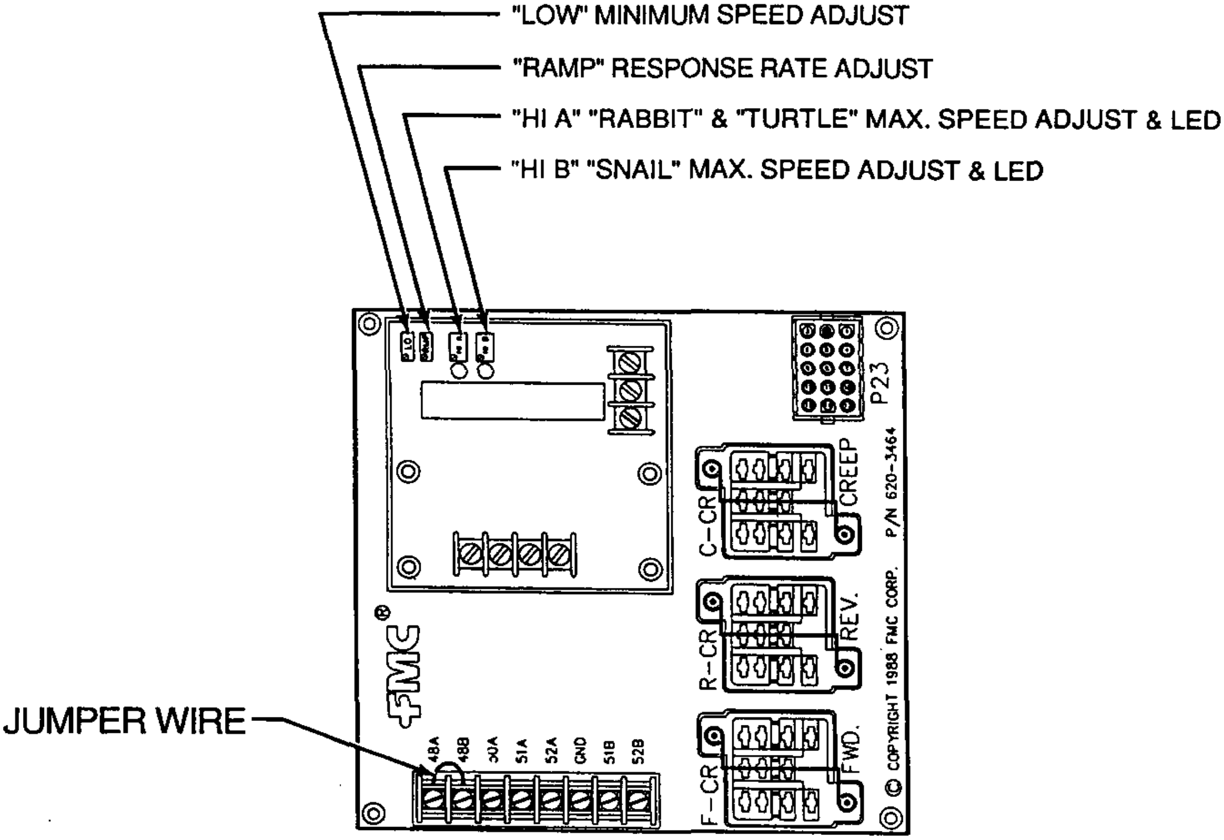
(12) Adjust "LOW" trim pot to 4.0 ± 0.5 volts. Release accelerator pedal.

(13) Repeat steps 7 through 10, as required until all adjustments are correct.

NOTE: Adjustments may affect each other and adjustment procedure may require repeating to achieve correct settings on trim pots.

(14) Disconnect voltmeter and close main panel door.

(15) Drive loader and make final adjustments. (Propulsion Performance Adjustments).



GENERAL INFORMATION

FEATURE	FUNCTION	PRELIMINARY SETTING
"RAMP" TRIMPOT	RESPONSE RATE ADJUST	TURN 20 TURNS CCW
"HI B" TRIMPOT	SNAIL MAX. SPEED ADJUST	10.5 ± 0.5 VOLTS
"HI B" LED	"ON" DURING SNAIL OUTPUT	-
"HI A" TRIMPOT	"RABBIT" & "TURTLE" MAX. SPEED ADJUST	13.0 ± 0.5 VOLTS
"HI A" LED	"ON" DURING RABBIT OR TURTLE OUTPUT	-
"LOW" TRIMPOT	MINIMUM SPEED ADJUST	4.0 ± 0.5 VOLTS

PROPEL BOARD ADJUSTMENTS
Figure 42

S. Propulsion Performance Adjustments (Fig. 42)

NOTE: An assistant is required for this procedure. Hydraulic oil must be at normal operating temperature.

NOTE: Loader performance tests are to be made on smooth, hard, dry and level surface.

PROPULSION PERFORMANCE SPECIFICATIONS

RABBIT	30 Meters (100 Feet)	10 to 12 Seconds
SNAIL	30 Meters (100 Feet)	60 to 70 Seconds

(1) Mark a measured distance of 30 meters (100 feet) on surface where performance tests will be made.

(2) Have assistant drive loader in "RABBIT" mode through measured distance with accelerator fully depressed and record time to drive 30 meters (100 feet).

NOTE: Loader must be at maximum speed when traveling through measured distance.

(3) "RABBIT" (HIGH SPEED) adjustment.

Turn "HI-A" trim pot clockwise to increase speed and counterclockwise to decrease speed. Make adjustments in 1/4 turn increments until propulsion speed is within specifications of 30 meters (100 feet) in 10 to 12 seconds.

NOTE: If power unit lugs down (looses RPM) continuously when driving straight, or when "cornering", turn "HI-A" trim pot counter-clockwise in 1/4 increments to decrease maximum speed. Lugging condition can be eliminated and propulsion speed will remain within specifications.

(4) TURTLE (MEDIUM SPEED) changes hydraulic oil flow from series to parallel through propulsion motors, and is not adjusted on propel board. Check turtle speed by driving and the speed should be approximately one half (1/2) of RABBIT speed and will take 20 to 24 seconds to travel 30 meters (100 feet).

(5) Have assistant drive loader in "SNAIL" mode through measured distance with accelerator fully depressed and record time to drive 30 meters (100 feet).

NOTE: Loader must be at maximum speed when traveling through measured distance.

(6) Snail (Low Speed) adjustment.

Turn "HI-B" trim pot clockwise to increase speed and counterclockwise to decrease speed. Make adjustments in 1/4 turn increments until propulsion speed is within specification of 30 meters (100 feet) in 60 to 70 seconds.

(7) Whenever an adjustment is made to "HI-A" trimpot in RABBIT speed it is mandatory that SNAIL speed be rechecked and when an adjustment is made to "HI-B" trimpot, RABBIT speed must be rechecked. The adjusting of one trimpot has an effect on the other trimpot, therefore, it may require readjusting each trimpot a number of times until both trimpots are correctly adjusted to obtain the specified propel speeds in RABBIT and SNAIL.

(8) Shut power unit down, close main panel door and secure with retention bolts.

SECTION 4 TROUBLESHOOTING

1. GENERAL

WARNING: TROUBLESHOOTING OF THIS EQUIPMENT SHOULD ONLY BE DONE BY QUALIFIED TECHNICIANS THAT ARE TRAINED IN THE USE AND OPERATION OF THE EQUIPMENT. THE MAIN DRIVE WHEELS MUST BE CHOCKED TO PREVENT LOADER MOVEMENT IN EITHER DIRECTION AND PLATFORM MAINTENANCE STANDS MUST BE INSTALLED FOR SUPPORT WHENEVER PLATFORM IS RAISED FOR MAINTENANCE OR ADJUSTMENTS. FAILURE TO FOLLOW GOOD SAFETY PRACTICES DURING MAINTENANCE AND TROUBLESHOOTING PROCEDURES COULD RESULT IN DEATH OR SERIOUS INJURY TO PERSONNEL AND/OR DAMAGE TO THE EQUIPMENT.

The information contained in this section is provided as a guide to assist technical service personnel in troubleshooting operational malfunctions in the Commander Container/Pallet Loader Hydraulic and Electrical Systems. The information should be used in conjunction with the Troubleshooting Section, Schematics, Reference Designators, and Adjustment Procedures incorporated in this manual.

A. Before starting troubleshooting procedures, verify that the correct operating procedures were used. An incorrect operating procedure can cause apparent malfunctions.

B. The most important practice to observe when working on the hydraulic system is cleanliness. Serious damage can result quickly from foreign material (contamination) in the hydraulic system. When a hydraulic system is opened, cap or plug all ports and openings to keep foreign material and moisture laden air (contamination) from entering the system. DO NOT use teflon tape or pipe compound on straight threads.

2. INTRODUCTION

The FMC Commander is a hydraulically operated - electrically controlled aircraft pallet/container loader. The hydraulic and electrical systems are complex and require a thorough understanding to determine the cause of a malfunction, or failure of a component. System diagnosis is mandatory to locate a component that is out of adjustment, or has failed, in the minimum amount of time.

3. HYDRAULIC SYSTEM

A. The hydraulic system is a closed center system with a load sensing control that automatically regulates pump displacement. When there is no system demand, the pump stands by at near zero flow and low pressure. When the system demands flow, the pump delivers only the flow required by the system at a pressure required to move the load, plus standby pressure.

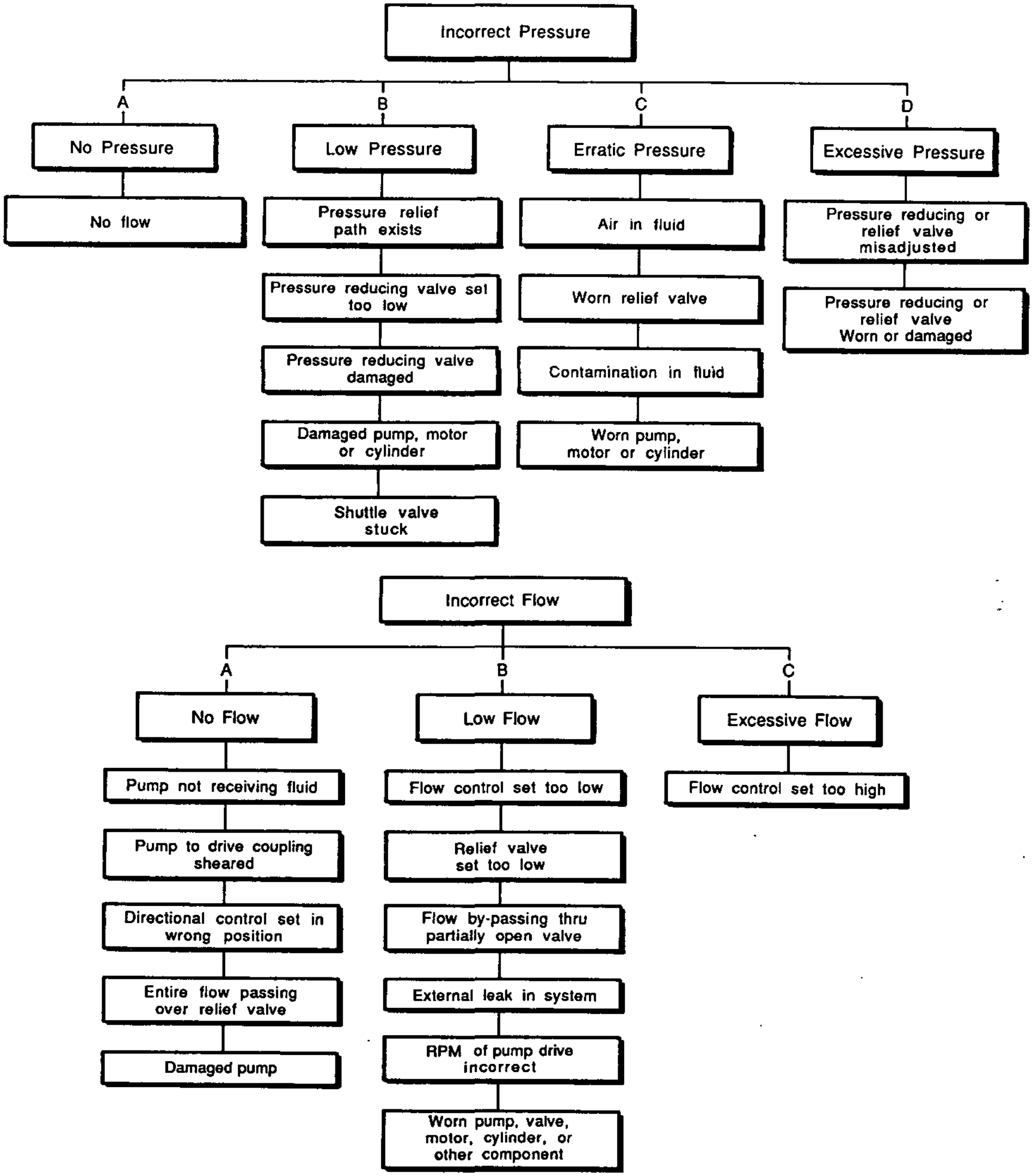
B. A heavy duty liquid filled pressure gauge is installed on the pump and hydraulic system diagnosis is accomplished by observing the pressure readings on the gauge when a particular hydraulic circuit has oil flowing. The hydraulic schematics, and adjustment procedures, indicate the pressure reading that should be indicated when a hydraulic system (load function) is in use.

C. The first step in diagnosing a malfunction is to isolate the malfunction to the hydraulic system or to the electrical control system.

All solenoid actuated control valves in the hydraulic system are equipped with a manual override that can be used to actuate the valve should there be a loss of electrical current. The manual override, when depressed, shifts the valve spool and permits oil flow for the loader function to operate. The pressure gauge on the variable displacement pump can be observed for the correct pressure reading for the system (loader function) in use.

<u>NOTE:</u> To obtain oil flow and pressure, it will be necessary to actuate the pilot valve with the directional control valve in hydraulic circuits with a pilot valve.

D. Use the troubleshooting guide (Fig. 1) to assist in locating the cause of a malfunction when incorrect pressure or incorrect flow has been determined.



HYDRAULIC TROUBLE SHOOTING GUIDE
Figure 1

4. ELECTRICAL SYSTEM

The Commander Loader has a 24 volt DC electrical system that controls all functions of the loader. The components of the electrical system are located in the engine panel, the main panel, and on the operator's console. Proximity switches in various locations sense a specific position of a mechanical component for the actuation and interlocking of electrical circuts.

A. Engine Panel

The engine panel is located on the power unit and contains relays and contactors associated with operation of the power unit, circuit breakers for overload protection, elasped time hour meter, tachometer (optional), emergency stop switch and an auxiliary start switch. A terminal block strip is located below the relays and contactors that is used for interconnecting the power unit wiring with the loader's electrical system.

B. Driver's Panel

The driver's panel on the console has the power unit (engine) instruments and the switches required to drive and position the loader at the aricraft.

C. Control Panel

The control panel on the console has the necessary switches for the loader functions that are required for cargo operations and an emergency stop switch that will shut the loader power unit down, and disconnects power to the control circuits.

D. Main Panel

The main panel is located in the console and contains the relay panel, propulsion board and the system status panel. Wire harnesses connect these components to the engine panel, driver's panel, control panel, solenoid valves, and proximity switches.

E. Propulsion Board

The propulsion board, mounted on the side wall of the main panel contains the relays, a sealed (potted) electronic module for propulsion control, trim pots (potentiometers) for adjusting the module for propulsion performance and LED indicating lights that provide a visual signal that the module is providing an output voltage for propulsion. Refer to the electrical adjustment procedures for the adjustment of the propel board.

F. Relay Panel (Fig. 2)

The relay panel, mounted on the back wall in the main panel, is a circuit board with diodes and control relays. Wire harnesses have plugs that are inserted in the sockets, that are mounted near the edges of the relay board, and these sockets are permanently connected to the relay sockets and diodes on the circuit board. A diode assembly is inserted in the edge connector on the left side of the relay circuit board.

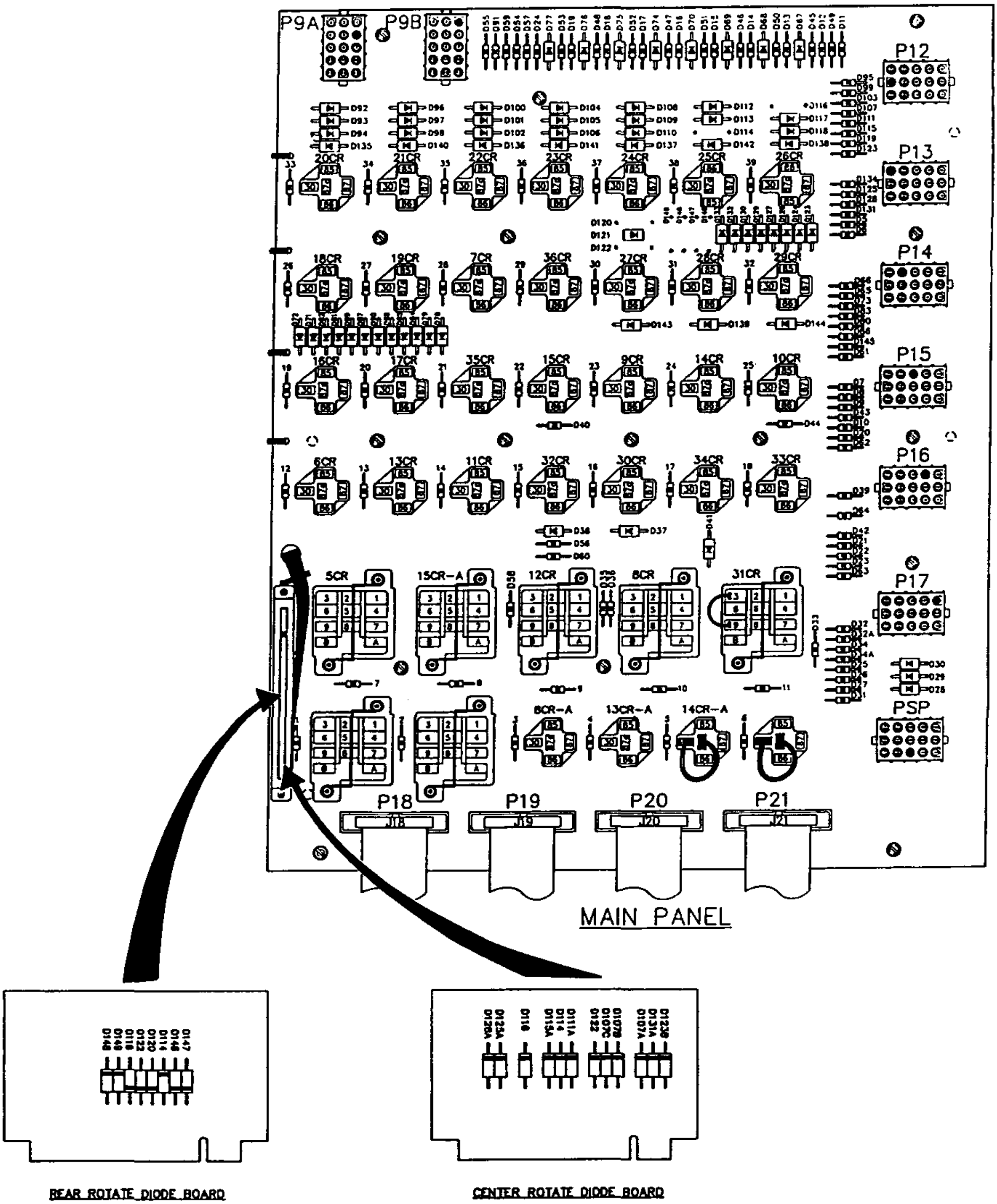
NOTE: Loader configuration determines the circuits on this diode assembly.

CAUTION: WHEN TROUBLESHOOTING THE ELECTRICAL SYSTEM, USE AN ACCURATE VOLTMETER TO VERIFY CIRCUITS AND RELAY OPERATION. JUMPER WIRES, AND SOME TEST LIGHTS, CAN SEVERLY DAMAGE THE CIRCUITS ON THE RELAY PANEL THAT WOULD REQUIRE REPLACEMENT OF THE RELAY PANEL.

G. Status Panel (Fig. 3)

The status panel, mounted on the inside of the panel door, is connected to the relay panel with four (4) ribbon cables. The status panel monitors the Commander Electrical System and provides a visual indication of relays that are energized (actuated) and the solenoid valve circuits that are energized at any given time, and reduces the time required to locate a misadjustment or a failed component. This visual approach to troubleshooting eliminates many electrical checks with a voltmeter and the use of test lights. JUMPER WIRES SHOULD NEVER BE USED AS AN ERROR (SHORT CIRCUIT) CAN DESTROY THE CIRCUIT BOARD. Schematic drawings of the electrical system must be used when troubleshooting and using the status panel as a visual aid.

Troubleshooting the Commander Loader is simplified with the status panel, and most troubleshooting can be done with the power unit (engine) off. With the ignition switch in the "ON" position, electrical current is provided to the control switches, and then when a control switch is actuated for a loader function, a combination of lights will illuminate on the status panel. With the power unit "OFF", and there is no hydraulic flow, the loader remains static and the electrical system can be diagnosed for a misadjustment or failed component.



RELAY PANEL
Figure 2

To use the status panel as a troubleshooting aid, start the power unit and place the "MODE" switch in "OPERATE" position to let the stabilizers fully extend and then shut the power unit down. Turn the ignition switch to the "ON" position, but DO NOT start the power unit. Actuate a switch that commands the loader function that has a problem and observe and record the status panel lights that are illuminated. Refer to the status panel function guide on Pages 9 thru 12 for the lights that should be illuminated for a loader function.

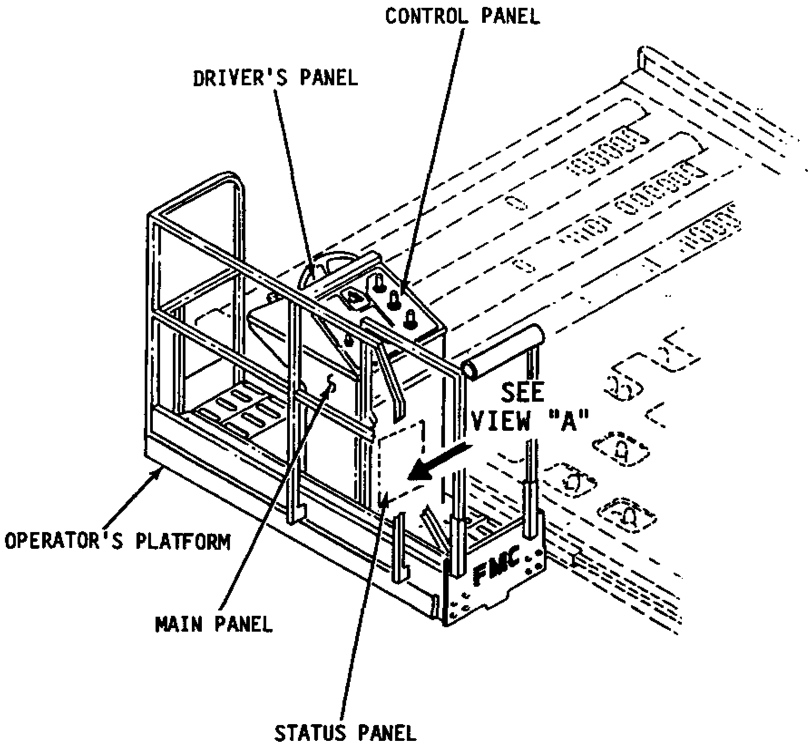
NOTE: Some troubleshooting checks will require the "MODE" switch be in "DRIVE" position and the stabilizers fully retracted when observing the status panel indicator lights.

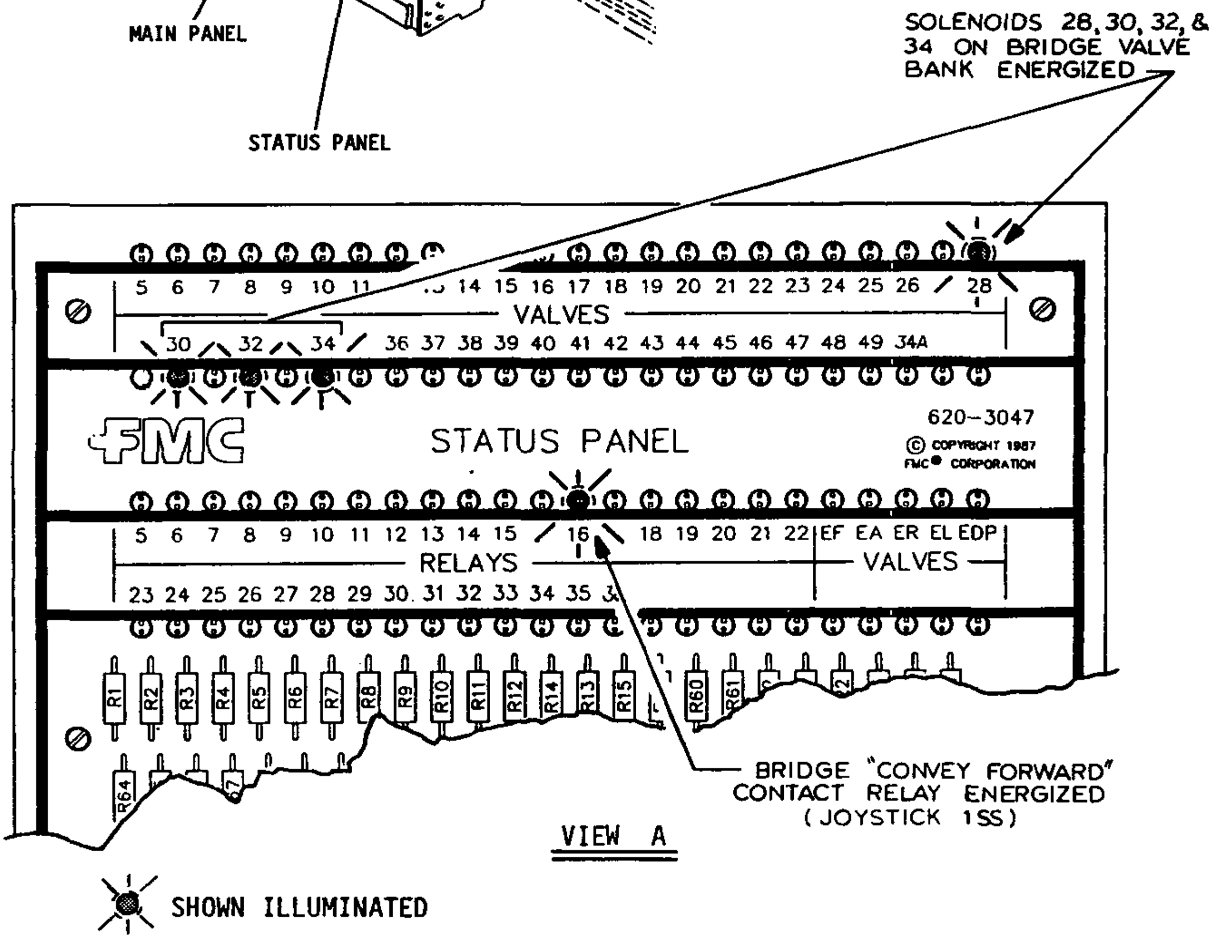
Raise or lower the platform, or bridge, to the position a malfunction occurs and shut the power unit down. Turn the ignition switch "ON" (DO NOT START THE POWER UNIT) and then observe the illuminated lights on the status panel. Refer to the status panel function guide for the lights that should be illuminated.

Incorrect display of status panel indicator lights will require reviewing the electrical schematics to diagnose the problem.

Failure to obtain relay lights indicates there is a possible failure in the power feed, the switch being actuated or of an interlock contact (another relay) that did not actuate closed to complete the circuit. If the relay light is illuminated as required, the control circuit has been completed and no further checking is required.

The solenoid valve indicator lights indicate that control circuits have been completed and there is an output from the relay panel to the solenoid valves. If the solenoid valve does not actuate with the indicator light illuminated, a voltmeter check must be made at the valve to verify that there is not an open circuit between the console and the valve. Always make voltmeter checks across the solenoid valve terminals; DO NOT use the loader frame for ground.





STATUS DISPLAY PANEL
Figure 3

STATUS PANEL FUNCTION GUIDE

NOTE 1: All commands to check status panel indicator light display requires the platform to be fully lowered unless marked by an (*) asterick.

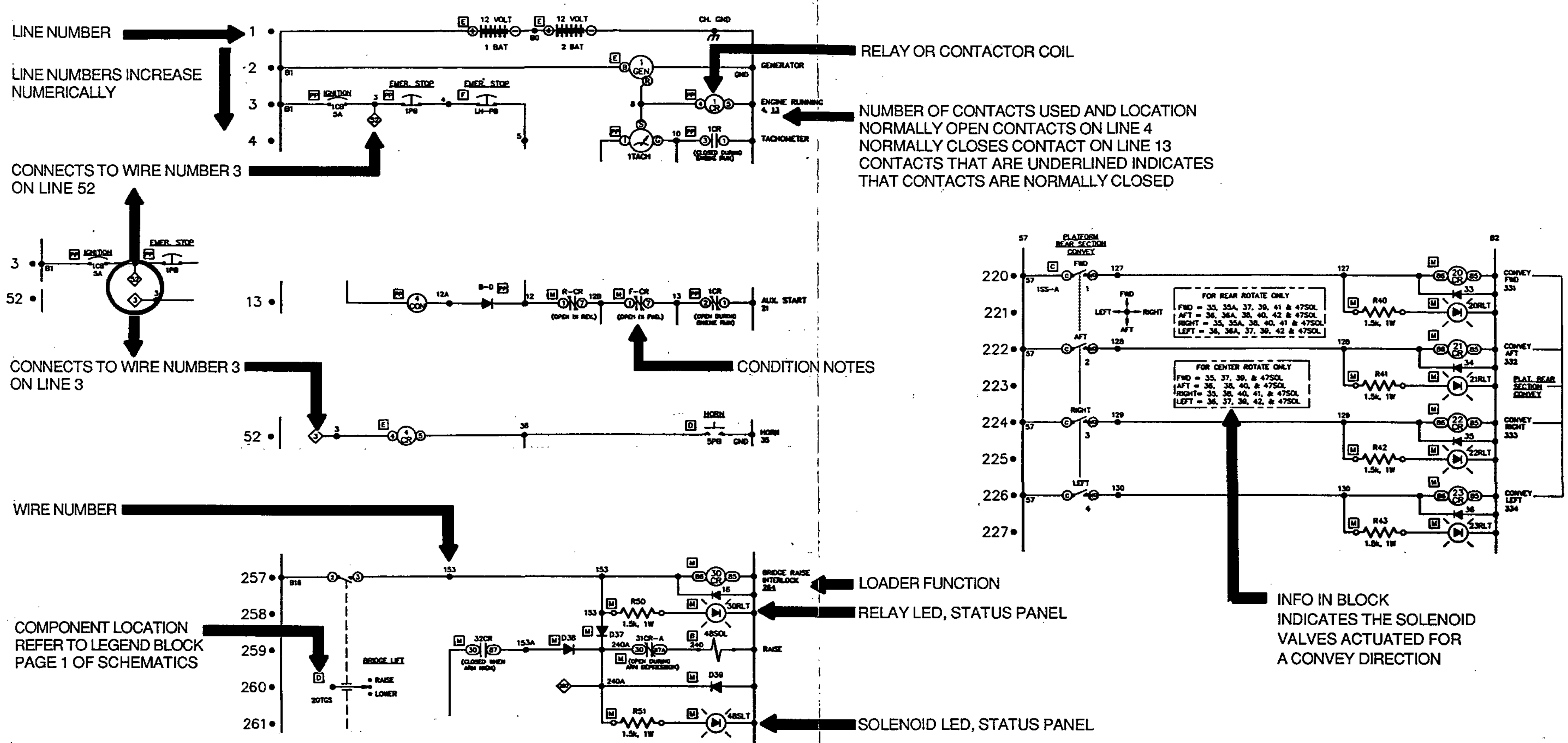
NOTE 2: Relay and solenoid valve status panel indicator lights with numbers boxed will be illuminated when the switch is actuated.

COMMAND	RELAY ACTUATED (RLT)	SOLENOID VALVE ACTUATED (SLT)
DRIVE MODE		
Rabbit (high speed propel)	35	5
Bogy wheels, RAISE	36	9, 11
Bogy wheels, LOWER	36	10, 11
Cab, EXTEND	36	12, 34
Cab, RETRACT	36	13, 34
Bridge guide, SHIFT LEFT	36	14, 34
Bridge guide, SHIFT RIGHT	36	15, 34
Bridge, UP	30, 36	48
Bridge, DOWN	36	49
104" wing, RAISE	36	16, 34
104" wing, LOWER	36	17, 34
134" wing, RAISE	36	18, 34
134" wing, LOWER	36	19, 34
Stabilizer (during retract)	36	6, 11

COMMAND	RELAY ACTUATED (RLT)	SOLENOID VALVE ACTUATED (SLT
OPERATE MODE		
Stabilizers (during extend)	7, 15A, 36	8, 11
Platform right guide, DOWN	7, 15A, 6, 36	24, 27
AUTO DOWN	7, 15A	24, 27
Platform rear guide, DOWN	7, 15A, 6, 36	25, 27
AUTO DOWN	7, 15A	25, 27
Platform left guide, DOWN	7, 15A, 6, 36	26, 27
AUTO DOWN	7, 15A	26, 27
PLATFORM CONVEY, REAR ROTATION PLATFORM		
Forward section, FORWARD	7, 15A, 26, 36	43, 45, 47
AFT	7, 15A, 27, 36	44, 46, 47
LEFT	7, 15A, 29, 36	44, 45, 47
RIGHT	7, 15A, 28, 36	43, 46, 47
Rear Section, FORWARD	7, 15A, 20, 36	35, 37, 39, 41, 47
AFT	7, 15A, 21, 36	36, 38, 40, 42, 47
LEFT	7, 15A, 23, 36	36, 37, 39, 42, 47
RIGHT	7, 15A, 22, 36	35, 38, 40, 41, 47
Rotate, CLOCKWISE	7, 15A, 24, 36	36, 37, 40, 41, 47
Rotate, COUNTERCLOCKWISE	7, 15A, 25, 36	35, 38, 39, 42, 47
PLATFORM CONVEY, CENTER ROTATION PLATFORM		
Forward section, FORWARD	7, 15A, 26, 36	39, 43, 45, 47
AFT	7, 15A, 27, 36	40, 44, 46, 47
RIGHT	7, 15A, 28, 36	40, 41, 43, 46, 47
LEFT	7, 15A, 29, 36	39, 42, 44, 45, 47

COMMAND	RELAY ACTUATED (RLT)	SOLENOID VALVE ACTUATED (SLT)
Rear section, FORWARD	7, 15A, 20, 36	35, 37, 39, 47
AFT	7, 15A, 21, 36	36, 38, 40, 47
RIGHT	7, 15A, 22, 36	35, 38, 41, 47
LEFT	7, 15A, 23, 36	36, 37, 39, 42, 47
Rotate, CLOCKWISE	7, 15A, 24, 36	36, 37, 39, 41, 43, 46, 47
Rotate, COUNTERCLOCKWISE	7, 15A, 25, 36	35, 38, 39, 41, 44, 45, 47
* PLATFORM RAISE		
Platform below 24"	7, 15A 10, 35	20
Platform above 24" and below 30"	15A 10, 35	20
Platform above 30" but below 4" of bridge interface	10, 11, 35	20, 21
Platform between 4" of interface and bridge interface	8, 10, 35	20
* PLATFORM LOWER		
Platform below bridge interface, but above 4" of interface	8, 12, 36	22
Platform below 4" of interface and above 30"	12, 13, 36	22, 23
Platform below 30" and above 24"	15A 12, 36	22
Platform below 24"	7, 15A, 12, 36	22

COMMAND	RELAY ACTUATED (RLT)	SOLENOID VALVE ACTUATED (SLT)
* PLATFORM AT BRIDGE INTERFACE	8, 9, 15	
* PLATFORM ABOVE BRIDGE (OVERTRAVEL)	$\boxed{8, 9, 12, 14, 15, 36}$	$\boxed{22}$
AUTO TRACK (OPTIONAL)		
Hook, CENTERED (Locked "ON")	7, 15A, 31, 33	
Hook, LOW (Locked "ON")	7, 15A, 31, 33 $\boxed{34, 36}$	$\boxed{49}$
Hook, HIGH (Locked "ON")	7, 15A, 31, 33 $\boxed{32, 36}$	$\boxed{48}$
EXTENSION DECK (OPTIONAL)		
CONVEY FWD	7, 15A $\boxed{36}$	$\boxed{EF, EDP}$
CONVEY AFT	7, 15A $\boxed{36}$	$\boxed{EA, EDP}$
RAISE	7, 15A $\boxed{36}$	$\boxed{ER, EDP}$
LOWER	7, 15A $\boxed{36}$	$\boxed{EL, EDP}$
BRIDGE CONVEY		
CONVEY FWD	7, 15A $\boxed{16, 36}$	$\boxed{28, 30, 32, 34}$
CONVEY AFT	7, 15A $\boxed{17, 36}$	$\boxed{29, 31, 33, 34}$
CONVEY LEFT	7, 15A $\boxed{19, 36}$	$\boxed{31, 32, 34A}$
CONVEY RIGHT	7, 15A $\boxed{18, 36}$	$\boxed{30, 33, 34A}$



NOTES
1. FOR DETROIT ENGINE
2. FOR DEUTZ ENGINE
3. FOR ISUZU ENGINE
4. FOR ONAN ENGINE
5. FOR PERKINS ENGINE

LEGEND
- B - BRIDGE
- C - CONTROL PANEL
- D - DRIVE PANEL
- E - POWER UNIT (ENGINE)
- F - FRAME
- M - MAIN PANEL
- O - OTHER
- P - PLATFORM
- PP - POWER PANEL
- GC - GAUGE CLUSTER

ELECTRICAL SCHEMATIC INFORMATION
Figure 4

4. Troubleshooting

The following guide lists loader malfunctions and some possible causes of a listed malfunction. When there is a problem or malfunction of the loader, read through the list on the left side of the chart. Possible causes are listed to the right side.

This guide lists the most common problems that could be encountered, but is not meant to replace troubleshooting procedures that would require diagnosing a system malfunction using the hydraulic and electrical schematics.

The status panel indicator lights on the main panel access door and an accurate voltmeter must be used to identify electrical problems. Electrical schematics must be referred to when troubleshooting the Commander electrical system. Proximity switches and pressure switches must be adjusted to specifications when they are replaced. (Refer to the Adjustment Procedures).

Hydraulic troubleshooting can be done using the pressure gauge that is installed as standard equipment on the variable displacement pump, and the hydraulic schematics.

Hydraulic component problems are usually caused by oil contamination and many components can be made serviceable by a thorough cleaning. Hydraulic filter elements must be replaced when a system has been cleaned of contamination and the hydraulic oil replaced. The hydraulic filter element must be replaced whenever the warning indicator is visible.

Always check the hydraulic circuit, when a component has been repaired or replaced, for the correct indicated pressure and correct actuator speeds. Refer to the adjustments and performance specifications.

The troubleshooting guide does not include obvious causes such as burned out light bulbs, loose wire connections, physical damage to wire harnesses, components, etc. It is assumed that the technician will check those items before proceeding with detailed troubleshooting procedures and adjustments.

TROUBLE	POSSIBLE CAUSE
No lights; engine does not crank	Battery 1BAT and/or 2BAT discharged
	Emergency switch 1PB and/or 2PB pressed ES-PB-LH-PH (Optional)
	1CB tripped
Lights function; engine does not crank from either panel	Drive control not in neutral position
	Engine circuit breaker 2CB tripped
Engine cranks from driver's control panel, but not from power unit control panel	Ignition switch 1TGS in OFF position
	Auxiliary switch 4PB
Engine cranks but does not run	Fuel contaminated
	Cold engine (diesel)
	Filter(s) clogged or dirty
	Engine fuel
	Glowplugs
Engine starts but demand throttle does not function	Solenoid 2SOL
	Demand throttle control relay CR-35 faulty
	Demand throttle linkage improperly adjusted
Oil pressure gauge does not indicate pressure	Engine oil pump
	Oil pressure sending unit
	Oil pressure gauge
Coolant temperature gauge does not indicate temperature	Engine temperature sending unit
	Engine temperature gauge

TROUBLE	POSSIBLE CAUSE
Fuel gauge does not indicate fuel level	Fuel sending unit
	Fuel gauge
Voltmeter does not indicate	V-belt loose
	Volt meter
	Alternator regulator
Generator failure light does not go out when engine is running	V-belt loose
	Alternator
Oil pressure warning light does not go out when engine is running or alarm horn sounds	Oil pressure switch
	Oil pressure low
Engine coolant temperature warning light illuminates or alarm horn sounds	Low coolant level
	Engine thermostat
	Engine temperature switch
Hydraulic oil temperature warning light illuminates or alarm horn sounds	Hydraulic oil temperature above 180°
	Hydraulic oil temperature switch
Low fuel warning light illuminates or alarm horn sounds	Low fuel
	Low fuel float switch
Headlamps and parking lights do not illuminate	Circuit breaker 3CB tripped
Floodlights do not illuminate	Circuit breaker 4CB tripped
Positioning light does not illuminate	Circuit breaker 4CB tripped
Stoplights do not illuminate	Stop light switch
Turn Signals do not function	Circuit breaker 3CB tripped
	Flasher
	Turn signal switch

TROUBLE	POSSIBLE CAUSE
Backup alarm does not sound when loader is in reverse	Alarm horn
	Switch 2LS
Backup lights do not light when loader is in reverse	Switch 2LS
Bridge up reverse alarm (Optional) does not sound with bridge raised and unit in reverse	Bridge up reverse alarm BURAH faulty
	Switch 2PLS
Horns do not sound	Horn switch
Emergency pump does not operate	Circuit breaker 4CB tripped
	Electric pump motor
Loader does not drive or propel in either direction	Drive selector switch contol in neutral
	Parking brake set
	Circuit breaker 5CB tripped
	Forward/Reverse directional switch
	Accelerator control faulty or maladjusted
	Propulsion control board faulty or maladjusted
	Stabilizer proximity switch 1PLS maladjusted
	Parking brake pressure reducing valve maladjusted
	Drive hubs disengaged
	Drive motors siezed
	Main system relief valve pressure improperly adjusted
	Pump compensator maladjusted
	Shuttle Valve Stuck

TROUBLE	POSSIBLE CAUSE
Loader does not drive or propel in either direction (continued)	Brakes Brake valve faulty Pump failure
Loader moves forward but not in reverse	Propulsion valve Fwd/Rev. Directional Switch
Loader moves in reverse but not forward	Propulsion valve Fwd/Rev. Directional Switch
Loader moves in fast mode only	Hub drive disengaged left or right Drive motor Drive motor shaft broken Drive hub - disengaged or failed
Loader moves or drives in forward or reverse but is slow or sluggish	Engine RPM low Accelerator control improperly adjusted Main system relief improperly adjusted Sense line shuttle check valve between propulsion valve and pump control valve blocked Pump control Propulsion valve
Loader drives normally but has little or no dynamic braking when accelerator is released	Dynamic brake relief valve improperly adjusted Propulsion valve
Loader drives normally forward and reverse but has severe dynamic braking when accelerator is released	Dynamic brake relief valve improperly adjusted Propulsion valve

TROUBLE	POSSIBLE CAUSE
Stabilizers do not extend	Circuit breaker 5CB tripped
	Pressure switch 4PS improperly adjusted
	Stabilizer relief valve improperly adjusted
Stabilizers extend but indicator light does not light or indicate stabilizers are extended	Pressure switch 4PS improperly adjusted
	Stabilizer relief valve improperly adjusted
	Shuttle check valve
Stabilizers extend but do not retract	Circuit breaker 5CB tripped
	Stabilizer proximity limit switch 1PLS improperly adjusted
	Solenoid valve 6SOL
Stabilizers extend but one or more do not move or fully extend	Last stabilizer up or down restrictor (right center) stabilizer blocked, improperly adjusted
	Stabilizer extend pressure switch 4PS improperly adjusted
Stabilizers retract but one or more do not move or fully retract	Stabilizer check valve
	Last stabilizer up or down restrictor valve improperly adjusted
Stabilizer movement erratic or cylinder chatters when being extended	Last stabilizer down pressure switch 4PS improperly adjusted
	Stabilizer relief valve improperly adjusted

TROUBLE	POSSIBLE CAUSE
Hydraulic powered bogy wheels do not extend	Circuit breaker 5CB tripped
	Bogy extend solenoid valve 9SOL
	Stabilizer pilot solenoid valve 11SOL
	Hydraulic cylinder faulty
	Flow control valve for lowering speed improperly adjusted
	Bogy lower solenoid drive 10SOL
Operator's cab does not extend or retract	Circuit breaker 5CB tripped
	Bridge pilot solenoid valve 34SOL
	Cab extend retract solenoid valve 12SOL and/or 13SOL
	Bridge sense line shuttle valve
	Cab extension retract cylinder
	Cab extension cylinder restrictor valve closed
Operator's cab extends but does not retract	Cab extend solenoid valve 12SOL
	Flow control valve faulty
Operator's cab moves slowly when extending and retracting	Cab extend/retract restrictor valve improperly adjusted
	Cab extend retract solenoid valve 12SOL and/or 13SOL
	Bridge pilot solenoid valve 34SOL
Loader drives or propels in both forward and reverse but no function on either bridge or platform	Circuit breaker 5CB tripped

TROUBLE	POSSIBLE CAUSE
Bridge side guides do not move left or right	Circuit breaker 5CB tripped
	Bridge pilot solenoid valve 34SOL
	Bridge side guides solenoid valves 14SOL and/or 15SOL
	Bridge side guides speed adjust restrictor valve incorrectly adjusted
	Restrictor valve
	Hydraulic cylinder
Bridge side guides move left but not right	Bridge side guide solenoid valve 15SOL
	Pilot operated check valve
Bridge side guides move right but not left	Bridge side guide solenoid valve 14SOL
	Pilot operated check valve faulty
Bridge powered wing 104 in. (Optional) does not move up or down	Options circuit breaker 6CB tripped
	Bridge down proximity limited switch 2PLS maladjusted
	104 In. folding wing up and/or down solenoid valves 16SOL and 18SOL
	Bridge pilot solenoid valve 34SOL
	Restrictor valve closed
	Hydraulic cylinder faulty
Bridge powered wing 104 in. (Optional) moves up but not down	104 In. wing down solenoid valve 18SOL
	Hydraulic cylinder

TROUBLE	POSSIBLE CAUSE
Bridge powered wing 104 in. (Optional) moves down but not up	104 In. wing up down switch 12TGS
	104 In. wing raise solenoid valve 16SOL
	Hydraulic cylinder faulty
Bridge powered wing 134 in. (Optional) does not move up or down	Circuit breaker 6CB tripped
	Bridge down proximity limit switch 2PLS maladjusted
	134 In. folding wing solenoid valves 17SOL and/or 19SOL
	Bridge pilot solenoid valve 34SOL
	Restrictor valve closed
	Hydraulic cylinder faulty
Bridge powered wing 134 in. (Optional) moves up but not down	134 In. powered wing down solenoid valve 19SOL
	Hydraulic cylinder faulty
Bridge powered wing 134 in. (Optional) moves down but not up	Powered wing 134 in. up down switch 13TGS
	134 In. wing up solenoid valve 17SOL
	Hydraulic cylinder
Bridge does not convey in any direction	Circuit breaker 5CB tripped
	Bridge circuit breaker 8CB tripped
	Bridge pilot solenoid valve 34SOL or 34SOL-A
Bridge does not convey left	Bridge convey solenoid valves 31SOL, 32SOL, & 34SOL-A
Bridge does not convey right	Bridge convey solenoid valves 30SOL, 33SOL, & 34SOL-A
Bridge does not convey AFT	Bridge convey solenoid valves 29SOL, 31SOL & 34SOL

TROUBLE	POSSIBLE CAUSE
Bridge does not convey FWD	Bridge convey solenoid valves 28SOL, 32SOL &34SOL
One or more roller assemblies do not rotate when any function is selected on bridge for convey	Bridge convey solenoid valves 28SOL, 29SOL, 30SOL, 31SOL, 32SOL, and/or 33SOL
	Drive motors
	Driver roller drive chains broken
	Sprocket keys sheared
Bridge does not raise or lower	Bridge circuit breaker 8CB tripped
	Bridge raise lower solenoid valves 48SOL and/or 49SOL
	Bridge raise and lower speed adjustment control valve improperly adjusted
	Bridge sense line flow control valve closed
	Sense line shuttle valve
Bridge raises but does not lower	Bridge lower solenoid valve 49SOL
	Bridge cylinder counterbalance valves improperly adjusted
	Sense line shuttle valve
Bridge lowers but does not raise	Bridge lift solenoid valve 48SOL
	Sense line shuttle valve
Bridge lowers unevenly	Bridge lift cylinder counterbalance valves improperly adjusted
	Bridge lift cylinders
Bridge raises unevenly	Raise level flow control valve improperly adjusted
	Bridge lift cylinder counterbalance valves
	Bridge lift cylinders

TROUBLE	POSSIBLE CAUSE
Bridge auto level or auto tracking mode does not function (Optional)	Hook assembly out of range
	Bridge centered proximity switch 10PRS maladjusted
Tracking sensor senses up but not down	Auto track down proximity switch 11PRS maladjusted
Tracking sensor senses down but not up	Bridge auto track up proximity switch 9PRS maladjusted
	Centered proximity switch 10PRS maladjusted
Auto tracking mode does not lock on (Optional)	Centered proximity switch 10PRS maladjusted
Platform does not raise	Drive operate mode switch not in operate position
	Circuit breaker 5CB tripped
	Platform slow raise solenoid valve 20SOL
	Platform overtravel proximity switch 5PRS maladjusted
	Platform interfacing proximity switch 4PRS maladjusted
	Bridge rear stops held in down position
	Platform slow raise flow control valve improperly adjusted
	Platform slow down flow control valve
	Platform raise lower hydraulic bridge valve
	Sense line shuttle valve stuck
	Lift cylinders faulty

TROUBLE	POSSIBLE CAUSE
Platform raises very slowly or does not shift into fast speed	100mm of bridge proximity switch 4PRS-A maladjusted
	760mm proximity switch 4PRS maladjusted
	Platform raise solenoid valve 21SOL
	Platform fast raise pilot pressure reducing valve incorrectly adjusted
	Platform fast raise delay restrictor valve (choke) improperly adjusted
	Platform pilot operated valve
	Platform fast raise flow control valve (in bridge valve assembly) improperly adjusted
Platform raises to (650mm) 25.6 in only	Right, left, or rear stop of platform in down position
	Guide down proximity switches 1PRS, 1PRS-A, 2PRS, 3PRS, 3PRS-A maladjusted
	Platform below 650mm proximity switch 4PRS maladjusted
Platform will not lower	Circuit breaker 5CB tripped
	Rear stops on bridge held down or stuck in down position
	Bridge rear stop lowered proximity switches 6PRS &/or 6PRS-A maladjusted
	Platform slow down solenoid valve 22SOL
	Platform down pilot pressure reducing valve improperly adjusted
	Platform slow flow control valve improperly adjusted

TROUBLE	POSSIBLE CAUSE
Platform will not lower (continued)	Platform lift cylinder pilot operated check valves
Platform lowers very slowly	Platform guide held in down position
	Side guides lowered proximity switches 1PRS. 1PRS-A 2PRS, 3PRS. 3PRS-A, maladjusted
	Platform within 100mm of bridge proximity 4PRS-A maladjusted
	Platform fast down solenoid valve 23SOL
	Platform fast raise/lower flow control valve improperly adjusted
Platform lowers only part way; one stage of either lift cylinder does not retract	8PRS-B (1700mm) proximity switch maladjusted
	Lift cylinder pilot operated check valve faulty
	Mechanical binding of scissor or lift cylinder components
Platform raises only part way. Secondary stage of lift cylinders do not extend	8PRS-A (1800mm) proximity switch maladjusted
	20SOL-A platform sequence raise solenoid
Platform does not convey in any direction	Circuit breaker 5CB tripped
	Platform convey pilot solenoid valve 47SOL
	Sense line shuttle valve

TROUBLE	POSSIBLE CAUSE
Platform rear section conveys forward but not AFT	Solenoid valves 36SOL, 36ASOL 38SOL, 40SOL, 42SOL (REAR ROTATE ONLY) Joystick switch
Platform rear section conveys AFT but not forward	Convey solenoid valves 35SOL, 35ASOL, 37SOL, 39SOL, 41SOL (REAR ROTATE ONLY) Joystick switch
Platform rear section does not convey left or right	Platform convey solenoid valves 35SOL, 35ASOL, 36SOL, 36ASOL, 37SOL, 38SOL, 39SOL, 40SOL, 41SOL, 42SOL (REAR ROTATE ONLY) Joystick switch
Platform does not rotate cargo (Container Rotation Option)	Circuit breaker 5CB tripped Rotate switch
Platform rotates cargo counterclockwise but not clockwise	Container rotation switch
Platform rotates cargo clockwise but not counterclockwise	Container rotation switch
Front section of platform does not convey	Platform convey solenoid valves 35ASOL, 36ASOL, 43SOL, 44SOL, 45SOL, 46SOL (REAR ROTATE ONLY) Joystick switch
One or more roller assemblies do not rotate on platform when a specific function is selected	Solenoid valves 35SOL thru 46SOL Convey motors M5 thru M14 Roller chains broken Sprocket keys sheared or missing Chains broken

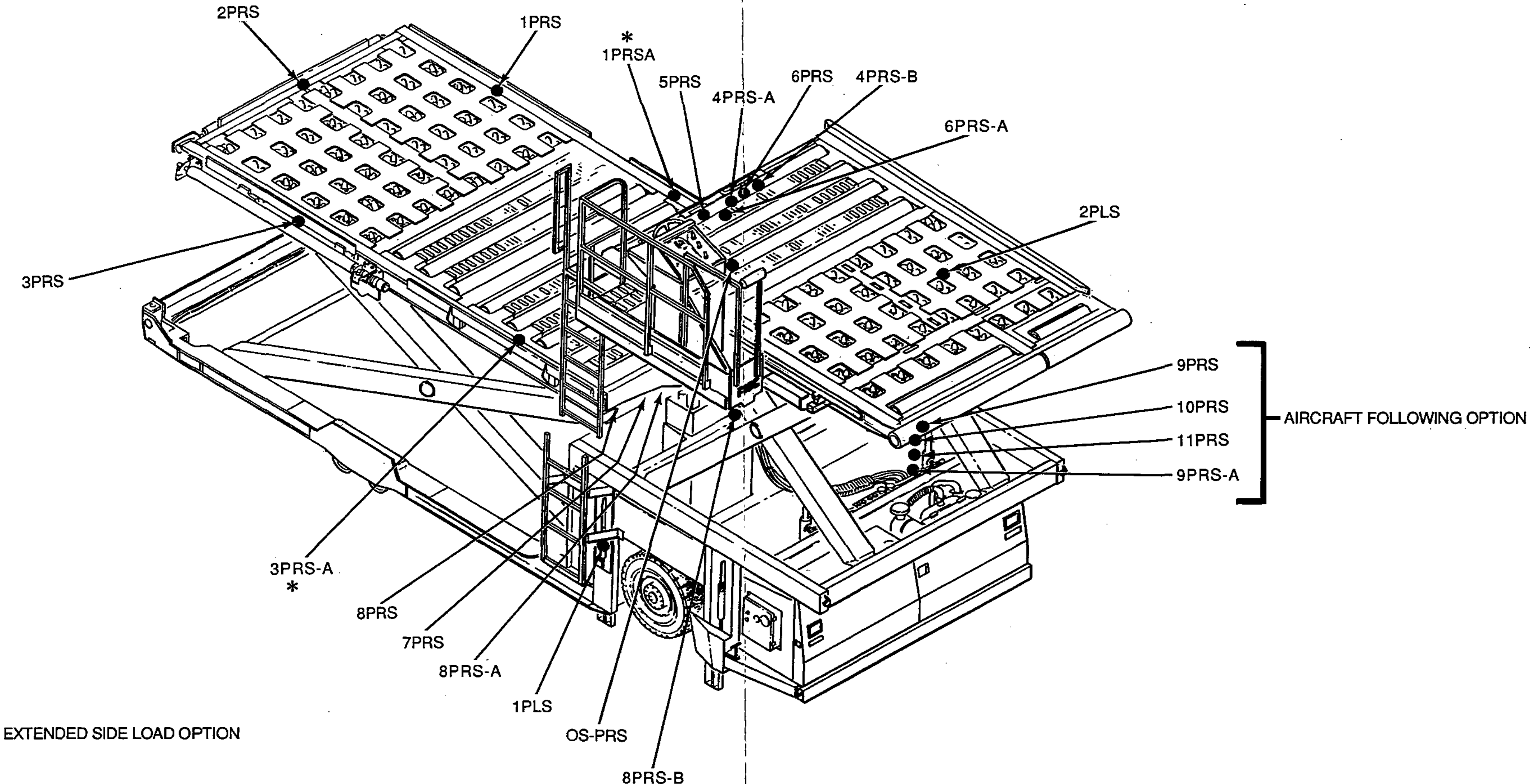
TROUBLE	POSSIBLE CAUSE
Platform side and rear guides do not function	Circuit breaker 6CB tripped
	Platform below 650mm proximity switch 4PRS maladjusted
Platform side and rear guides do not function (continued)	Side guide pilot solenoid valve 27SOL
	Shuttle valve
	Side guide pressure reducing valve improperly adjusted
	Side guide cylinders
Platform right guide does not lower	Right guide lower solenoid valve 24SOL
	Cylinder faulty
Platform rear guide does not lower	Rear guide lower solenoid valve 25SOL
Platform left guide does not lower	Left guide lower solenoid 26SOL
	Cylinder faulty
Parking brake does not release	Parking brake solenoid valve 7SOL
	Parking brake pressure reducing valve improperly adjusted
	Shuttle valve
	Brake assembly
	Brake actuator valve
Loader hard to steer or no power steering	Power steering pressure reducing valve improperly adjusted
	Shuttle valve stuck
	Steering valve
	Hydraulic cylinder for steering

TROUBLE	POSSIBLE CAUSE
Loader steers in one direction only	Steering valve
	Hydraulic cylinder
Loader has little or no braking action when pedal depressed	Power steering pressure reducing valve improperly adjusted
	Brake hydraulic actuating valve
	Sense line shuttle valve
	Air in lines from brake valve to wheel assembly
	Wheel brake assembly
Loader pulls to left or right when brakes are applied	Brake assembly

EXTENSION DECK (OPTIONAL)

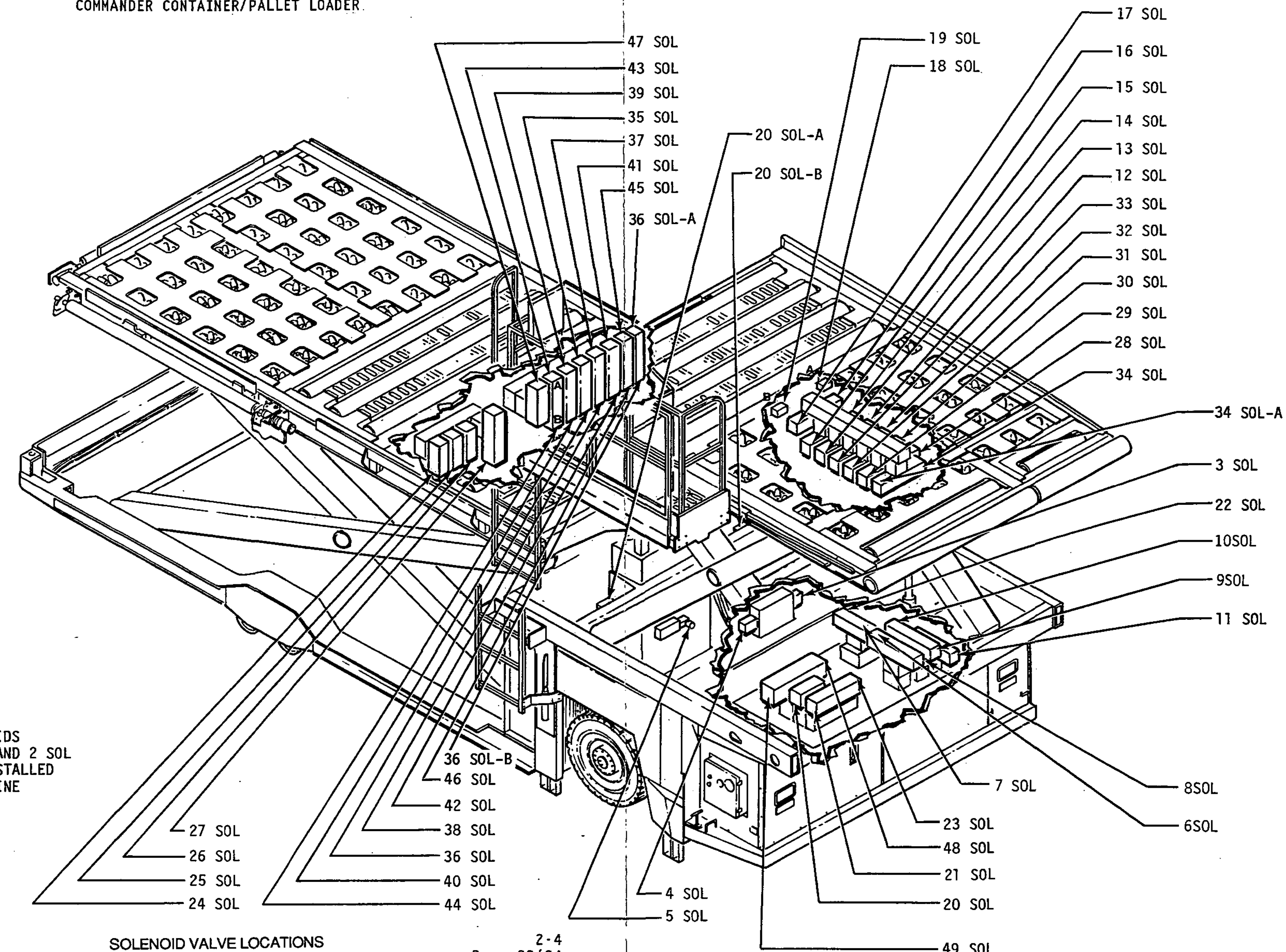
Extension deck will not operate	Platform below 650mm
	Extension deck pilot solenoid valve EDT-SOL
Extension deck will not convey FWD or AFT	Extension convey solenoid valves EP-SOL, EF-SOL and EA-SOL
Extension deck conveys FWD but not AFT	Convey AFT solenoid valve EA-SOL
Extension deck conveys AFT but not FWD	Convey forward solenoid valve EF-SOL
Extension deck lift does not raise	Extension deck raise solenoid valve ER-SOL
	Pilot valve EP-SOL
	Extension deck lift cylinders
Extension deck does not lower	Extension deck lower solenoid valve EL-SOL
	Pilot valve EP-SOL
	Mechanical obstruction or binding

NOTE:
2PLS, 4PRS-A, 4PRS-B, 7PRS
5PRS, 6PRS, 6PRS-A, OS-PRS
ARE LOCATED UNDER BRIDGE.



* EXTENDED SIDE LOAD OPTION

PROXIMITY SWITCH LOCATIONS
Figure 5

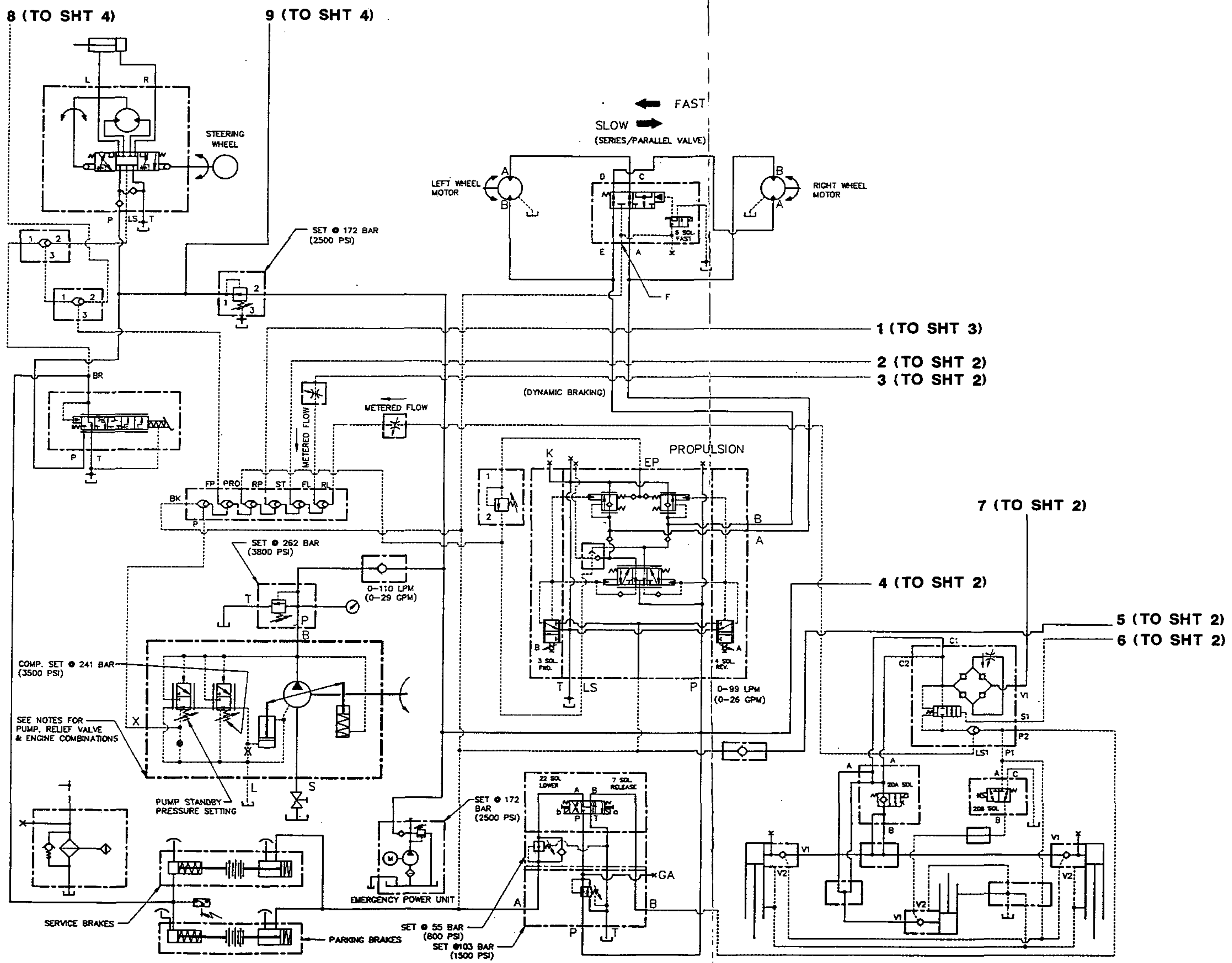


NOTE: SOLENOIDS
1 SOL AND 2 SOL
ARE INSTALLED
ON ENGINE

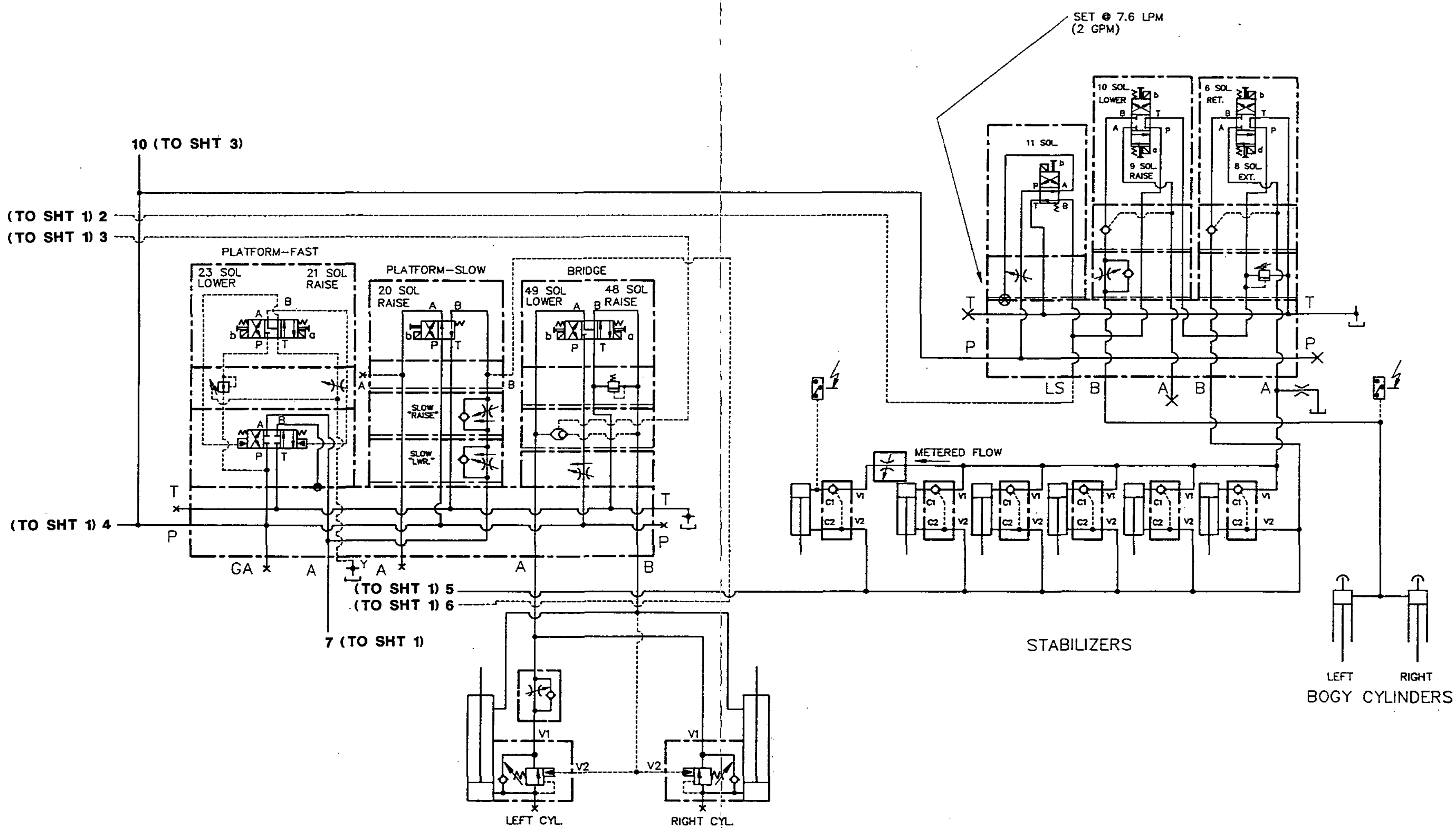
SOLENOID VALVE LOCATIONS
Figure 6

ATTENTION

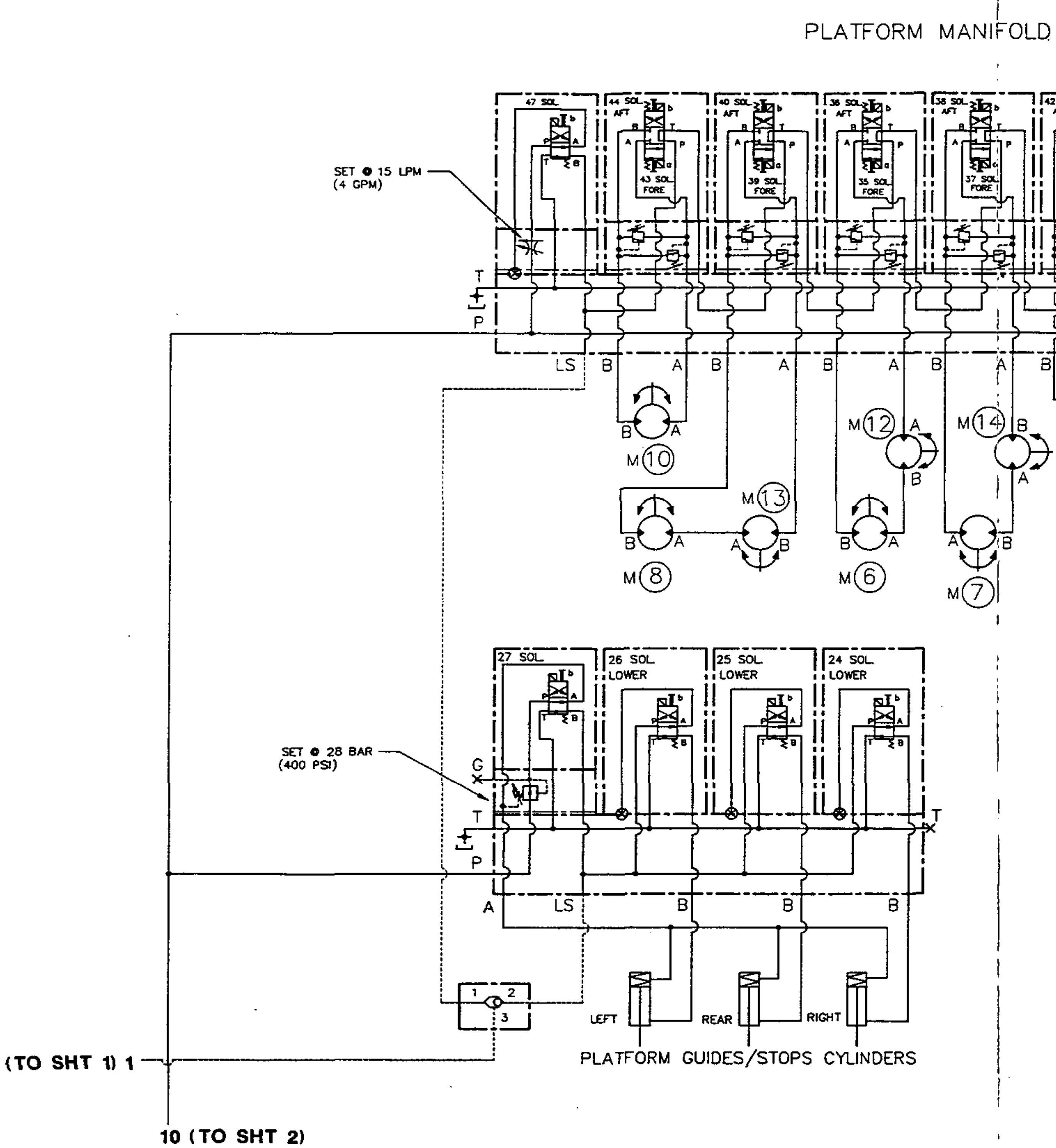
THE FOLLOWING SCHEMATIC DRAWINGS COVER ALL POSSIBLE OPTIONS THAT MAY BE INCORPORATED ON A SINGLE UNIT. THESE DRAWINGS ARE FOR GENERAL PURPOSE USE AND REFLECT OPTIONS THAT ARE AVAILABLE ON CURRENT PRODUCTION LOADERS.

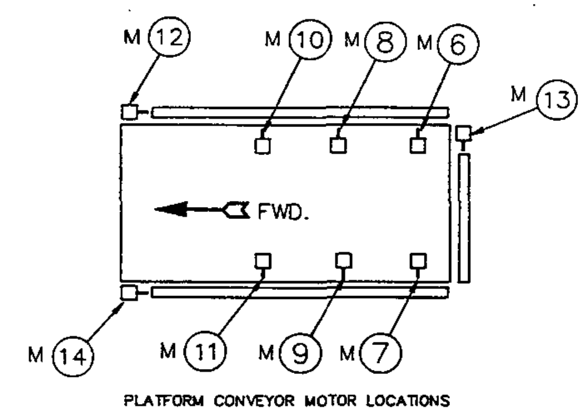


HYDRAULIC SYSTEM SCHEMATIC
620-2903
(SHEET 1 of 6)
Figure 7

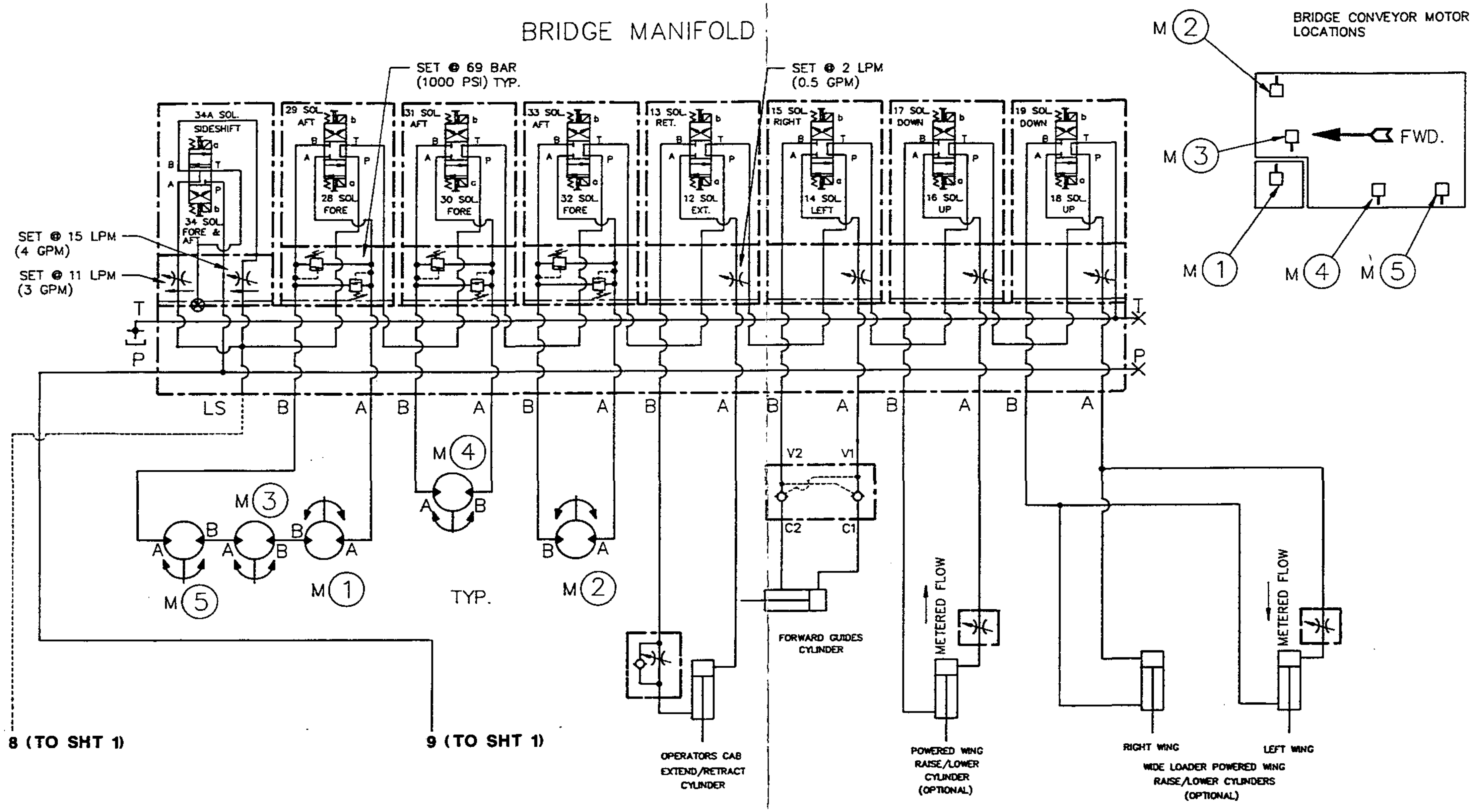


HYDRAULIC SYSTEM SCHEMATIC
620-2903
(SHEET 2 OF 6)
Figure 7

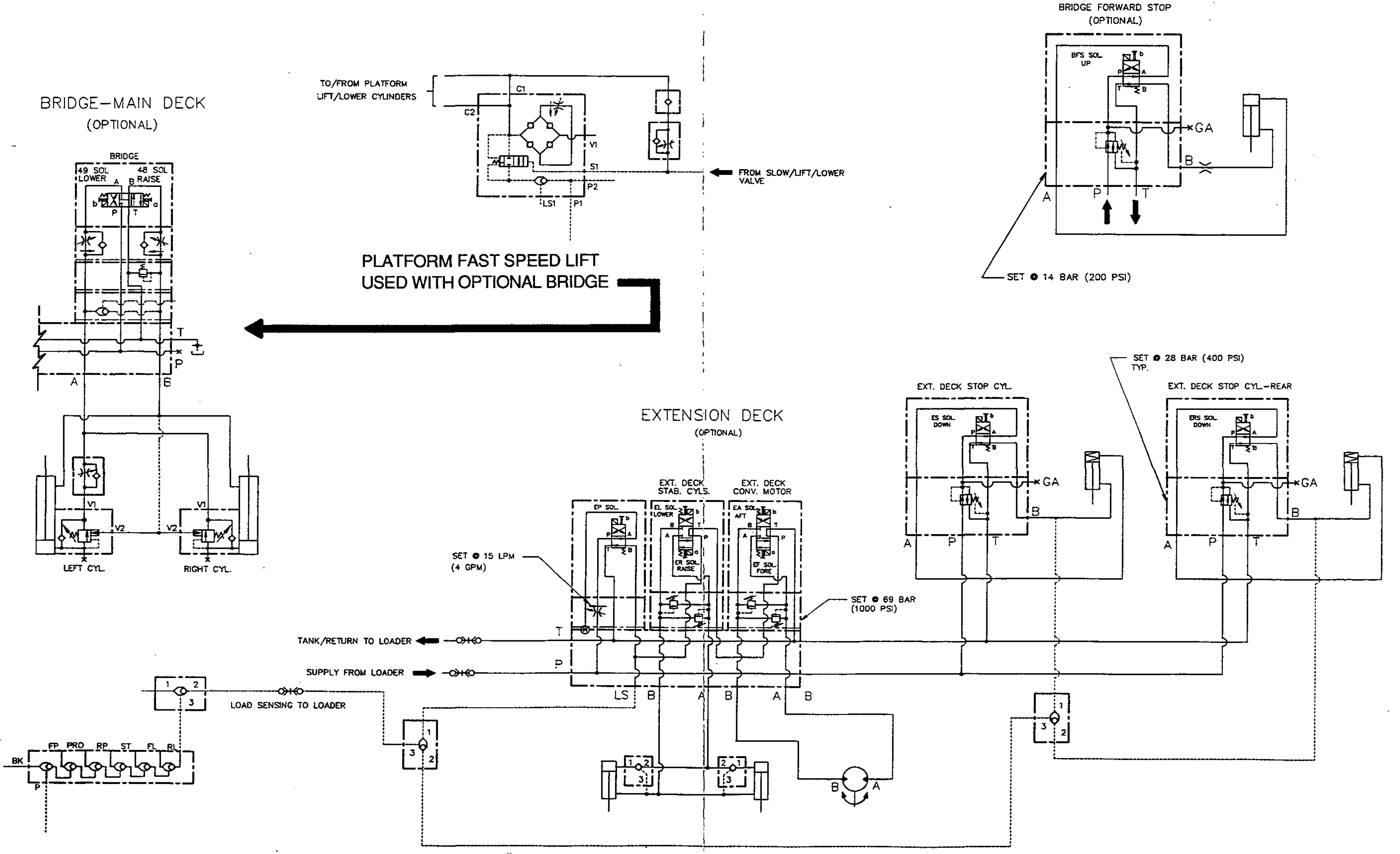




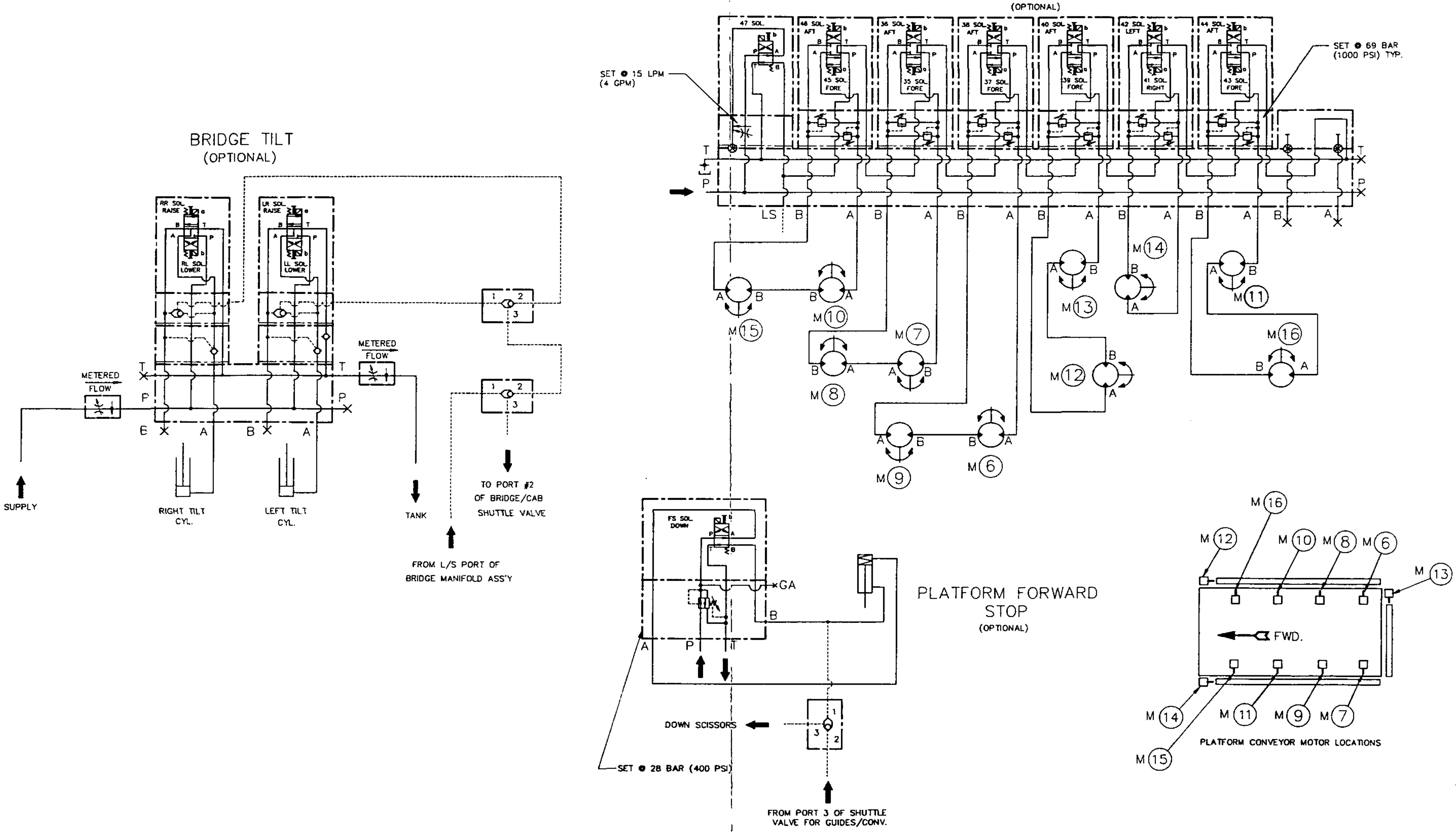
HYDRAULIC SYSTEM SCHEMATIC
620-2903
(SHEET 3 OF 6)
Figure 7



HYDRAULIC SYSTEM SCHEMATIC
620-2903
(SHEET 4 OF 6)
Figure 7



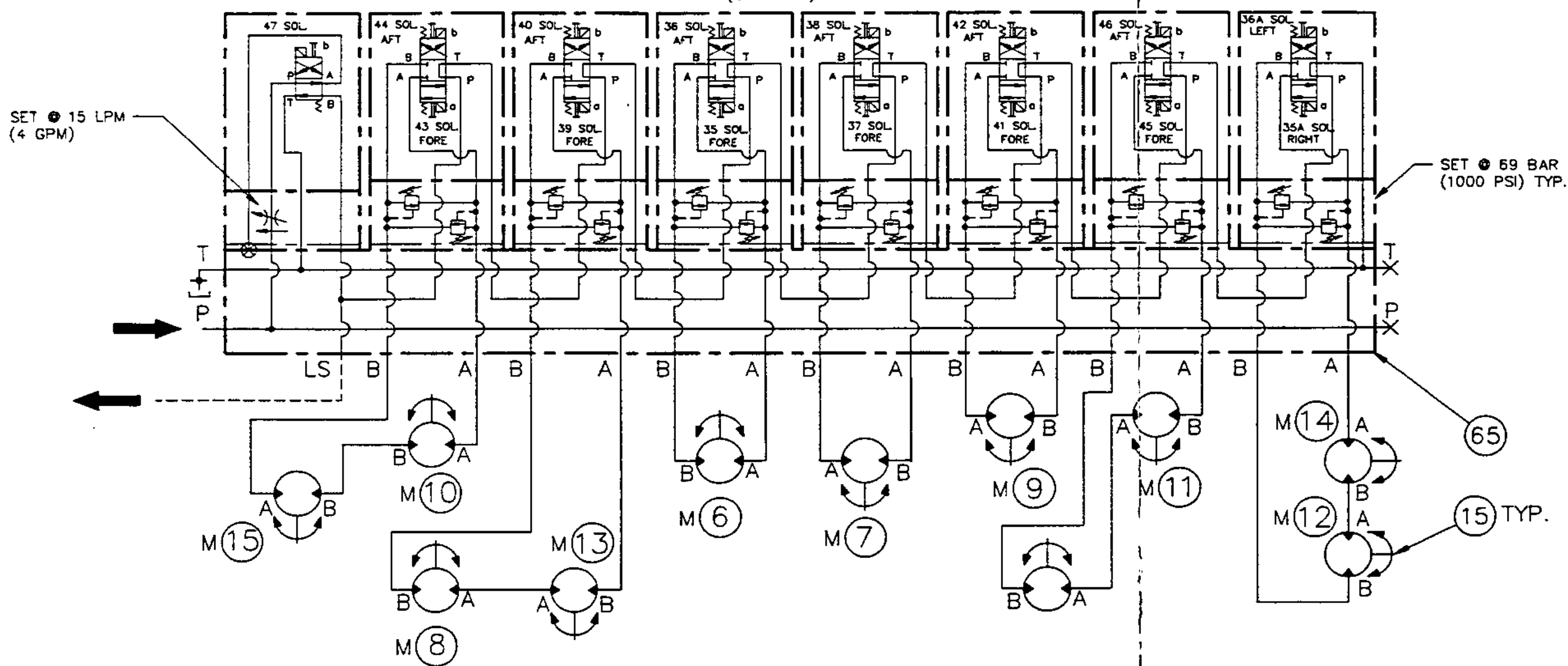
HYDRAULIC SYSTEM SCHEMATIC
620-2903
(SHEET 5 OF 6)
Figure 7

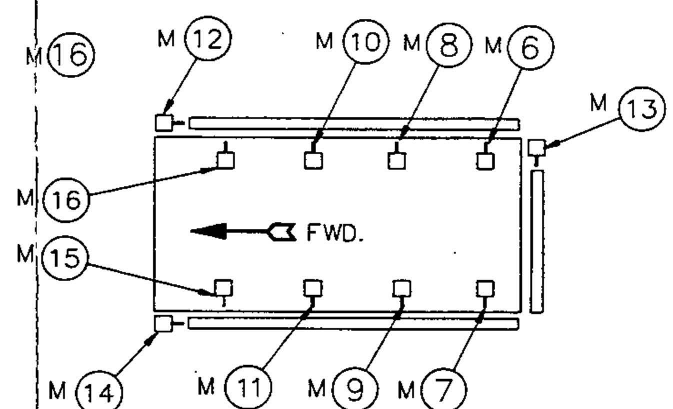


HYDRAULIC SYSTEM SCHEMATIC
620-2903
(SHEET 6 OF 6)
Figure 7

PLATFORM MANIFOLD EXTENDED SIDE LOAD

(OPTIONAL)

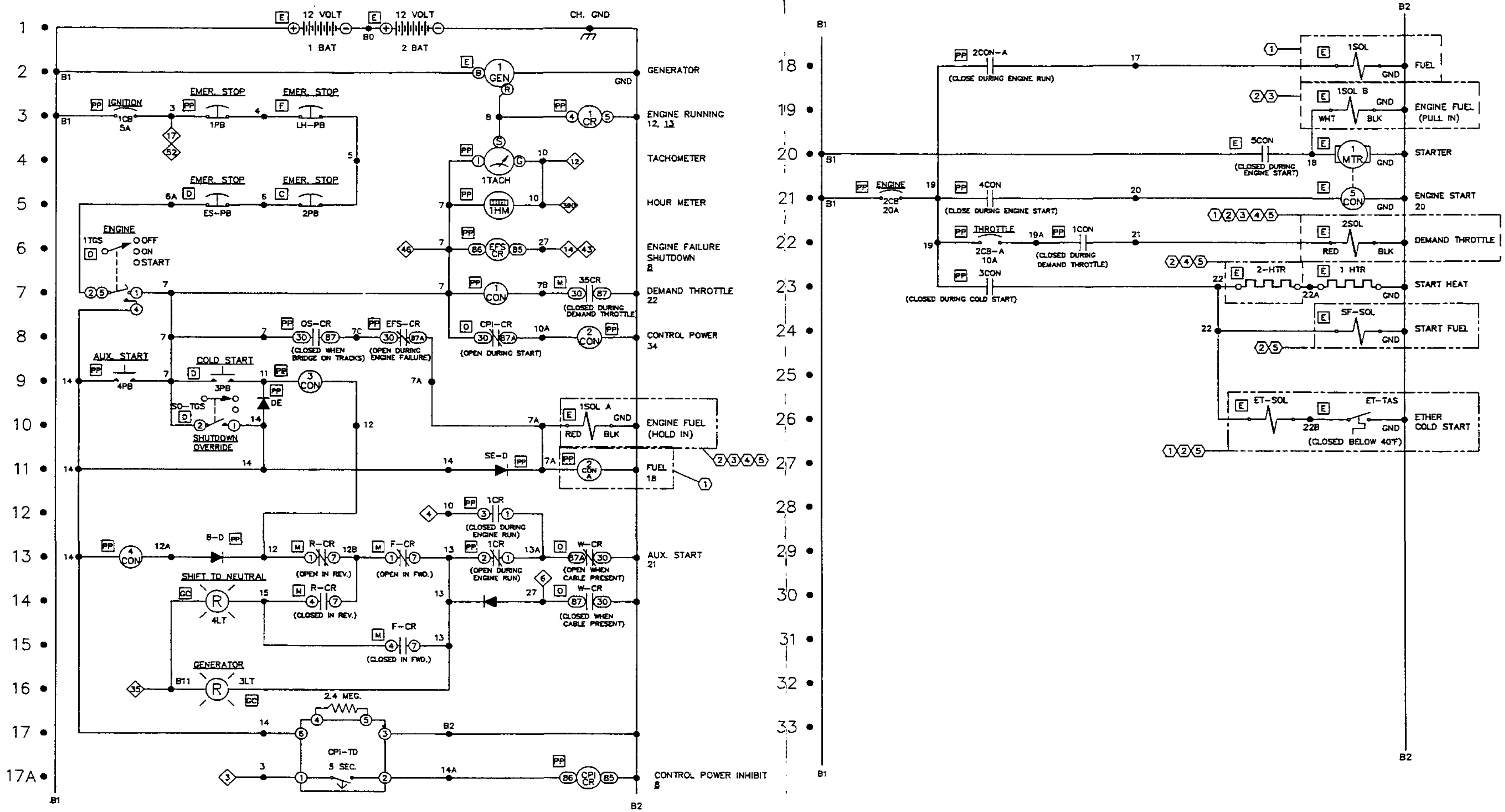




PLATFORM CONVEYOR MOTOR LOCATIONS

HYDRAULIC SCHEMATIC
620-2903
(SHEET 6A OF 6)
Figure 7

FMC
AIRLINE EQUIPMENT DIVISION
COMMANDER CONTAINER/PALLET LOADER



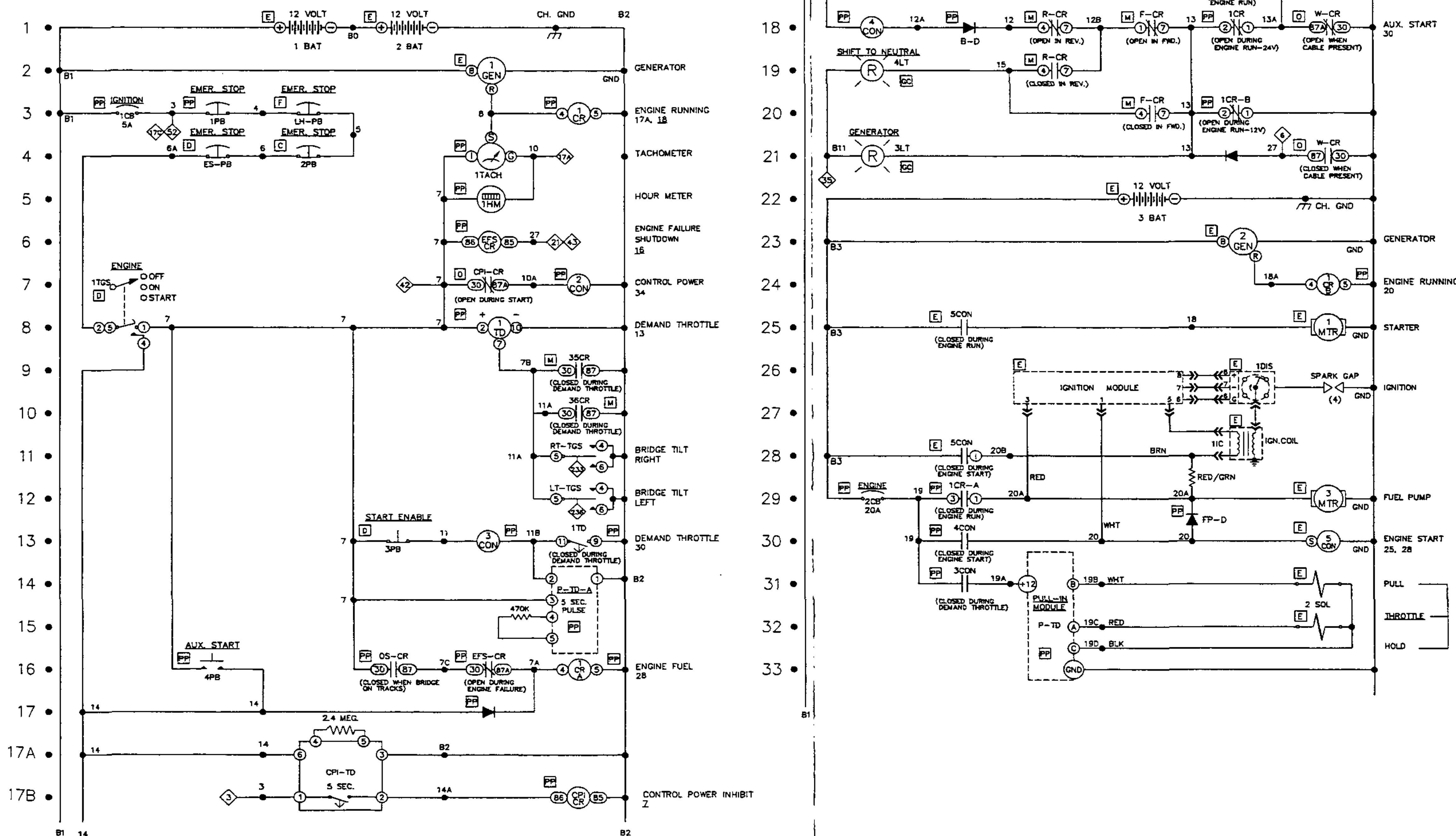
NOTES
1. FOR DETROIT ENGINE
2. FOR DEUTZ ENGINE
3. FOR ISUZU ENGINE
4. FOR ONAN ENGINE
5. FOR PERKINS ENGINE

LEGEND
- B - BRIDGE
- C - CONTROL PANEL
- D - DRIVE PANEL
- E - POWER UNIT (ENGINE)
- F - FRAME
- M - MAIN PANEL
- O - OTHER
- P - PLATFORM
- PP - POWER PANEL
- GC - GAUGE CLUSTER

FOR DIESEL ENGINE

ELECTRICAL SCHEMATIC
621-1200
(SHEET 1A OF 12)
Figure 8

FMC
AIRLINE EQUIPMENT DIVISION
COMMANDER CONTAINER/PALLET LOADER



NOTES

1. FOR DETROIT ENGINE
2. FOR DEUTZ ENGINE
3. FOR ISUZU ENGINE
4. FOR ONAN ENGINE
5. FOR PERKINS ENGINE

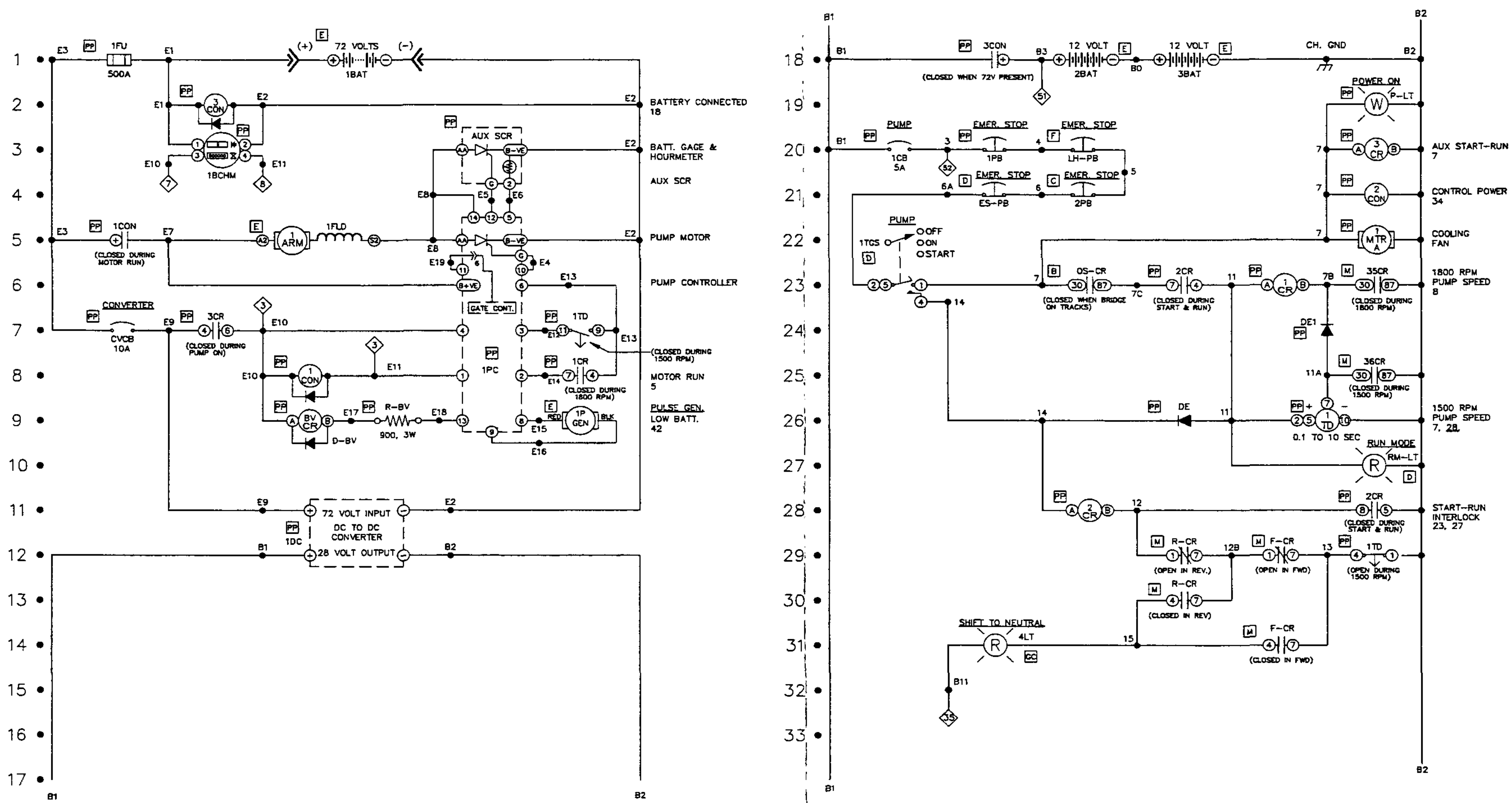
LEGEND

B - BRIDGE	F - FRAME
C - CONTROL PANEL	M - MAIN PANEL
D - DRIVE PANEL	O - OTHER
E - POWER UNIT (ENGINE)	P - PLATFORM
GC - GAUGE CLUSTER	PP - POWER PANEL

FOR GAS ENGINE

ELECTRICAL SCHEMATIC
621-1200
(SHEET 1B OF 12)
Figure 8

FMC
AIRLINE EQUIPMENT DIVISION
COMMANDER CONTAINER/PALLET LOADER



NOTES
1. FOR DETROIT ENGINE
2. FOR DEUTZ ENGINE
3. FOR ISUZU ENGINE
4. FOR ONAN ENGINE
5. FOR PERKINS ENGINE

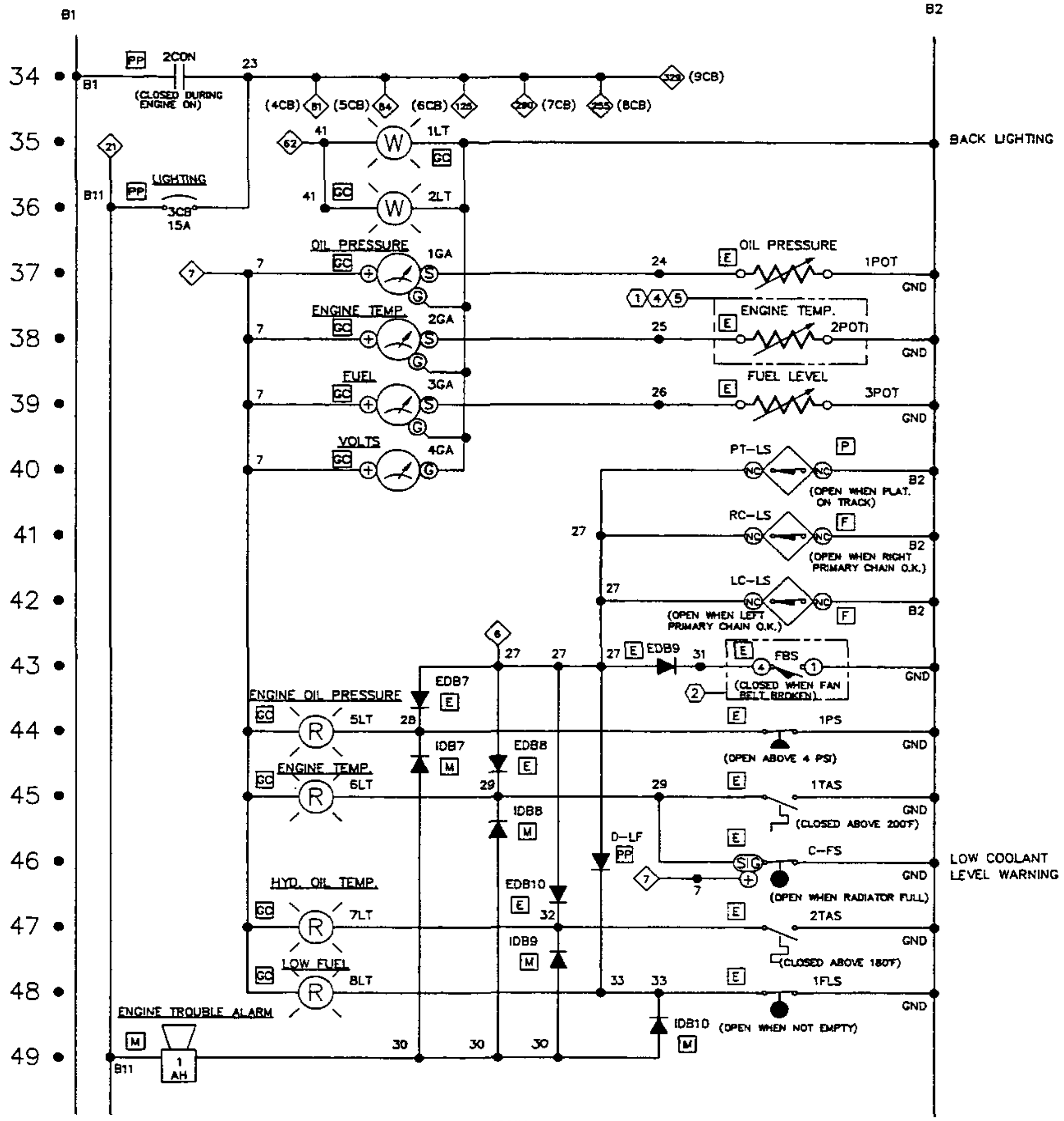
LEGEND
- B - BRIDGE
- C - CONTROL PANEL
- D - DRIVE PANEL
- E - POWER UNIT (ENGINE)
- F - FRAME
- M - MAIN PANEL
- O - OTHER
- P - PLATFORM
- PP - POWER PANEL
- GC - GAUGE CLUSTER

FOR ELECTRIC ENGINE

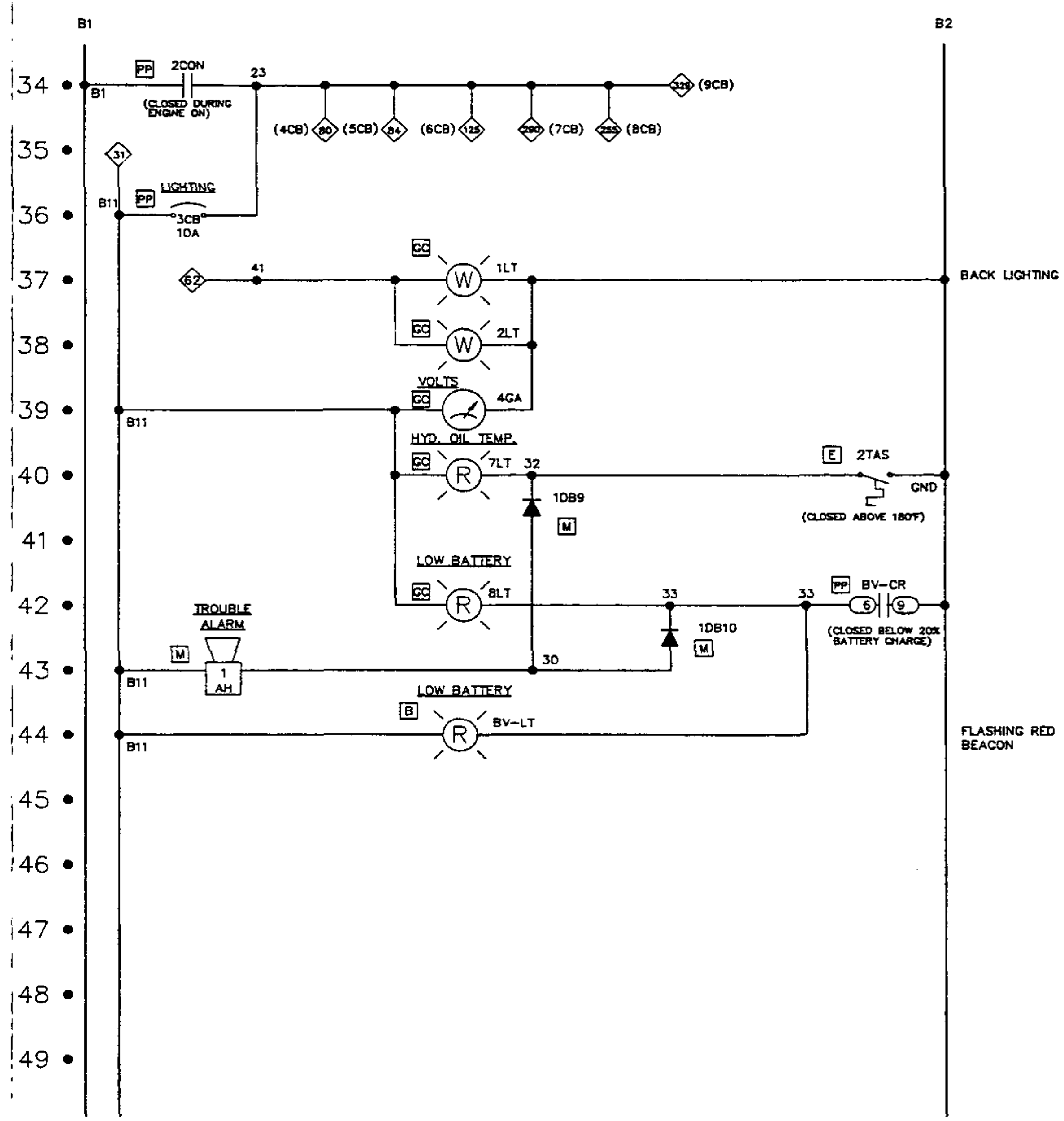
ELECTRICAL SCHEMATIC
621-1200
(SHEET 1C OF 12)
Figure 8

AIRLINE EQUIPMENT DIVISION

COMMANDER CONTAINER/PALLET LOADER



DIESEL/FORD GAS

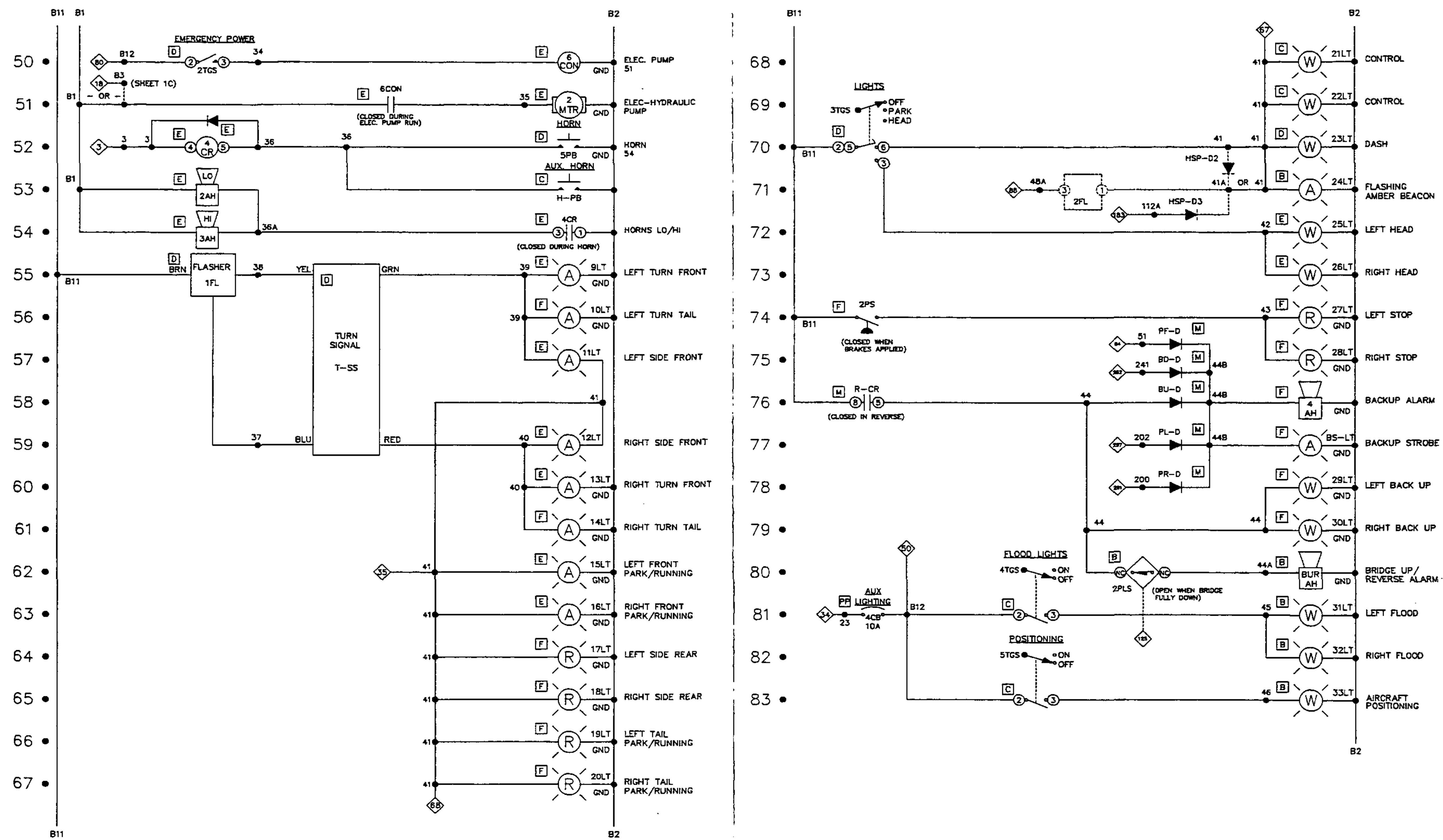


ELECTRIC

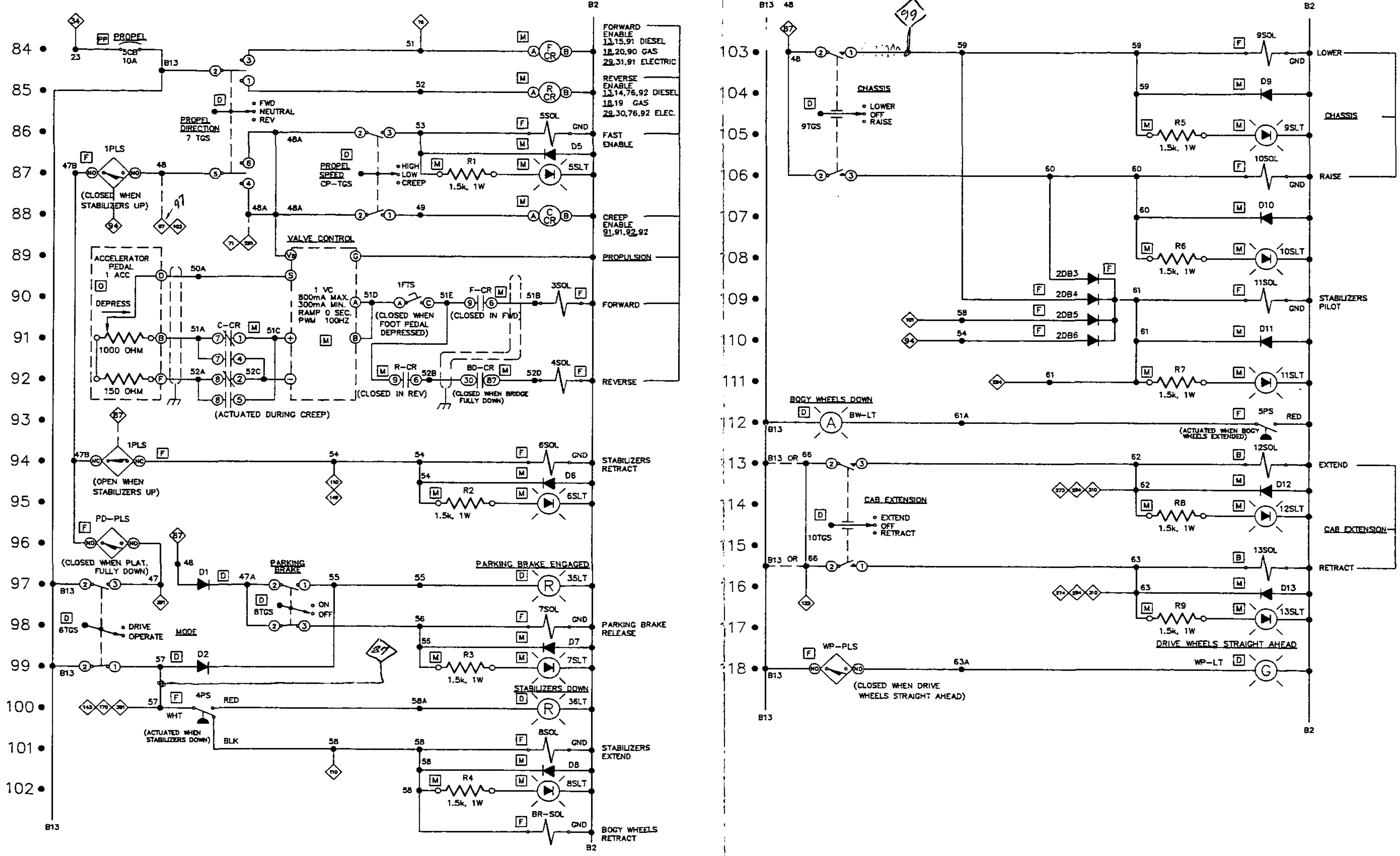
NOTES
1. FOR DETROIT ENGINE
2. FOR DEUTZ ENGINE
3. FOR ISUZU ENGINE
4. FOR ONAN ENGINE
5. FOR PERKINS ENGINE

LEGEND
- B - BRIDGE
- C - CONTROL PANEL
- D - DRIVE PANEL
- E - POWER UNIT (ENGINE)
- F - FRAME
- M - MAIN PANEL
- O - OTHER
- P - PLATFORM
- PP - POWER PANEL
- GC - GAUGE CLUSTER

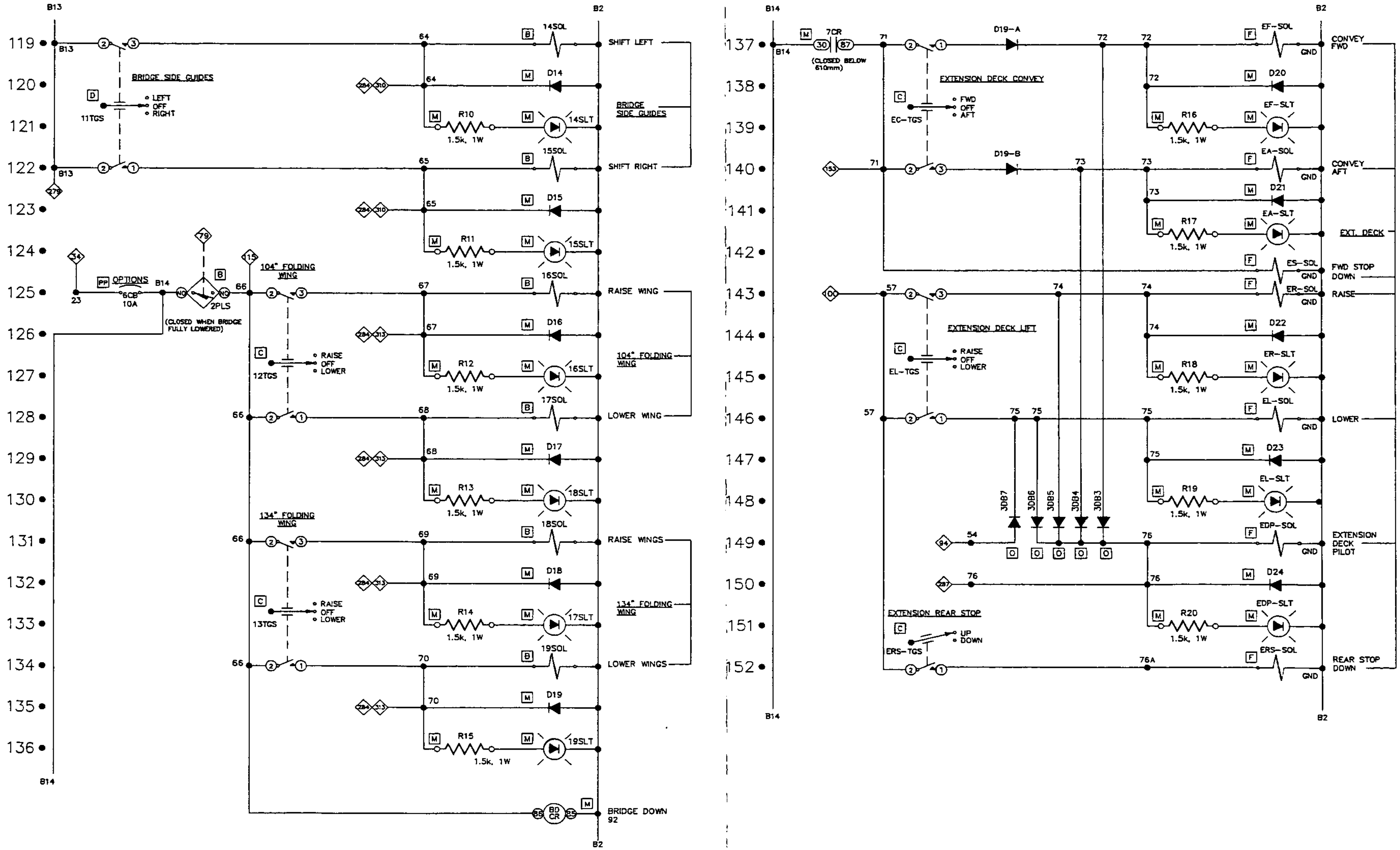
ELECTRICAL SCHEMATIC
621-1200
(SHEET 2 OF 12)
Figure 8



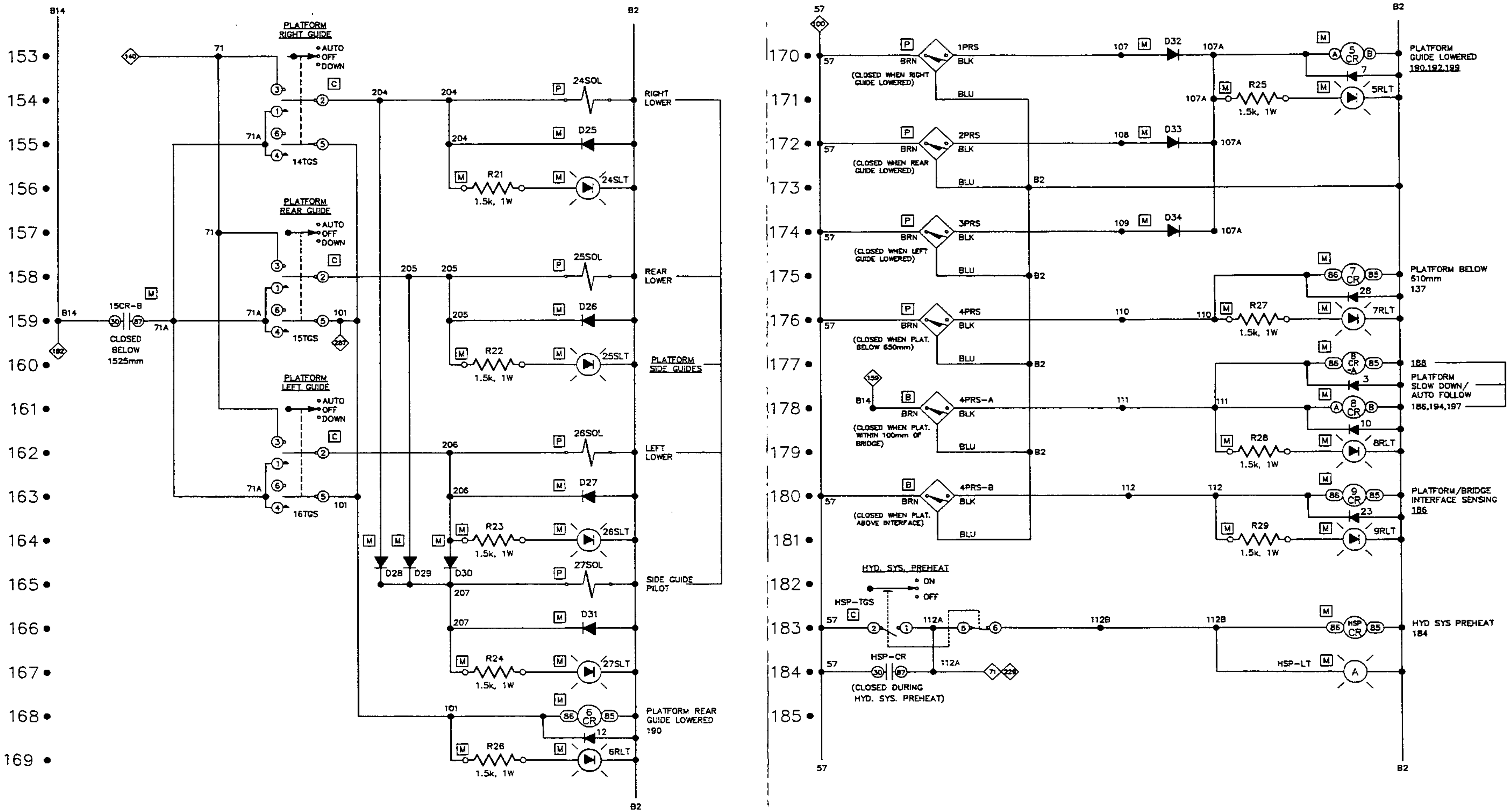
ELECTRICAL SCHEMATIC
621-1200
(SHEET 3 OF 12)
Figure 8



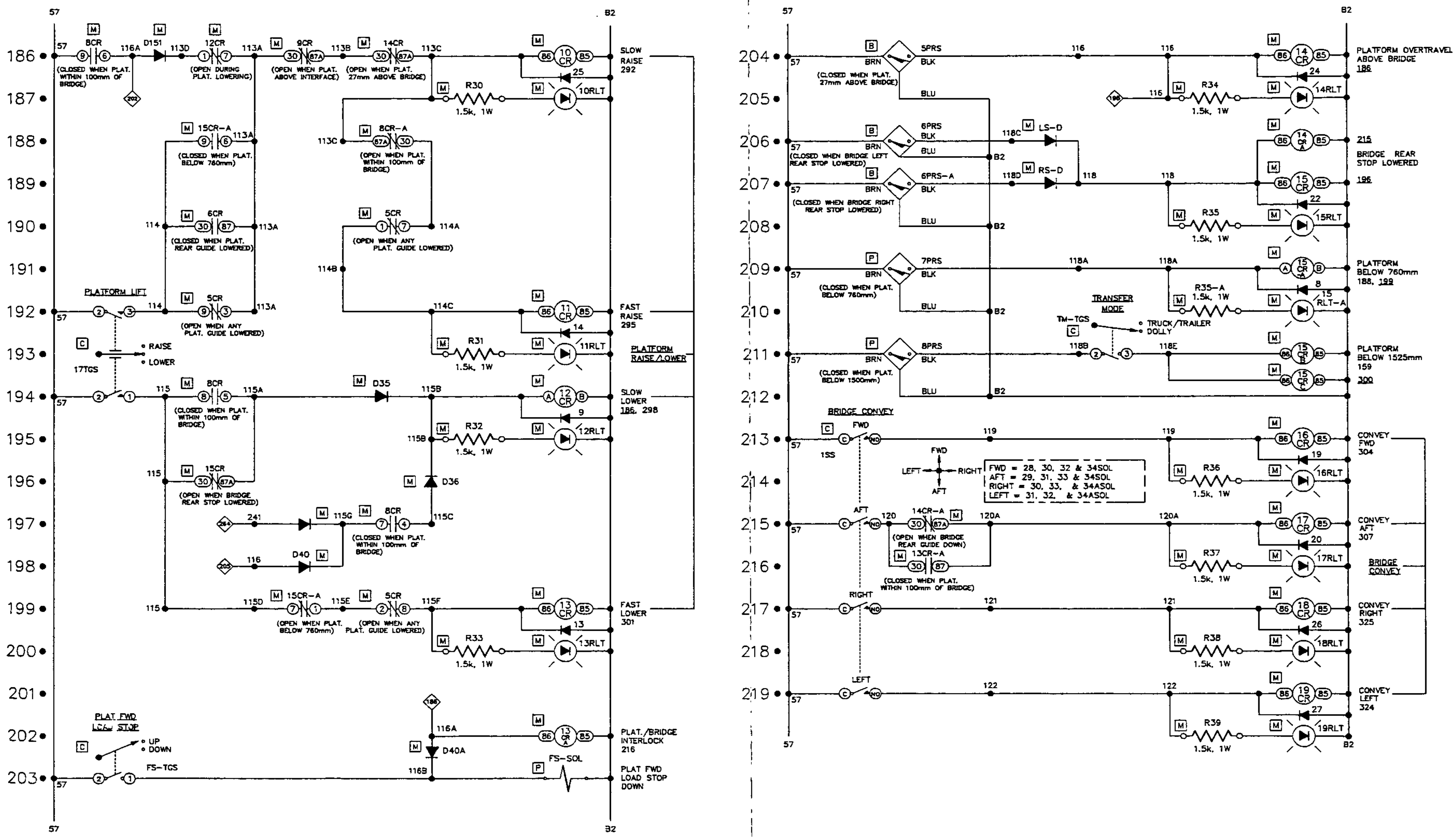
ELECTRICAL SCHEMATIC
621-1200
(SHEET 4 OF 12)
Figure 8



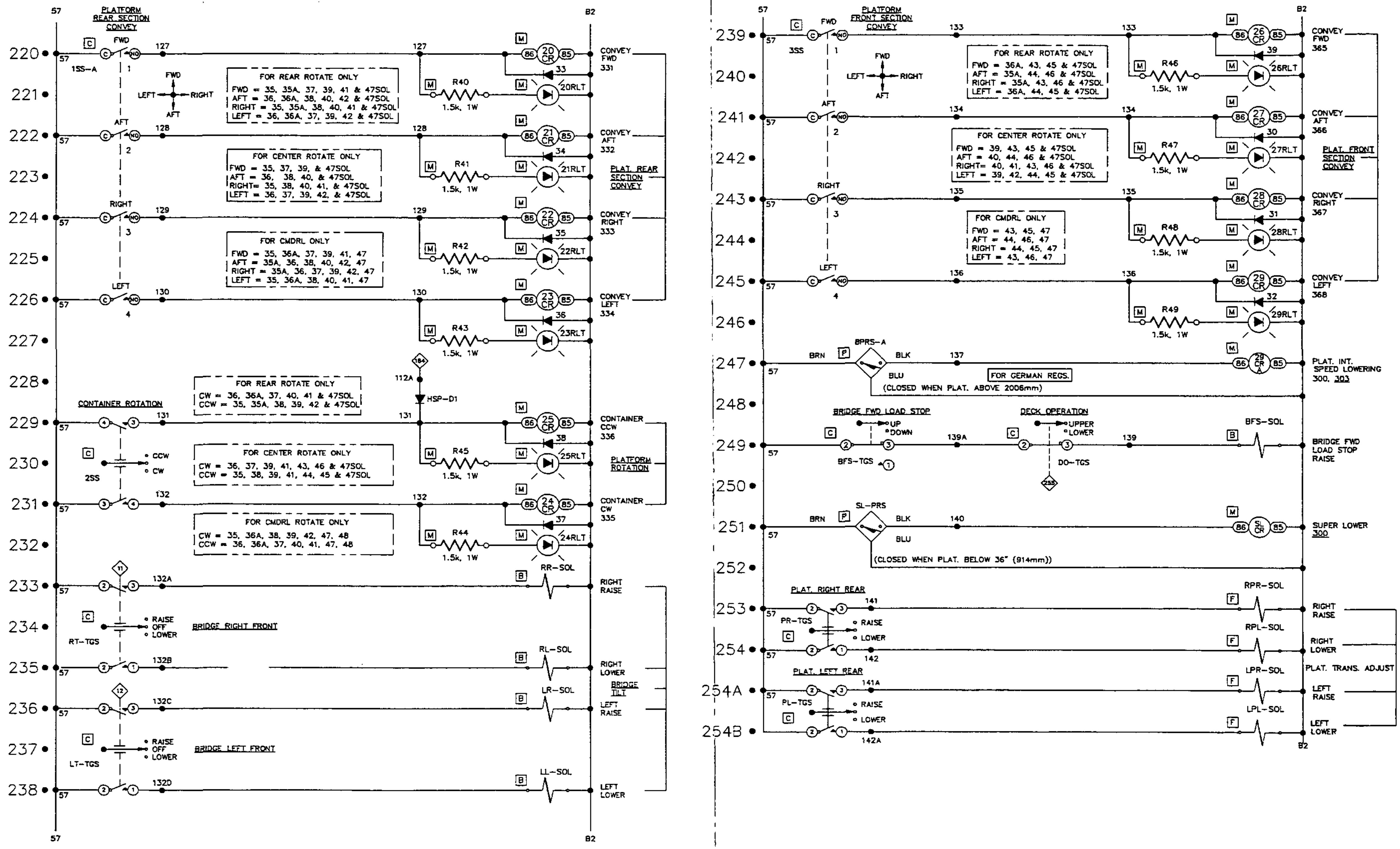
ELECTRICAL SCHEMATIC
621-1200
(SHEET 5 OF 12)
Figure 8



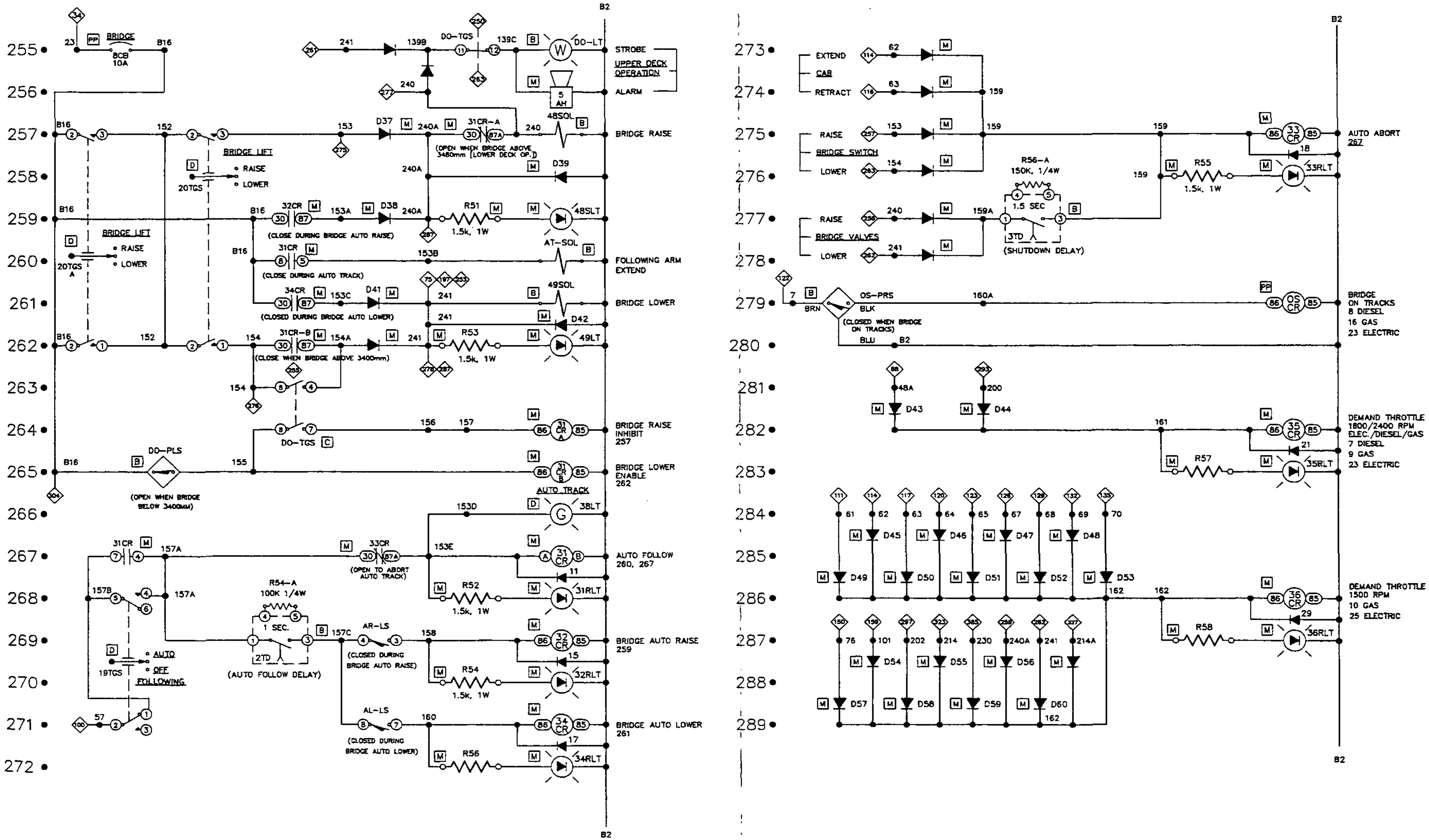
ELECTRICAL SCHEMATIC
621-1200
(SHEET 6 OF 12)
Figure 8



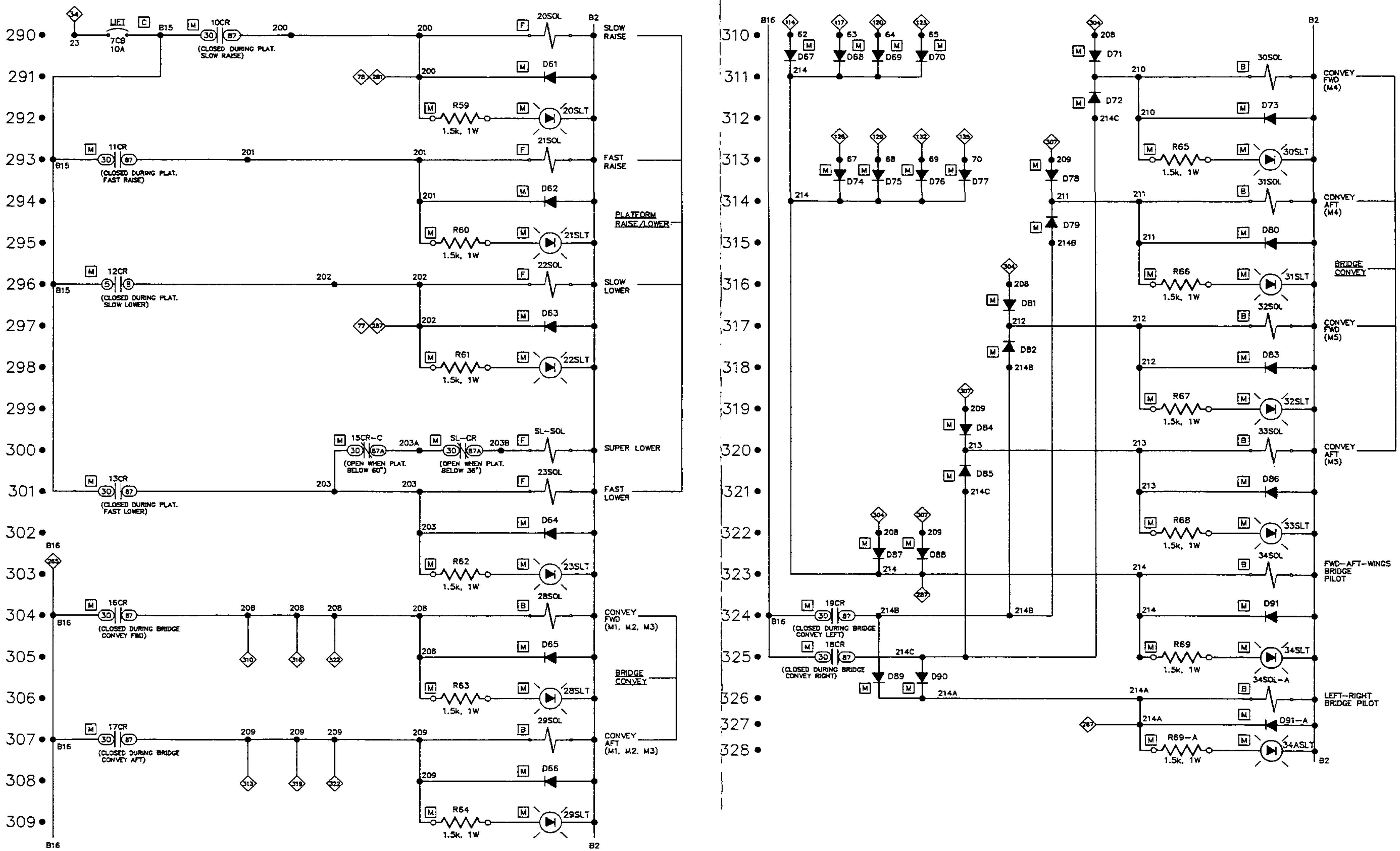
ELECTRICAL SCHEMATIC
621-1200
(SHEET 7 OF 12)
Figure 8



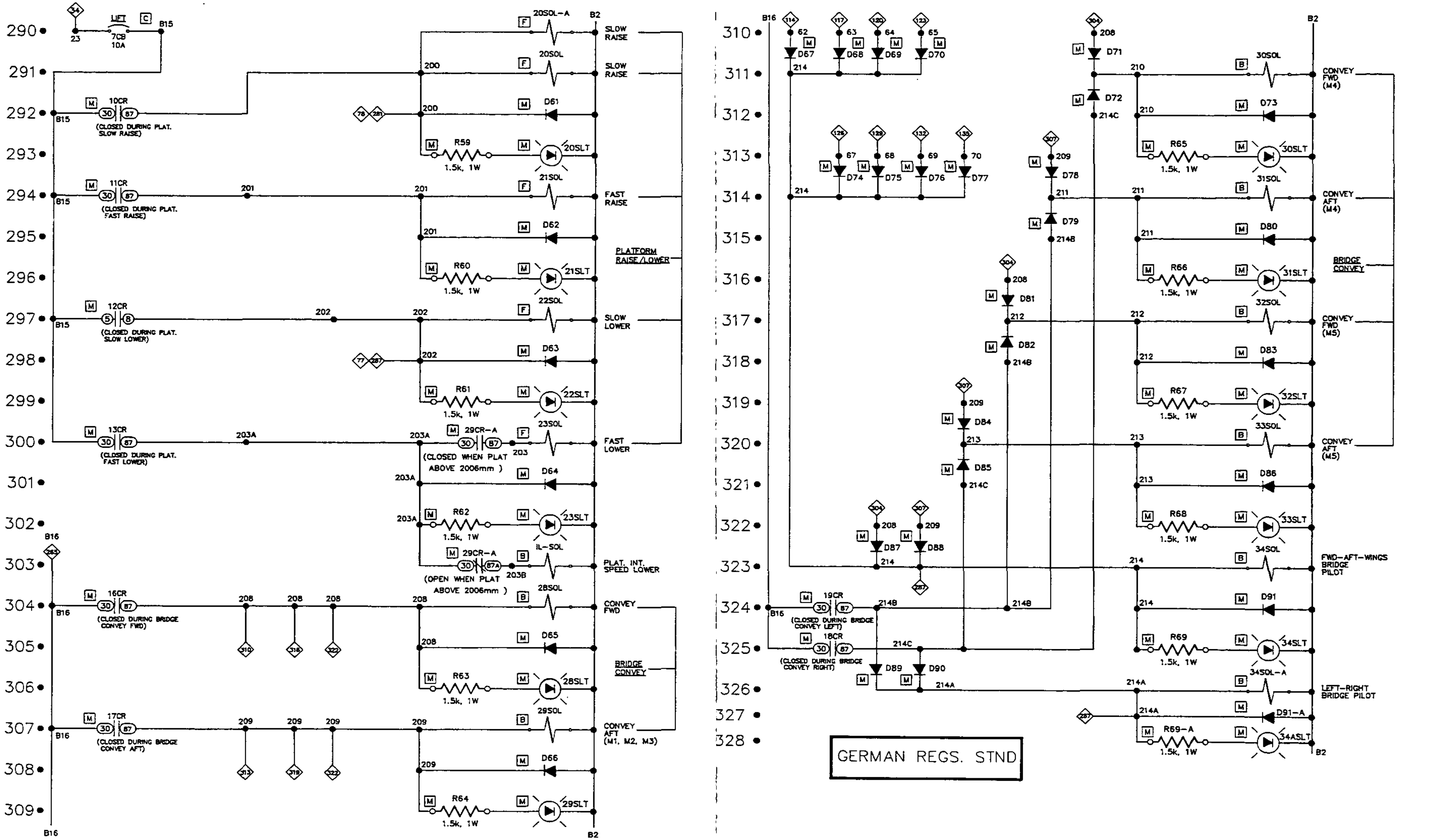
ELECTRICAL SCHEMATIC
621-1200
(SHEET8 OF 12)
Figure 8



ELECTRICAL SCHEMATIC
621-1200
(SHEET 9 OF 12)
Figure 8



ELECTRICAL SCHEMATIC
621-1200
(SHEET 10 OF 12)
Figure 8



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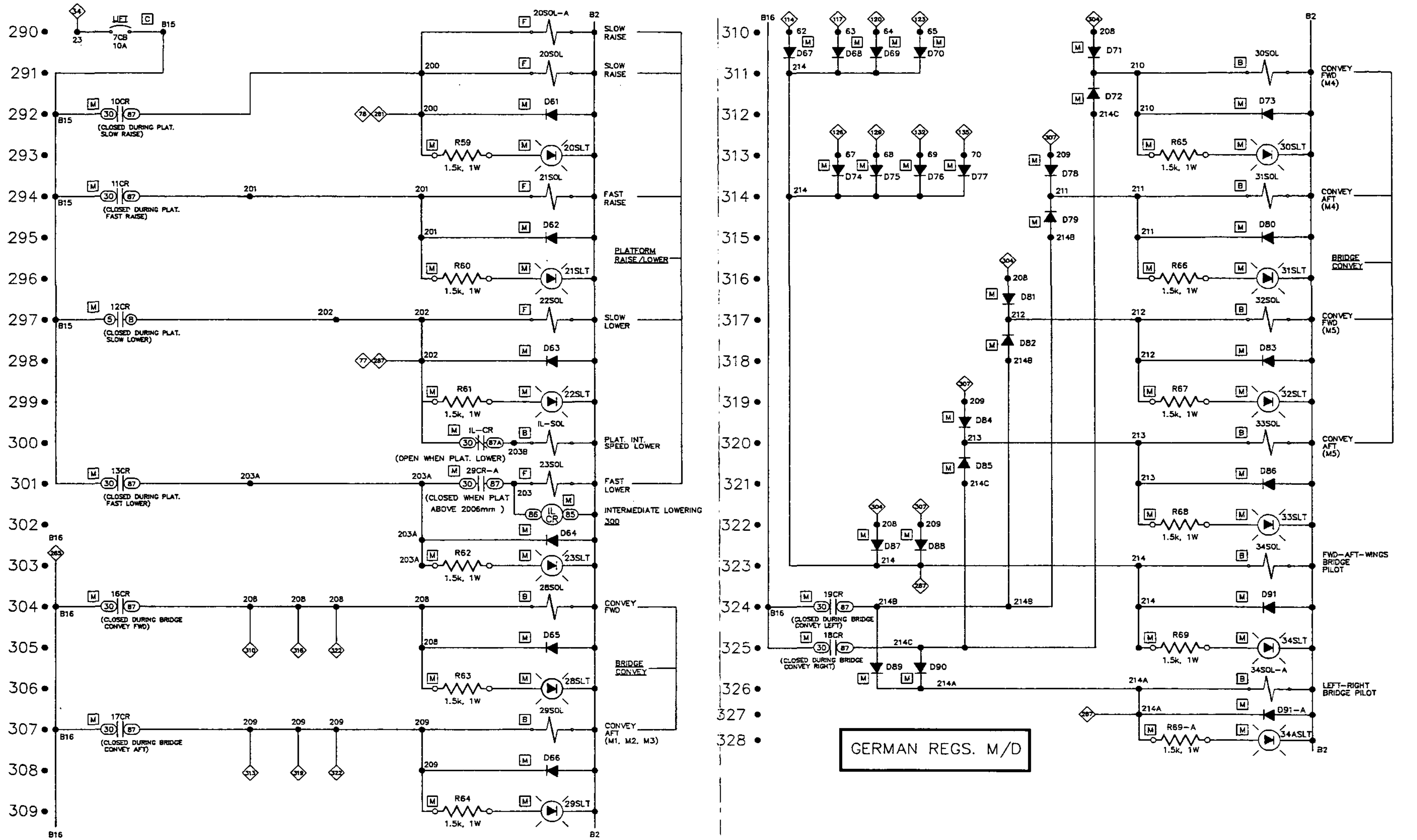
621-1200
(SHEET 10A OF 12)
Figure 8



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(SHEET 10B OF 12)
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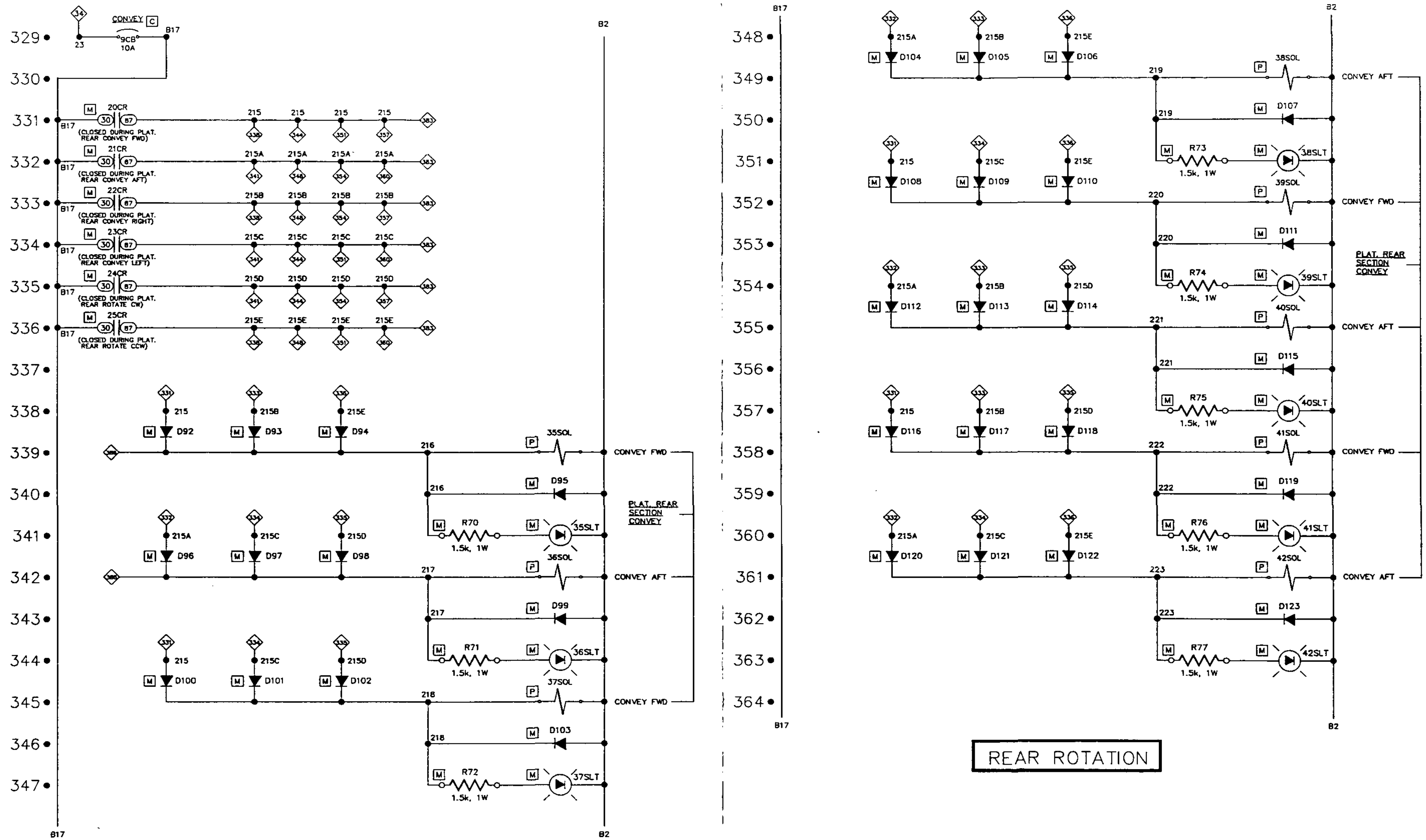

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(SHEET 11 OF 12)
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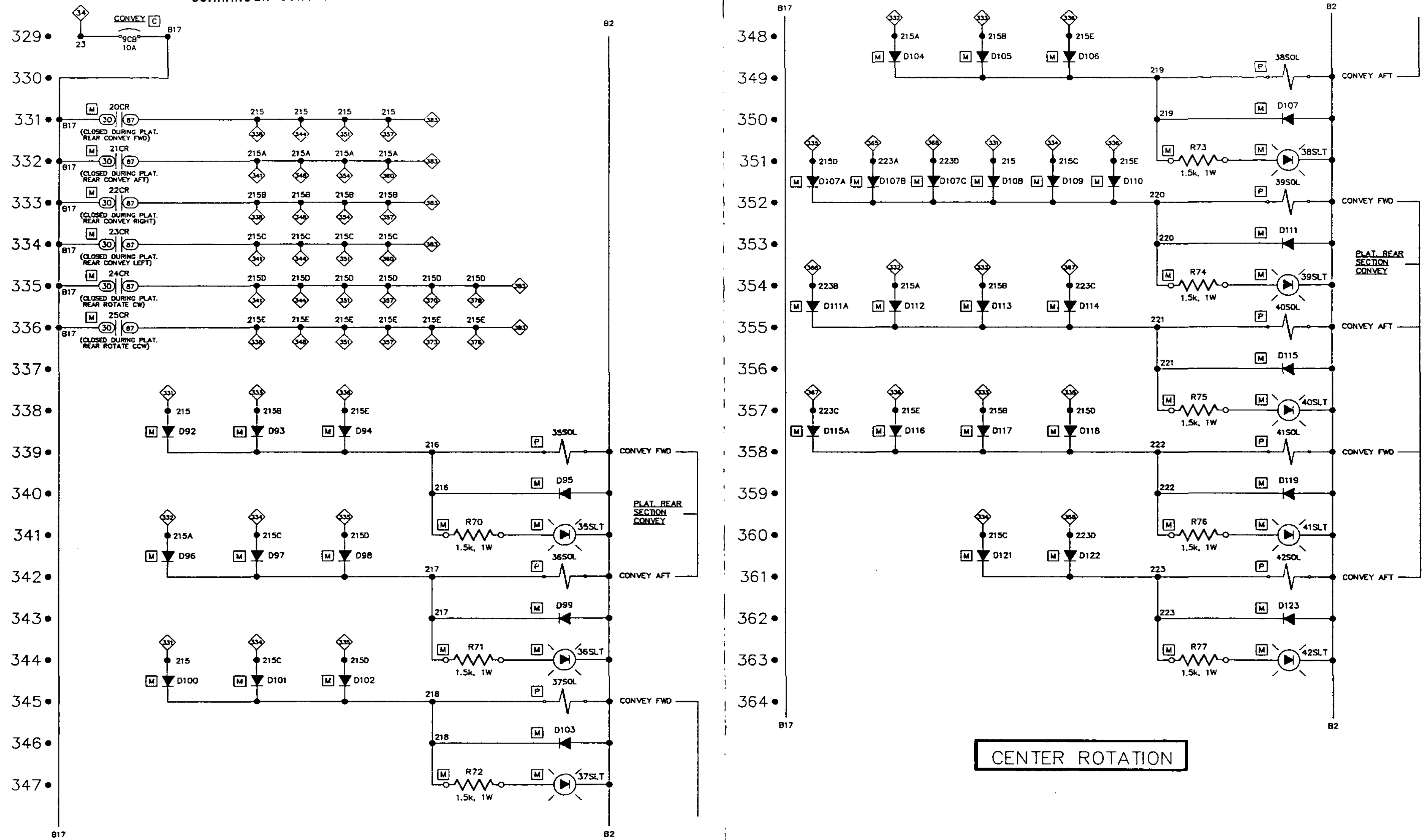

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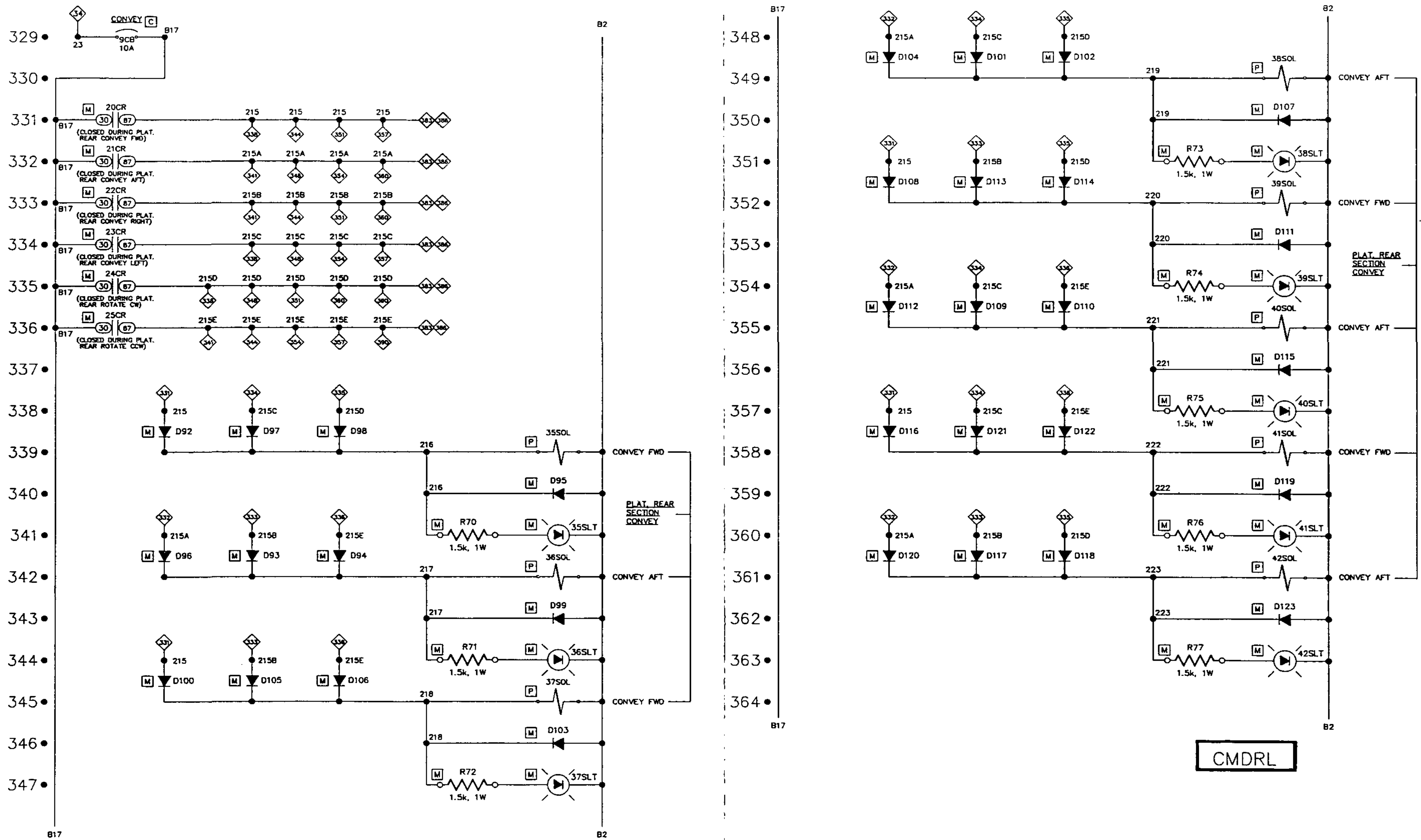
621-1200
(SHEET 11A OF 12)
Figure 8



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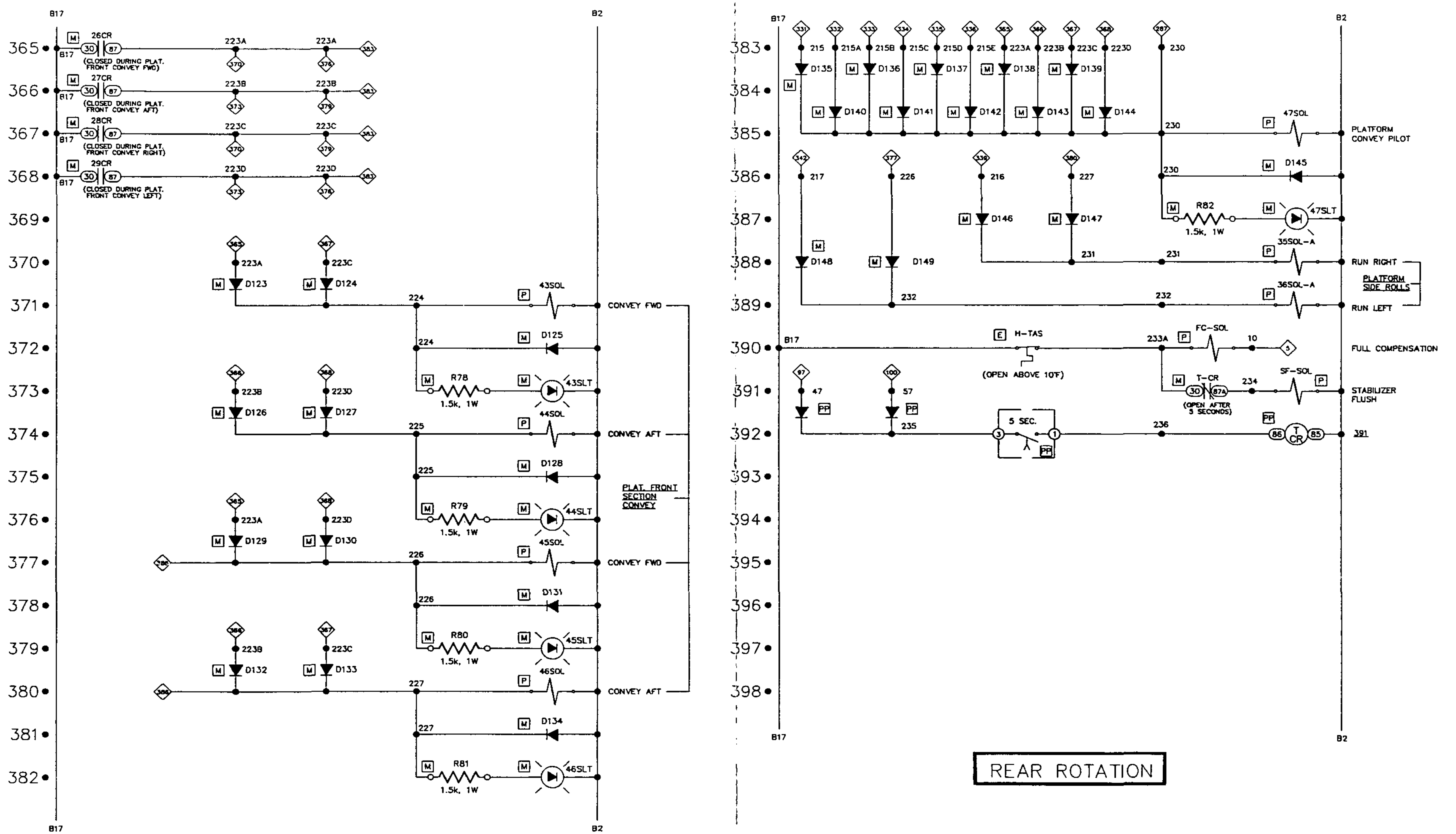
621-1200
(SHEET 11B OF 12)
Figure 8



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(SHEET 12 OF 12)
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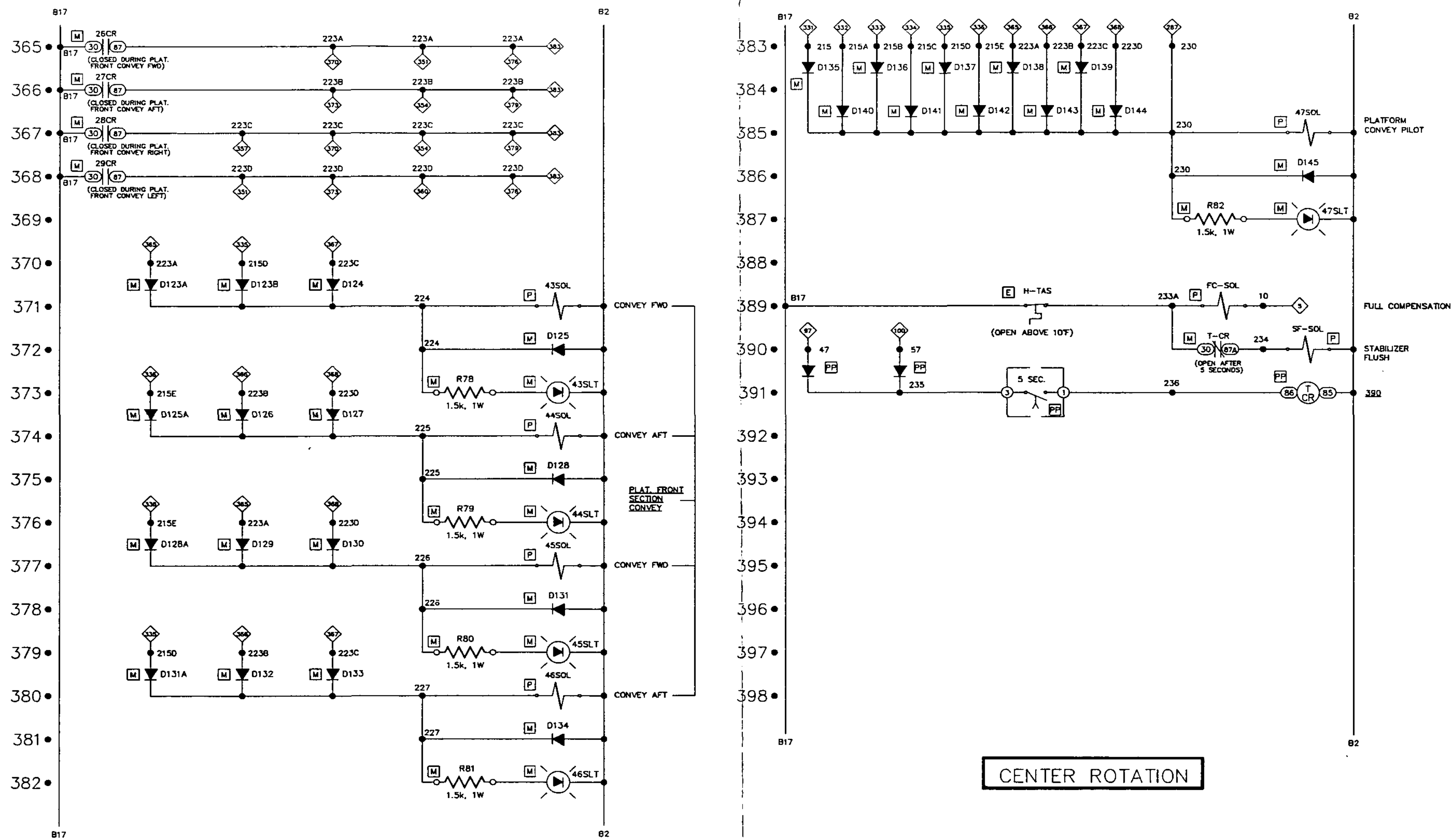

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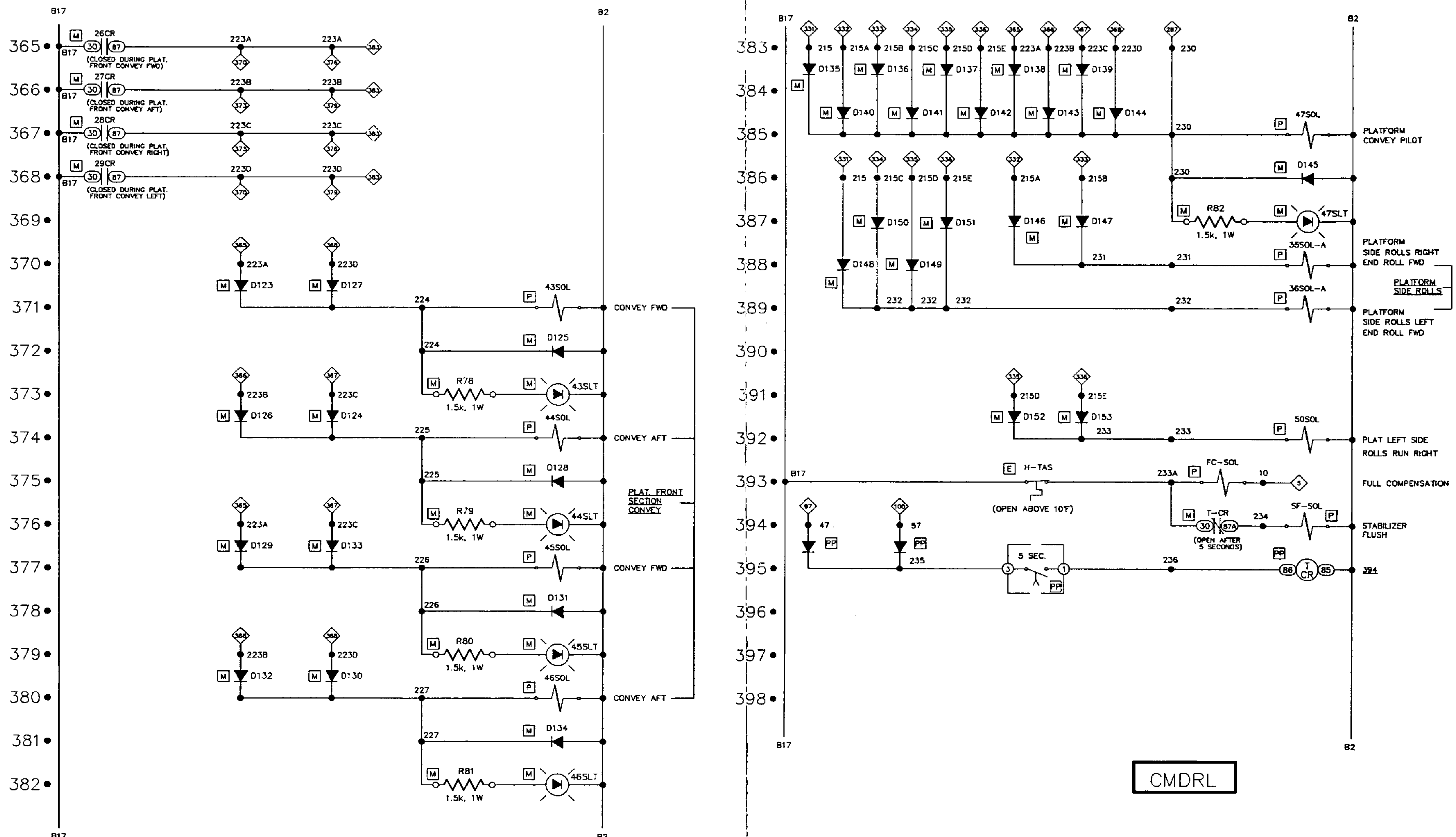
(SHEET 12A OF 12)
Figure 8



ELECTRICAL SCHEMATIC
621-1200
(SHEET 12B OF 12)
Figure 8

The section on REFERENCE DESIGNATORS will be provided at a later date.

CHAPTER 3 MANUFACTURERS' APPENDICES

TABLE OF CONTENTS

SECTION 1. INTRODUCTION

Chapter 3 contains instruction bulletins, parts lists, service manuals, etc., issued by manufacturers of major components of the COMMANDER CONTAINER/PALLET LOADER. Information is included only for components that are considered repairable.

A complete list of vendors is included in Chapter 4, Section 2.

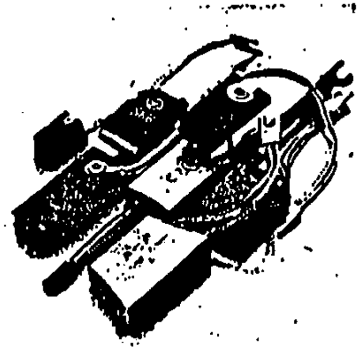
V01288

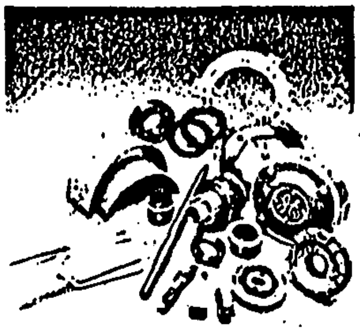
General Electric Company

Direct Current Motor & Generator

3001 East Lake Road

Erie, PA 16531





FMC P/N 620-2108

MODEL Number 5BT1374B28
38.8HP 66V 490A 1785RPM

Drawing Number	Description	Qty
36A290947AGG01	ARMATURE	1
36A290987ADG01	FR,WOUND	1
36A291277ABG01	COVER,C.E.	1
36A291277ABG02	COVER,C.E.	1
36A291277AHG01	COVER,D.E.	1
36A291477ACG02	BR RIGGING	1
36B547926 G01	BRUSHHOLDER SPRING	8
36B550773AD001	BRG BRKT,D.E.	1
894A605ZJ 009	BEARING,D.E.	1
894A605ZK 006	BEARING,C.E.	1
955A492 005	BRUSH	4
36A291270BDG04	COMMUTATOR	1
36A291355AAG01	ARMATURE COIL	1
36A291457AFG01	SHAFT	1
36B550304AG001	FAN	1
8796888 108	RING,RTNG	1
36A287978ACG01	COIL,MN	1
36A287978ACG02	COIL,MN	1
36A287978ACG03	COIL,MN	1
36A287978ACG04	COIL,MN	1
36A291748BBG01	STUD & NUT	1
36B550763ACG02	YOKE&HLDR	1
36D845657ANG02	SPRT,YOKE&BRG	1

DIRECT CURRENT ELECTRIC VEHICLE MOTORS

TYPE BT FRAMES 1300 AND 2300

INTRODUCTION

This instruction book covers Types BT1300 and BT2300 D-C Motors. Type BT1300 motors are low voltage (12 to 72 volts), low speed (4000 RPM max.), self-ventilated, non-commutating pole motors used typically as battery powered, fork lift truck pump, steering and drive motors. Type BT2300 motors are higher voltage (up to 240 volts), higher speed (up to 9000 RPM), blower ventilated commutating pole motors used typically as electric vehicle (car, bus, truck, etc.) drive motors. Either type can be face or foot mounted with splined or keyed shaft extension(s). For application information refer to the General Electric Company.

WARNING: HIGH VOLTAGE AND ROTATING PARTS CAN CAUSE SERIOUS OR FATAL INJURY. THE USE OF ELECTRIC MACHINERY, LIKE ALL OTHER UTILIZATION OF CONCENTRATED POWER AND ROTATING EQUIPMENT, CAN BE HAZARDOUS. INSTALLATION, OPERATION, AND MAINTENANCE OF ELECTRIC MACHINERY SHOULD BE PERFORMED BY QUALIFIED PERSONNEL. FAMILIARIZATION WITH NEMA SAFETY STANDARDS FOR CONSTRUCTION AND GUIDE FOR SELECTION, INSTALLATION, AND USE OF INTEGRAL HORSEPOWER MOTORS AND GENERATORS, NATIONAL ELECTRIC CODE AND SOUND LOCAL PRACTICES IS RECOMMENDED.

WARNING: INSTALLATION OF THE MACHINE WHERE HAZARDOUS, INFLAMMABLE, OR COMBUSTIBLE VAPORS OR DUSTS PRESENT A POSSIBILITY OF EXPLOSION OR FIRE SHOULD BE IN ACCORDANCE WITH THE NATIONAL ELECTRIC CODE, ARTICLES 500-503, AND CONSISTENT WITH SOUND LOCAL PRACTICES.

These instructions do not purport to cover all details or variations in equipment, nor to provide every possible contingency or hazard which may be met in connection with installation, operation and maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the General Electric Company.

RECEIVING

These motors should be placed in a suitable storage area immediately upon receipt, as packing coverings are NOT suitable for out-of-doors or unprotected storage.

Each shipment should be carefully examined upon arrival. Any damage should be reported promptly to the carrier and to the nearest office of the General Electric Company.

STORAGE

If a motor is not to be installed immediately, it should be stored in a clean dry place and protected from low temperatures and sudden changes in temperature and humidity. The brushes should be lifted off the commutator during extended storage periods otherwise corrosion may occur and later result in flat spots on the commutator. Shaft extensions and machined surfaces are slushed before shipment to prevent rusting. Slushing compound can be removed readily with mineral spirits or any other suitable solvent which can be obtained at any hardware or paint store.

WARNING: MINERAL SPIRITS ARE FLAMMABLE AND MODERATELY TOXIC. THE USUAL PRECAUTIONS FOR HANDLING CHEMICALS OF THIS TYPE SHOULD BE OBSERVED. THESE INCLUDE:

1. AVOID EXCESSIVE CONTACT WITH SKIN.
2. USE IN WELL VENTILATED AREAS.
3. TAKE NECESSARY PRECAUTIONS TO PREVENT FIRE OR EXPLOSION HAZARDS.

HANDLING

CAUTION: MOTORS WHICH ARE PACKED IN CARDBOARD CARTONS WITH THE DRIVE END EXTENSION VERTICAL SHOULD BE LIFTED OUT OF THE CARTON WITH A 3/8" SHOULDER TYPE EYEBOLT SCREWED SECURELY INTO THE SHAFT CENTER. THE LARGER MOTORS HAVE A SPOT FACED TAPPED HOLE FOR A LIFTING SHOULDER TYPE EYEBOLT IN THE FRAME. THIS MAY BE USED FOR LIFTING AND HANDLING ONCE THE MOTOR IS REMOVED FROM THE CARTON. SMALLER MOTORS THAT DO NOT HAVE THE LIFTING EYEBOLT HOLE MUST BE LIFTED AND HANDLED WITH A SLING AROUND THE MAGNET FRAME WHEN HANDLING IN A HORIZONTAL POSITION IS REQUIRED. CARE SHOULD BE EXERCISED TO PROTECT TERMINALS, SHAFT EXTENSION(s) AND ACCESSORIES FROM DAMAGE DURING HANDLING.

INSTALLATION

WARNING: GROUND THE MACHINE PROPERLY TO AVOID SERIOUS INJURY TO PERSONNEL. GROUNDING SHOULD BE IN ACCORDANCE WITH NATIONAL ELECTRIC CODE AND CONSISTENT WITH SOUND LOCAL PRACTICES.

Before installation the motor should be given a general overall inspection to verify that there has been no damage during shipping and handling. Connections should be made according to the connection diagram. A careful alignment is recommended for smooth operation. A check for unusual noises and vibration after starting is good practice and may save later serious trouble. In general, vibration should not exceed .002" as measured on a G.E. light beam indicator. The most likely causes of vibration in a new motor are misalignment due to improper installation, loose mounting bolts, distortion of the frame caused by mismatching of the feet to the mounting surface, or damage in shipment. Most openings in the motor are screened. Those which are left completely open should be protected so as to avoid all possibility to motor damage or personnel injury.

WARNING: DO NOT OPERATE A SERIES MOTOR UNLOADED AS EXCESSIVE SPEED MAY OCCUR WHICH CAN CAUSE DAMAGE TO THE MOTOR AND INJURY TO PERSONNEL.

DESCRIPTION

Electric vehicle motors are built in a variety of shaft extensions, end shield mounting interfaces, with and without feet, open and enclosed, series, shunt and compound wound, and in four pole designs. Type BT1300 motors have main poles and coils only and non-adjustable brush riggings. Type BT2300 motors have both main and commutating poles and coils and adjustable brush riggings.

The armature assembly consists of a shaft, armature core, armature windings, and commutator. The coiled frame consists of the magnet frame, main poles and coils, commutating poles and coils (BT2300 only) and the field terminals. Other basic parts of the motor include the drive end bearing bracket, commutator end bearing bracket, bearings, bearing seals (when equipped), brushholder yoke with brushholders, brushes and brushholder springs, and covers. Openings over the brushholders provide accessibility to the brush rigging and commutator for inspection and brush replacement. Standard bearings are the single row, doubled shielded, Conrad type pre-lubricated with high temperature grease (G.E. spec D6A2C9) with ABEC1 tolerance and AFBMA #3 internal radial clearance.

MAINTENANCE

WARNING: IF POSSIBLE, MAKE SURE MOTOR IS DISCONNECTED FROM POWER SOURCE BEFORE PERFORMING ANY MAINTENANCE OPERATIONS ON THE MOTOR OR THE TRUCK. WHEN POWER IS REQUIRED TO PERFORM ANY MAINTENANCE, VIGILANT CARE AND ATTENTION SHOULD BE EXERCISED.

BEARINGS

Standard bearings are double shielded and pre-lubricated and normally do not require lubrication. Under normal conditions the bearings fail after several years service due to lack of proper lubrication, either from dirty contaminant in the grease or insufficient oil in the grease. New grease consists of about 80% oil, 20% soap. When bleeding results in a reduction of oil to about 60%, the bleed rate is reduced to a level that may not supply sufficient lubrication. For this reason when maintenance overhauls are performed after several years of service, bearings are automatically replaced as a routine practice. A bearing should be replaced with an exact replacement or one with all interchangeable features. It is especially important that the bearing have high temperature grease.

INSULATION

Insulation resistance should be checked during each maintenance inspection. Low resistance may be caused by excessive dirt, moisture or impending failure. Although motors can be successfully run with insulation resistance as low as 1/4 megohm it is well to investigate the reasons for any insulation resistance below 1 megohm. Low resistance values due to dirt can usually be corrected by cleaning followed by a varnish dip and bake. Low resistance due to moisture can be corrected by baking the motor in a 90°C oven until the insulation resistance rises above this value and stabilizes to a nearly constant valve. A new motor should withstand for one minute without breakdown the application of a 60 Hertz potential of 500 volts for voltage up to 60 volts or 1000 volts plus twice rated voltage for voltages higher than 60 volts. Old motors should be tested at 75% of these values.

BRUSHES

Brush condition and remaining brush life should be checked at each maintenance inspection. Each brush should be checked for length and each spring for proper pressure. When installing new brushes, each brush should be sanded into the curvature of the commutator for most reliable performance. A minimum of 85% surface contact with 100% brush arc is recommended. Replacement brushes should be exactly the same brush grade as original.

COMMUTATOR

Commutator runout should not exceed .002" total indicated runout with a bar-to-bar variation of .0002". The mica bar-to-bar insulation should always be kept below the copper surface. When commutator wear results in flush or protruding mica, the mica should be undercut to a depth equal to the thickness of the mica or about .025". The undercut slot should be kept clean and free of dirt.

CLEANING

Both the interior and exterior of the motor should be kept clean and free of dirt and grease. Loose dirt may be removed by vacuum cleaning or dry compressed air. Vacuum cleaning is preferred because compressed air may drive dirt deeper into cracks and voids in the insulation system. Loose dirt can be removed with a cleaning rag or a soft bristle brush. Clogged air openings should be cleaned out using care not to damage insulated parts.

CAUTION: SOLVENTS MUST NOT BE USED. LIQUID SOLVENT MAY CARRY ELECTRICAL CONDUCTING DIRT DEEP INTO CRACKS AND VOIDS IN THE INSULATION SYSTEM.

If insulation resistance is low after cleaning it may be necessary to either bake the armature at 90°C to remove moisture or to varnish treat and bake for reliable repair.

MECHANICAL

Check for unusual noises or vibration which were not present when the unit was originally installed. Check all electrical and mechanical connections for tightness. Clean screen covers and ventilating ducts.

DISASSEMBLY INSTRUCTION

The following instruction will describe the disassembly process of a standard motor. It should be recognized that special requirements and special applications require special construction and there will be many variations to which standard instructions do not apply. The following steps can still serve as a helpful guide when disassembling a motor:

1. Remove the brushholder springs and brushes from the brushholders.

2. With the motor in a vertical position, drive end up, remove the drive end bearing bracket bolts.

3. a. On motors which do not have a restrained drive end bearing the drive end bearing bracket can be tapped loose and removed. Next the armature can be removed using a lifting eyebolt in the center hole in the shaft.

b. On motors which have a restrained drive end bearing, lift the armature and drive end bearing bracket using the lifting eyebolt in the center hole in the shaft, tapping the bracket loose from the magnet frame as it is lifted.

c. Both motors with and without restrained drive end bearings may be disassembled as described in 3 b. After removal the drive end bracket may be slid off the bearing.

4. Disconnect all connections between the magnet frame and the commutator end bearing bracket. Remove all bolts holding the commutator end bracket to the magnet frame. Remove the bracket from the frame, tapping it loose to disengage the rabbet.

5. Further disassembly or replacement of parts can now be accomplished as required by the situation.

6. Reassembly is accomplished in reverse order of steps 1 through 4.

FAILURE

WARNING: IF AN ELECTRICAL FAILURE OR AN EXTREME OVERLOAD OCCURS, ESPECIALLY IN A TOTALLY ENCLOSED MOTOR, PERSONNEL SHOULD NOT BREATHE THE FUMES WHICH HAVE BEEN GENERATED INSIDE THE MACHINE. THE HEAT OF THE FAILURE ARC OR OVERLOAD MAY GENERATE NOXIOUS FUMES BY PYROLYSIS OF THE INSULATION MATERIALS. ALL POWER SHOULD BE DISCONNECTED FROM THE MOTOR BEFORE ANY INVESTIGATION OF THE FAILURE IS ATTEMPTED. THE AREA AROUND THE MOTOR SHOULD BE WELL VENTILATED. PERSONNEL SHOULD NOT BREATHE THE TOXIC FUMES PRODUCED BY THE FAILURE. IF POSSIBLE, TIME SHOULD BE ALLOWED FOR THE MOTOR TO COOL AND FOR DILUTION OF THE FUMES WITH AIR.

Water should not be applied to any electrically energized equipment because of the danger of electric shock which can result in serious or fatal injury. In case of fire, disconnect all power and use a carbon dioxide extinguisher to quench the flame.

REPAIR

Repairs should be made only by qualified personnel using original or verified equivalent materials and processes for which the motor was designed. Many repairs can be easily performed with only assembly operations involving available General Electric replacement parts. If major repairs are undertaken (such as rewinding an armature) proper facilities should be available and suitable precautions observed.

WARNING: IN BURNING OFF OLD INSULATION MATERIALS (AS IN PREPARING TO REWIND A MOTOR) ADEQUATE VENTILATION MUST BE PROVIDED TO AVOID EXPOSING PERSONNEL TO NOXIOUS FUMES. THE OVEN MUST TAKE IN SUFFICIENT VOLUME OF AIR TO PERMIT COMPLETE COMBUSTION AND THE COMBUSTION PRODUCTS MUST BE CONFINED TO THE OVEN AND ADEQUATELY VENTED TO THE OUTSIDE ATMOSPHERE AWAY FROM PERSONNEL.

If warranty repair is to be claimed it is imperative that the work be done by a General Electric Service Shop. In cases of major repair it is usually less expensive to replace the component than to rewind or attempt extensive repair work.

RENEWAL PARTS

The motor serial number completely identifies the motor and every part therein. It must be given when ordering replacement parts. Any order for motor parts should give the number of parts desired, the description of the part, the serial number of the motor, and either the General Electric Company's model number or the OEM-customer identification number.

GENERAL ELECTRIC

GENERAL ELECTRIC COMPANY
DC MOTOR AND
GENERATOR DEPARTMENT
ERIE, PENNSYLVANIA 16531

11-79 (20M) D

Printed in U.S.A.

V09990

Parker-Hannifin Corporation

Hydraulic Valve Division

520 Ternes Avenue

Elyria, OH 44035-6252

V58114

Rexroth Corp.

Mobile Hydraulics Division

1700 Old Mansfield Rd.

P. O. Box 394

Wooster, OH 44691-9050

REXROTH CORPORATION
MOBILE HYDRAULICS DIVISION
WOOSTER, OHIO

By: CEB PUMP-VARIABLE DISPLACEMENT 5142-003-003

CATALOG NUMBER - A10VO63DFR/21R-PSC62N00

DESIGN NUMBER A - 959839 FMC P/N 620-1316

DESCRIPTION - PUMP, VARIABLE DISPLACEMENT

MANUFACTURING PLANT - BRUENINGHAUS, HORB

DISPLACEMENT (SIZE) - 3.84 CU IN/REV (63 CU CM/REV)

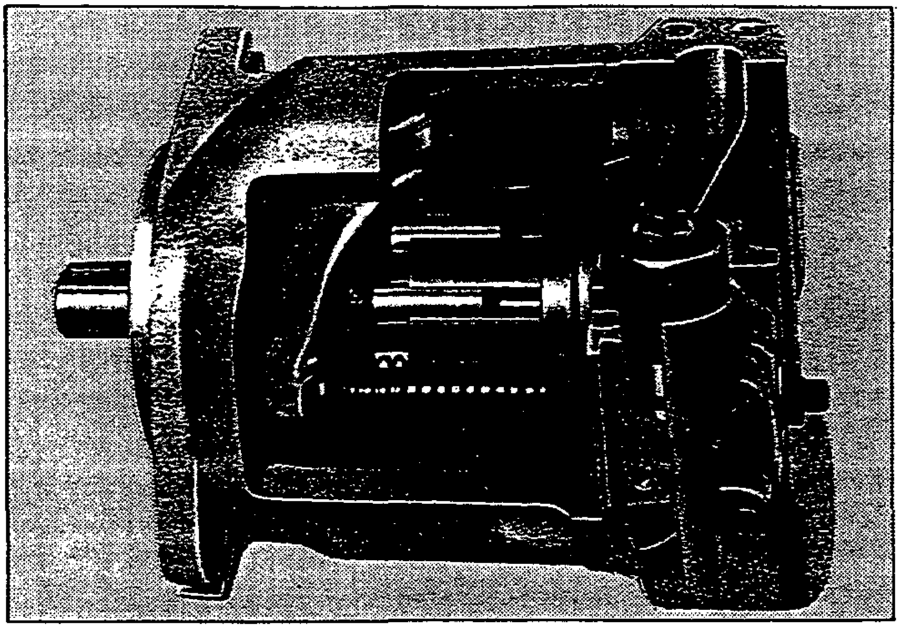
PHYSICAL DATA
- WEIGHT - 55 LBS (25 KG)
- MOUNTING FLANGE - SAE "C", 2-BOLT
- DRIVE SHAFT - SAE SPLINE, 1-1/4" 14T, 12/24 DP
- PRESSURE PORT - SAE 1-1/4"-3000 PSI, 4-BOLT FLANGE
- SUCTION PORT - SAE 2"-3000 PSI, 4-BOLT FLANGE
- DIRECTION OF ROTATION - RIGHT HAND (CW)
- CONTROL TYPE - FLOW AND PRESSURE COMPENSATED

DRAWING NUMBERS
- REXROTH, WOOSTER -
- BRUENINGHAUS, HORB -

ADJUSTMENTS
-PRESSURE COMPENSATOR TO BE SET AT 2500 PSI (172 BAR).
-PRESSURE DIFFERENTIAL OF FLOW COMPENSATOR=203 PSI (14 BAR).

ADDITIONAL FEATURES
1. SIDE FACING, SAE 4-BOLT FLANGE PORTS.
2. IRON REAR COVER.

REVISION: A
DATE: 12/5/86
APPROVED: CEB
NOTE:



Ordering Code

	A 10VS	O		/2X	–					*

Petroleum oils = no desig.
HFA, HFB & HFC fluids = E

Axial piston unit, variable displacement, stationary industrial design = A 10 VS

Open circuit operation = O

0.98 in^3/rev (16 cm^3/rev) size 16	=	# 16
1.53 in^3/rev (25 cm^3/rev) size 25	=	25
1.71 in^3/rev (28 cm^3/rev) size 28	=	* 28
2.44 in^3/rev (40 cm^3/rev) size 40	=	40
2.75 in^3/rev (45 cm^3/rev) size 45	=	* 45
3.84 in^3/rev (63 cm^3/rev) size 63	=	63
4.33 in^3/rev (71 cm^3/rev) size 71	=	*71

Pressure compensator = DR
Pressure/flow compensator = ** DFR
Constant power control = *** DFLR

Design series 2X = 2X

R = clockwise rotation
L = counter-clockwise rotation
(direction of rotation, viewed from shaft end)

P = Buna-N seals for petroleum oils
V = Viton seals for phoshate ester fluids

K = SAE parallel keyed shaft (to SAE J 744)
P* = metric parallel keyed shaft

C = SAE 2-bolt mounting flange (only with SAE shaft "K")
A* = ISO 2-bolt mounting flange (only with metric shaft "P")

62 = SAE connection flanges with U.N.C. threads
12* = SAE connection flanges with metric threads

N = without through drive
K = with through drive for combination pumps

Further details to be written in clear text

* These pump models, are not normally stocked. Please consult factory for delivery time.

** Orfice is installed in X-port standard; if plug is to be installed state in clear text

\# Size 16 shown for reference, (see RA 92 705)

*** When ordering, please state power characteristics in clear text. ex.: 7½ HP at 1800 RPM (5 kw at 1500 RPM)

Introduction

This manual is intended to provide the information required to successfully start up, adjust, troubleshoot and service the Rexroth Variable Displacement Pump, Type A10VS.

The adjustment and disassembly procedures described herein may be performed in clean conditions without affecting the warranty. Dismantling the units beyond the stages described in this manual without the express permission of Rexroth may void the warranty.

When performing any type of service or conversion to these pumps, the utmost cleanliness of work area, tools, cleaning rags, and the components is required. Dirt and contamination introduced during assembly and service is a major cause of failure in high pressure piston equipment. Therefore, the importance of cleanliness cannot be over emphasized.

For dimensions and detailed descriptions of the function of the various controls, please refer to the relevant "RA" engineering data sheet.

Specifications, descriptions and illustrative material shown herein were as accurate as known at the time this publication was approved for printing. Rexroth reserves the right to discontinue models or options at any time or to change specifications, materials, or designs without notice and without incurring obligation.

Optional equipment and accessories may add additional cost to the basic unit, and some options are available only in combination with certain models or other options. For the available combinations refer to the relevant data sheets for the basic unit and the desired option.

Information contained herein should be confirmed before placing orders.

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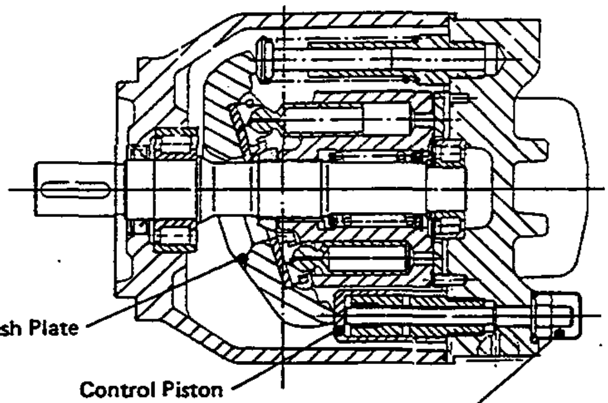
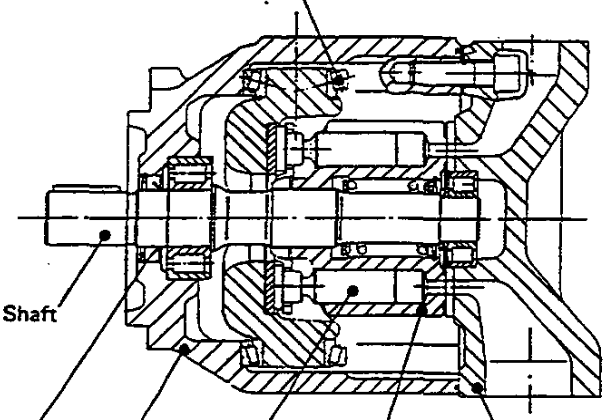
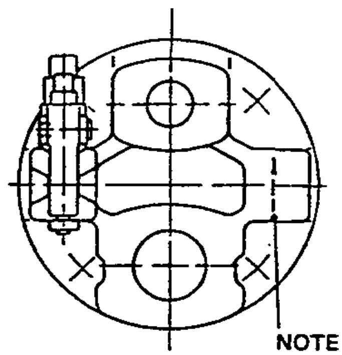
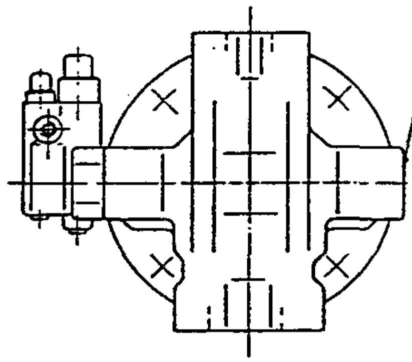
Cross Section





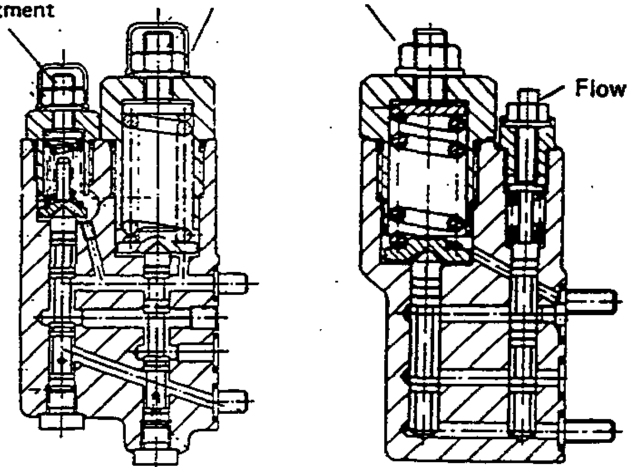
PORT PLATE NO. 2





PORT PLATE NO. 4 & NO. 8

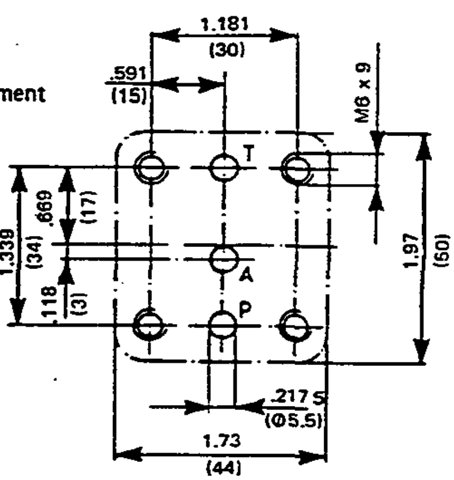
CONTROL VALVE



Series 20

Series 10

Subplate. Dimensions in Inches (mm)



Technical Details

GENERAL SPECIFICATIONS A10VS PUMP

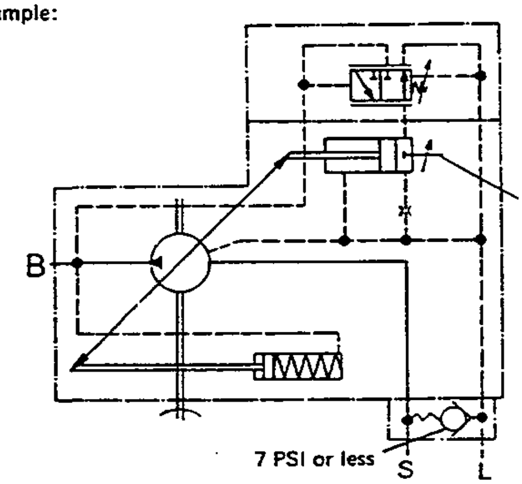
Specification		Unit	A10VS25	A10VS40	A10VS63
Displacement		in^3/rev	1.52	2.44	3.84
		cm^3/rev	25	40	63
Nominal Flow at 1000 rpm		gpm	6.6	10.5	16.6
		l/min	25	40	63
Torque Constant (theoretical)		lb ft/100 psi	2.01	3.23	5.09
		Nm/bar	0.39	0.64	1.00
Maximum Drive Speeds	Inlet Pressure, –3.0 psig	rpm	3000	2500	2200
	Inlet Pressure, 0 to 215 psig	rpm	3250	2800	2400
Rated Pressure (continuous)		psi	3000	3000	3000
		bar	207	207	207
Peak pressure (intermittent)		psi	3625	3625	3625
		bar	250	250	250
Minimum Operating Pressure		psi	75	75	75
		bar	5	5	5
Minimum Inlet Pressure at Suction Port 'S'		psig	–3.0	–3.0	–3.0
		bar	0.8	0.8	0.8
Maximum Inlet Pressure at Suction Port 'S'		psig	215	215	215
		bar	15	15	15
Weight (dry)		lbs	33.0	46.0	73.0
		Kg	15	21	33
Filling Capacity of Pump Case		in^3	43	61	97
		liter	0.7	1.0	1.6
Maximum Permissible External Loading of the Drive Shaft		F_A lbs	225	337	540
		N	1000	1500	2400
		F_R lbs	540	810	1350
		N	2400	3600	6000

Maximum Case Pressure

No more than 7 psi higher than inlet pressure, but not higher than 29 psig overall.

To reduce case pressure, check valve connection between L and S can be introduced, when the installation requires very long lines back to tank.

Example:



Port Connections

Size		25	40	63
SAE flange	suction port	1¼"	1½"	2"
4-bolt	pressure port	3/4"	1"	1¼"
Threaded connections	case drain port	3/4"–16 UNF-2B	7/8"–14 UNF-2B	7/8"–14 UNF-2B
	pilot port X	7/16–20 UNF-2B	7/16–20 UNF-2B	7/16–20 UNF-2B

Volumetric Efficiency

Leakage and flow readings (not to exceed) at 1800 RPM, 3000 PSI, 125 SSU - 122°F, petroleum based fluid.

Size	25	40	63
External Leakage Maximum GPM	0.5	0.75	1.2
Total Flow Loss (external plus internal leakage) Maximum GPM	0.7	1.1	2.0

HFA fluid leakage rates are double the above values, and are measured at 1200 RPM, 2000 psi, 100°F

Mineral Oil

Operating Viscosity

Recommended Viscosity Range: 80 to 170 SSU (for optimum performance).
Allowable operating viscosity 66 - 460 SSU

Note: This is viscosity required at operating temperature, not the viscosity rating by oil suppliers at standard temperature 100°F.

Please refer to data sheet RE 90 220 for recommended fluid properties before selecting hydraulic oil for your system.

Viscosity Limits

Minimum Viscosity: 60 SSU (only allowed at overheating limit of 190°F).
Maximum Viscosity: 4600 SSU (cold start-up)

To determine the proper fluid (viscosity) it is necessary to know the system operating temperature, which is related to ambient (air) temperature. Rexroth recommends that the fluid viscosity selected should be at the upper end of the optimum viscosity range, at the operating temperature predicted (refer to shaded area in the viscosity chart).

For example, at 140°F operating temperature, both VG 46 and VG 68 fluids fall within the optimum range. Use the VG 68 fluid.

Note: Case drain temperature, influenced by pressure and speed is always higher than circuit temperature. Nowhere in the installation should the temperature exceed 194°F (90°C).

Should for some reason the above specifications not be kept due to extreme operating parameters or high ambient temperatures, please consult factory.

Specifications for Use with Fire Resistant Fluids

HFA — High water base 95/5

HFB — Invert emulsion — water-in-oil

HFC — Water glycol

Refer to data sheet RE 90223 for further details.

All Sizes, Type A10VS

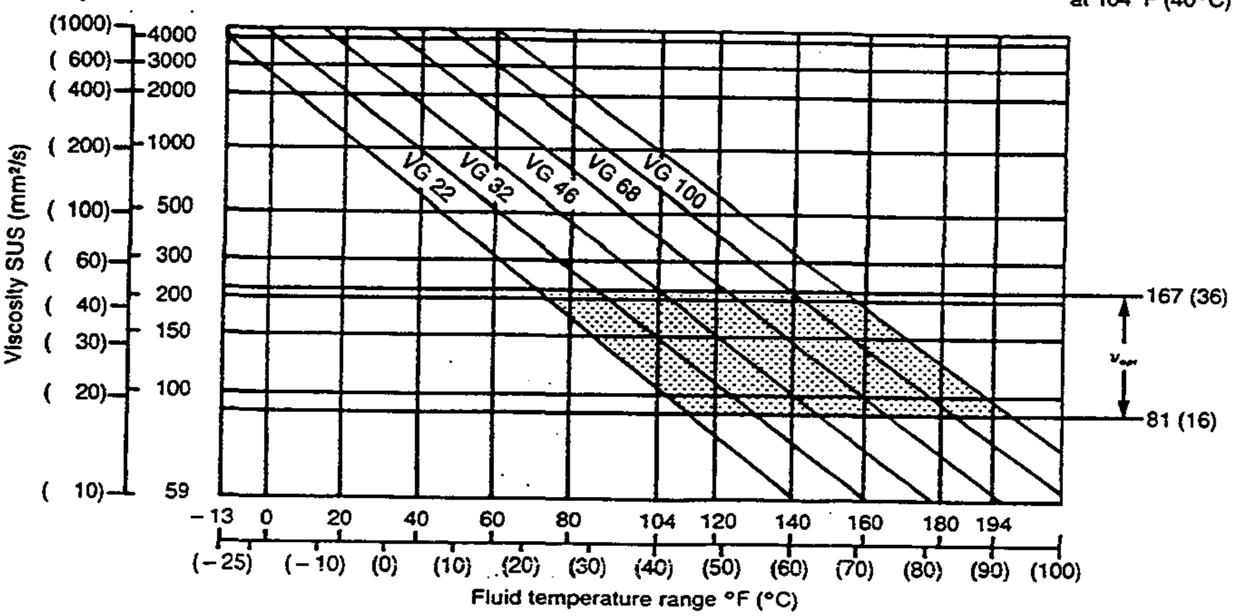
Rated Pressure:	2000 psi (140 bar)
Peak Pressure:	2300 psi (160 bar)
Maximum Drive Speed:	*1800 rpm*
Minimum Inlet Pressure:	15 psi absolute (flooded suction)
Fluid Temperature Range:	HFA – 40 to 110°F 120°F max HFB – 40 to 120°F 140°F max HFC – 14 to 120°F 140°F max

Filtration

Element Type:	Metal fibre
Nominal Rating:	10 μm (micron)

VG 22 = Viscosity Grade of 22 Centistokes at 104°F (40°C)

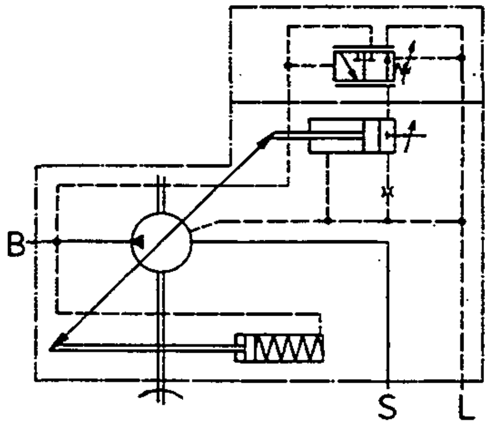
Viscosity Chart



Pressure Compensator, Type DR

The pressure compensator control gives maximum output flow to the system until the system reaches the pre-adjusted pressure setting of the control. The pressure compensator control then regulates the pump output flow to equal the flow requirements of the system while maintaining the pre-adjusted output pressure. When the system no longer requires flow, the pressure compensator control will cause the pump to destroke so that there is no output flow while maintaining the pre-adjusted pressure.

Mechanical Flow Limitation Available with Port Configuration 8 and 9



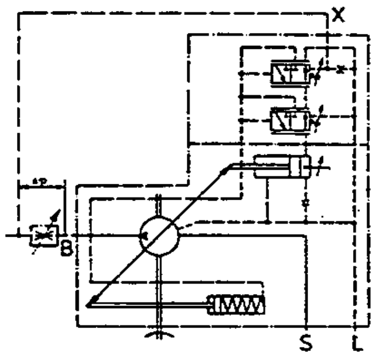
Flow & Pressure Compensator, Type DFR

The flow and pressure compensator control, also known as a load-sensing control, matches pump output flow and pressure to system demand. This control will automatically regulate the pump displacement to deliver the flow required to maintain a constant pressure drop across a valve spool or other flow limiting device. When there is no system demand, the pump stands by at zero flow and low pressure. When the system demands flow, the pump delivers only the flow required by the system, at a pressure required to move the load.

To protect the system from infinite load pressures, the pressure compensator section of the control will cause the pump to automatically destroke when the pre-adjusted maximum system pressure is reached.

Mechanical Flow Limitation Available with Port Configuration 8 and 9.

Stand-by Pressure
203 psi (14 bar)

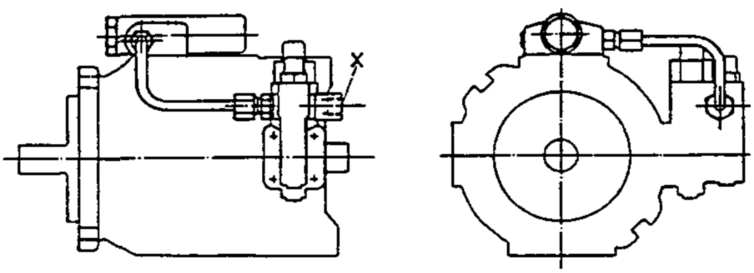


Directional control valve or other flow metering device. (not included with pump)

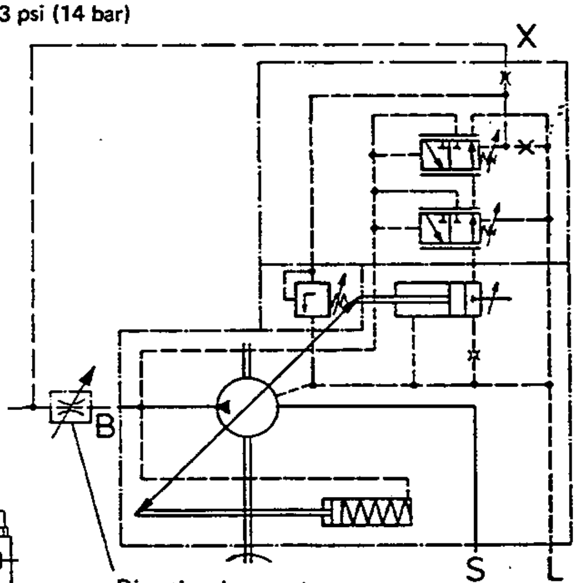
Constant HP Control, Type DFLR

The horsepower limiter type LR must be used in conjunction with the basic DFR control to give a complete DFLR assembly. The LR valve is essentially a feedback-controlled variable relief valve used as a pilot stage over the FR spool. Once the initial LR relief valve setting is reached, pump will begin to destroke due to the FR spool shifting in response to the LR valve. This raises the relief setting by way of the feed-back pin at the swashplate, and limits how far the pump destrokes to a relationship with system pressure. This arrangement causes the pump to follow a constant torque demand curve, keeping the product of flow times pressure constant. As a result a smaller prime mover can be used, saving energy.

This design allows the combined use of pressure control, load sense and horsepower limiting. The HP control only works when system pressure is externally connected to sensing port "X".



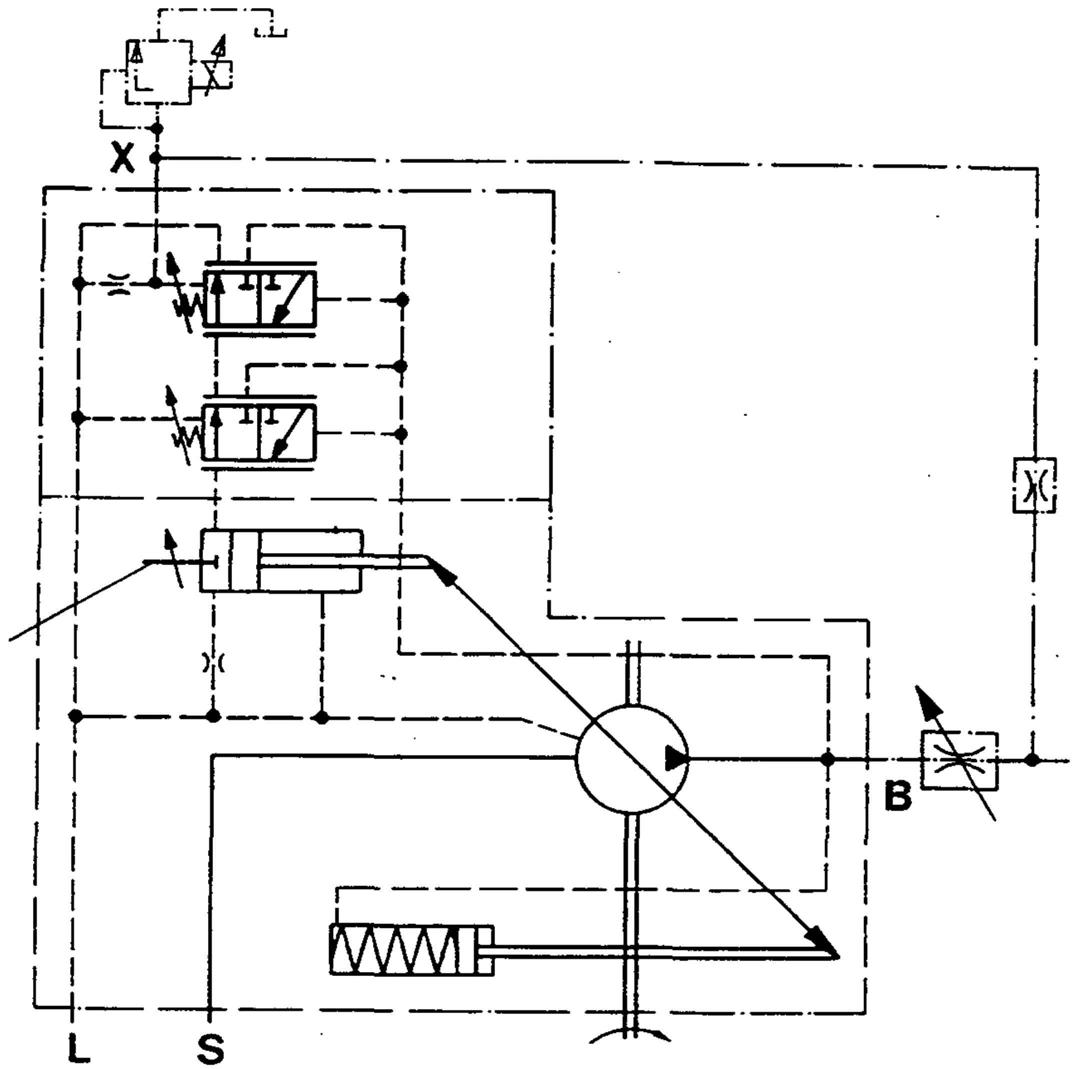
Stand-by Pressure
203 psi (14 bar)



Directional control valve or other flow metering device. (not included with pump)

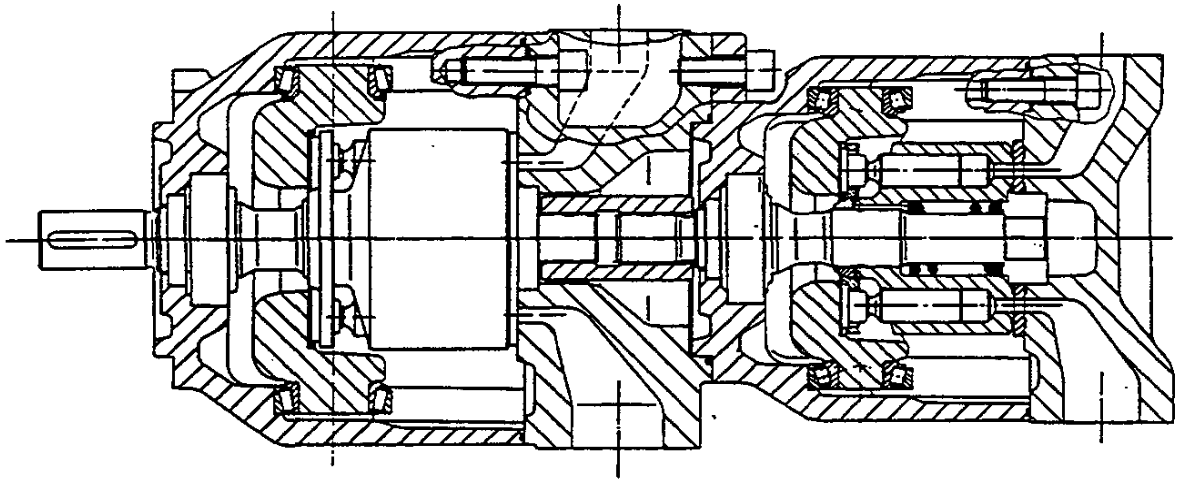
Mechanical Flow Limitation Available with Port Configuration 8 and 9.

Circuit Diagram for Remote Compensator Control



Please note that for remote compensator control, the pilot line is hooked up to the "X" port of the FR spool. This means the FR spool is being used for remote pressure control, so the pump to be used must have DFR control, not just DR control.

The remote valve to use for this control can be either DBD H6 for hydraulic or DBET-50 for electric remote control. All connections and components outside the pump envelope are customer supplied items.



Through Drive Mounting Pattern Possibilities

SAE - Size	Pattern	Pilot Dia.	Shaft Size	Type	Availability Pump Size 25	40	63
A	2-bolt	3.25"	5/8 dia. x 5/32 sq.	keyed	o	o	o
A	2-bolt	3.25"	18 mm dia. x 6 mm *	keyed	o	o	o
A	2-bolt	3.25"	5/8 dia.—9T, 16/32 DP	splined	o	o	o
—	4-bolt	2.48"	25 mm dia. x 8 mm **	keyed	o	o	o
B	2-bolt	4.00"	7/8 dia. x 1/4 sq.	keyed	o	o	o
B	2-bolt	4.00"	7/8 dia.—13T, 16/32 DP	splined	o	o	o
B-B	2-bolt	4.00"	1" dia. x 1/4 sq.	keyed		o	o
B-B	2-bolt	4.00"	1" dia.—15T, 16/32 DP	splined		o	o
C	2-bolt	5.00"	1¼" dia. x 5/16 sq.	keyed			o
C	2-bolt	5.00"	1¼"—14T, 12/24 DP	splined			o

* to fit A10V16 ** to fit R4 radial piston pump

Specify desired mount & shaft configuration in clear text when ordering

NOTE:
When considering pump combinations keep in mind the maximum overhanging load (moment of force) and shaft torque allowable. Refer to RA 92710.

Combination pumps are possible only by use of a special drive shaft and rear port plate. (Port plate option no. 6).

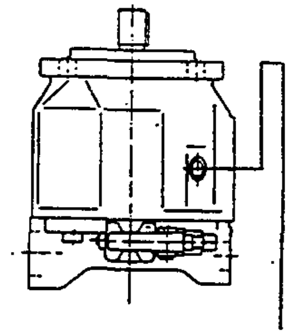
Conversion of the standard pumps to pumps with through drive is not economically feasible.

Mounting Position

The A10VS pump can be mounted in any position.

The pump housing must always stay filled with operating fluid. This can normally be assured by having the case drain port pointing up or nearly up. When this is not possible the pump case should be prefilled with oil before installation.

For vertical mounting shaft-up, the case drain line should be looped up to the height of the mounting face before going to tank. This is also true for in-tank mounting where the oil level will be below the mounting face of the pump.

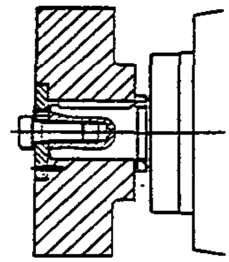


Coupling

A flexible-type coupling is recommended to accomodate slight shaft misalignment and dampen vibration. This should be attached to the drive shaft using a spacer between the coupling and the shoulder on the drive shaft, and locking the coupling to the shaft by using a cap screw in the threaded hole in the end of the shaft.

Gearbox Mounting

In this case the drive shaft cannot be secured to the pinion hub or spline adapter, allowing a slight relative movement, which can cause fretting corrosion if not properly lubricated.



The ideal method of lubrication is an oil bath from the gearbox sump. When not possible, the splines should be liberally coated with Optimoly Paste white T or equivalent before installation.

Connections

Sizing
All hydraulic lines should be at least the same size as the corresponding pressure, suction or case drain port on the pump.
Suction and case drain lines should have the least number of bends or fittings and be as short as possible to avoid back pressure and cavitation. For longer runs, the lines should be a size larger or sized to minimize pressure drop. **Please note carefully** the suction and case pressure ratings on the data sheet. Seamless piping and tubing is recommended.

Assembly
Protective caps and plugs should be kept in place until just before assembly of piping.
Good cleanliness practices must be observed at all times during assembly.

Filtration

In order to guarantee reliable function the operating fluid must be maintained to a minimum cleanliness grade of 9 to NAS 1638 or 6 to SAE, ASTM, AIA, or ISO 16/15 or better.

These levels can be obtained by using filters with a Beta 20 ratio $\geq$ 100

If suction filters are used they must be sized so that no more than -3 psig (0.8 bar absolute) or better is maintained in all conditions.

Cooling

There are several methods to consider for cooling when required by the duty cycle.

Full Flow (return lines) Cooling.
This method is effective when there is flow available most of the time the pump is running. However, in closed-center systems where there is blocked flow in neutral, the system can overheat if the pump stays at the compensator pressure during long idle periods.

NOTE:
It is not recommended to Tee in the case drain line to the main return line to also cool leakage flow. This could create high backpressure in the pump case which cannot be allowed. Please note case pressure ratings on the previous pages.

Case Drain Cooling.
In load sense or compensated systems this is normally the highest temperature fluid in the system. It is also a a very low flow (refer to efficiency charts). The heat exchanger used to cool this oil would have to be highly efficient and sized to give little or no back-pressure even during cold start-up. A low pressure by-pass should be installed to ensure this.

Recirculating Pump.
This type of system would only be needed in a large multiple pump system and extreme continuous duty cycles.

Reservoir

The capacity must be in proportion to the application. For industrial applications, especially 24 hour operation this is usually 2 - 3 times pump flow for best fluid life.

With shorter duty cycles such as 4 - 8 hours/day or run-as-needed, reservoir size can be correspondingly reduced. (e.g. run-as-needed size can be .75 to 1 times pump flow.)

Piping

All reservoir lines should terminate 2 - 3" below the minimum oil level in the tanks. The ends should be cut at a 45° angle and stop 2" from the tank floor to avoid stirring up sediment.

Venting

Reservoir vents should be 10 micron rated air filters sized to handle air flow due to volume changes from temperature and differential area cylinders.

The vent should be mounted at the highest point on the reservoir.

Commissioning

I. **Check List**

This should be performed prior to start-up of a new installation, or for a system in which new or overhauled components have been fitted.

1. Ensure that hydraulic reservoir, piping and pressure hoses are cleaned and flushed.

2. Fill the reservoir only through a fine filter (i.e. 10 micron abs.) to avoid adding more contamination to system.

   NOTE:
   Drum and bulk oil is dirty by hydraulic oil standards. Care should always be taken when filling or topping off the reservoir to use a filling filter.

3. If there is any doubt about the absolute cleanliness of the system, fit a large 10 micron abs. filter for clean-up in either the pump discharge line or the return line. This is in addition to any permanent filters in the system.

4. Check that all filters have elements of the correct rating and the filter housings are filled with the hydraulic fluid to be used in the system.

5. Arrange the circuit to allow the pump to discharge to tank through filters with minimum pressure drop. (Especially important with closed-center valves or blocked flow in neutral circuits.)

6. Where possible fill the high pressure lines.

7. Open suction line valves.

8. IMPORTANT: Fill pump and motor cases to the highest case drain or vent port. Use clean filtered fluid.

9. Check that all connections are tight and secure.

10. Any gearboxes used in the application should be filled with the correct type of oil to the proper level.

11. Back all high pressure reliefs all the way out and reset one half turn against the spring. Set compensator to a low pressure setting. Do not adjust load sense spool.

12. Hook up a 6000 psi gauge at the pump discharge port.

13. Hook up a 50 psi gauge at the pump case drain port.

14. Hook up a vacuum gauge to the pump suction line, as close as possible to suction port.

15. Rig up the system so that there is little or no load on the actuators. Winches should be started without any cable on the drum.

II. Start-Up Procedure

The purpose of following a special start-up procedure after installation of a new pump is to accomplish four major objectives. This procedure should be followed for any type of hydraulic system start-up.

The Objectives:

I Start-up pump at no load
II Flush system at full flow and low pressure
III Bleed air and fix leaks
IV Check out performance and function

A detailed procedure follows.

1. If the prime mover is:
   Electric motor: jog the starting circuit until pump discharge begins to show flow.
   Internal combustion engine: (Diesel, gasoline or LP) Remove the coil wire, close the injector rack or leave the gas turned off and turn the engine over until pump discharge begins to show flow.

2. Start the prime mover and run at no load to allow the system to fill with fluid and ensure adequate lubrication. If the pump is not delivering fluid free of air bubbles within 60 seconds, shut down and check the system again.

3. Listen for any abnormal noises.

4. Check for leaks.

5. In a system using the FR flow regulating valve for load sensing and/or with the LR horsepower limiting valve, bleed air from the sensing line using the opposite "X" port of either the FR or the LR valve.

6. After running for 10 or 15 minutes, if pump flows properly and sounds okay, then set up the circuit to power the system.

7. Operate control valves to work the system with no load. Check that the system is connected so that it operates in the correct direction related to control input.

8. Deaerate system by venting a bleed valve or by cracking the highest connections until fluid seeps out without bubbles.

9. Retighten all connections.

10. Check fluid level and add fluid if necessary.

11. Continue operating the system under no load conditions for about 15 minutes to stabilize the temperature and remove any residual air from the fluid.

12. Continue to monitor all pressure gauges and correct any irregularities. Check oil level and temperature.

13. Remove and inspect high pressure and return filters. If clean, the temporary high pressure cleanup filter may be removed from the circuit. If contamination is evident, install new elements and continue flushing until the system is clean.

14. Set pressures. Main system relief and control valve port or cross-over reliefs should be set at least 200 - 300 psi higher than pump compensator pressure to prevent overheating in the system.

    If load sensing or the flow regulating (FR spool) control is used, check ΔP setting (approximately 200 psi) across the flow metering device.

15. Check over all connections to be sure they are secure.

16. After cleanup, replace all filter elements in the system.

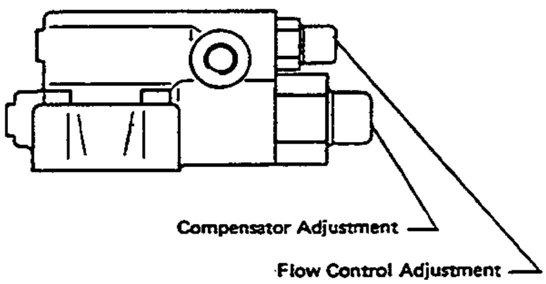
17. Operate the system under full and normal load conditions.

18. Erratic operation may indicate there is still air trapped in the system. By working control valves both ways the remaining air can be eliminated. The system is free of air when all functions can be operated smoothly and the oil in the reservoir shows no foam on the surface.

DR - Pressure Compensator Control

Tools: 4 mm Allen wrench and 13 mm Box wrench.

1. Hook up a 6000 psi gauge at or near the pressure outlet port of the pump.
2. Back out the compensator setscrew all the way after loosening the locknut by turning counter-clockwise. Then turn in one turn against the spring.
3. Start the pump, and block output flow by running a motor against a brake or "bottom out" a cylinder function to make the pump compensate.
4. In load sensing circuits, be sure the sensing line is included in the pressure side of the blocked flow, otherwise pump will only standby at the load sense pressure.
5. Turn the compensator setscrew clockwise until the desired pressure setting is achieved, then tighten the locknut.
6. One turn of the setscrew corresponds to 725 psi.



FR - Flow Regulating or Load Sensing Control

ΔP setting - All DFR pumps are factory set at 203 psi ΔP, at or near the maximum output flow of the pump. Setting the FR control is only necessary when converting a pump from DR back to DFR.

NOTE:
A DR pump always has an FR spool included, with the ΔP adjustment turned all the way in to lock out its function.

Tools: 3 mm Allen wrench and 10 mm Box wrench.

1. Hook up 6000 psi gauges at the pump discharge and into the sensing line that is connected to the "X" port of the pump.
   An alternative is to hook up a ΔP gauge to the above mentioned locations.
2. Arrange a circuit to give a flow condition across some throttling device such as: orifice plate, needle valve or directional valve.
3. If using a load sensing directional valve, operate a function such as a motor, or loop a hose across the work ports (A & B) of one of the spools and actuate that spool.
4. Depending on the circuit, it may be desirable to lower the compensator setting to about 500 - 1000 psi to minimize heat buildup.
5. With a flow condition generated as above, adjust the FR control setscrew to give approximately 200 - 250 psi ΔP, or until the regulator is stable. (Some load sensing directional valves may require a different setting.)
6. Run the pump in its designed circuit and check for stability and flow control (standby pressure will be somewhat higher than ΔP setting).

Mechanical Stroke Limiter

This adjustment is available only on port plate no. 8 and limits the maximum output flow of the pump.

NOTE:
Port plate no. 8 is the standard port configuration in stock at Rexroth.

Tools

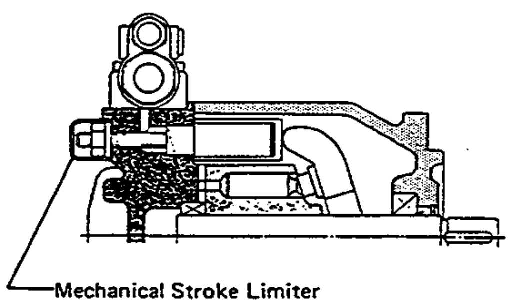
Pump Size	Locknut Hex	Allen Wrench
25	17 mm	5 mm
40	19 mm	6 mm
63	22 mm	6 mm

1. Loosen locknut and back out setscrew, then turn in until setscrew contacts piston.
2. Turn in the setscrew until the desired flow is attained, either by reading a flow meter or estimating the number of turns needed from the chart below.

Change in output flow per turn at 1000 rpm

Pump Size	Flow Change*
25	.403 gpm
40	.834 gpm
63	1.218 gpm

*approximate theoretical flow not considering volumetric efficiency.



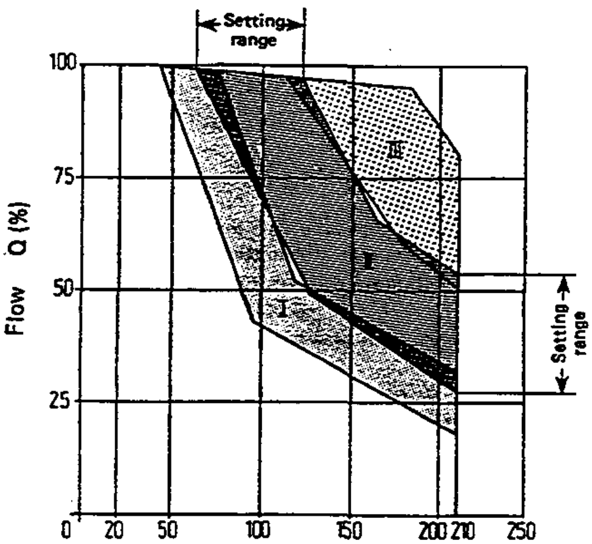
LR – HORSEPOWER LIMITING CONTROL

Setting the power level of this control is best done by the factory to your specifications. Be sure to give all technical details when placing the order, such as: horsepower, speed, maximum pressure and maximum flow.

Changing the settings of the LR horsepower valve is not recommended as the optimum performance of the pump throughout its output range could not then be guaranteed. The most accurate method of setting this control is by measuring the input torque to the pump at constant speed. This is the least likely method to be used in the field due to unavailability of equipment.

However, special circumstances may exist which make resetting the power level necessary.

NOTE:
As shown on the diagram the LR valve has three power ranges. Each range requires a different set of regulating springs. Be sure the pump has the proper springs for the power setting required.



The following procedure will help obtain a rough horsepower setting which should limit the maximum torque demand of the pump but may not yield the optimum constant torque demand normally associated with this type of control.

I. Preparation Before Adjustments
Determine set points.
The LR horsepower limiting valve has two spring elements, the first for the low-pressure end of the power curve, the second spring adds its force to the first spring at about the half-way point to keep the actual output close to the theoretical power curve throughout the second half.

1. Set Point No. 1
Calculate an approximate pressure point for adjusting setting screw no. 1. Use a point where pump has destroked to 85% of its total flow.

Use the following formula:

$$P_{begin} = \frac{\text{Horsepower x efficiency x 1715}}{\text{.85 x total flow}}$$

Use 89% or 0.89 for efficiency at this point.

2. Set Point No. 2
Calculate an approximate flow and pressure point that is somewhat past the point where the LR valve has engaged the second spring to change the regulating slope.

Use the following formula:

$$P_{second\ spring} = \frac{\text{Horsepower x efficiency x 1715}}{\text{M\% x total flow}}$$

Use the following values:

Power	M%	Efficiency
Range I	35 %	0.78
Range II	50 %	0.83
Range III	60 %	0.85

II. Set-Up of Equipment
a. Equipment required
1. Pressure gauge*
2. Flow meter*
3. Needle valve or relief valve (to create a test load on the pump output)
4. Tachometer (diesel) ammeter (electric motor)*
5. Tools
4 mm Allen wrench
13 mm box or open-end wrench
27 mm box or open-end wrench

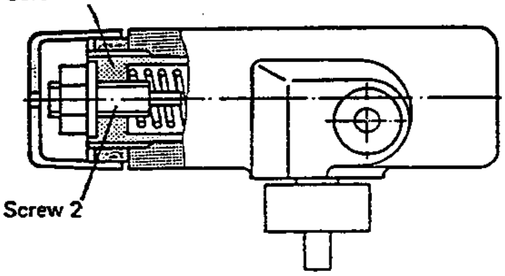
*Accurate, calibrated instruments are strongly recommended. Battery-operated devices should have automatic or manual calibration adjustments to compensate for voltage decay as batteries wear down.

b. Installation
Hook-up pressure gauge, flow meter and needle or relief valve at the outlet of the pump. Be sure the sensing line that runs back to the "X" port is upstream of the relief valve and flow meter. Pressure gauge should be at same point as the sensing line. If the system is set up for load sensing or flow regulating, the devices used (orifice, directional or needle valve) should be bypassed to avoid any interference with the LR valve function during these adjustments. Be sure the FR spool is functioning and properly set.

III. Adjustments

a. Set Point No. 1

If the prime mover used during test has limited horsepower, the LR valve setting should be lowered by backing out setting screw no. 1 to avoid stalling or overloading the prime mover. Do not backout set screw no. 2. When taking readings make sure the pump keeps at its rated speed. Otherwise settings will be in error. Always take readings with increasing pressure, not decreasing as there is a small difference in readings when taken each way. With the pump running, adjust the relief or needle valve to reach the pressure calculated for setting screw no. 1. Observe the reading on the flow meter to see if it is showing 85% of maximum flow. Adjust setting screw no. 1 until this reading is obtained.



Back-out the needle valve or relief valve if the load pressure changes when making flow changes and run up to calculated pressure again to recheck. After adjustments, tighten the 27 mm lock nut and check readings again.

b. Set Point no 2

After the readings for set point no. 1 are satisfactory, adjust the relief or needle valve to reach the pressure calculated for setting screw no. 2. See that the flow reading compares with the percentage of maximum flow used in the calculation and make any adjustments by loosening the 13 mm lock nut and turning setting screw no. 2 in or out. Do not disturb the 27 mm lock nut or setting screw no. 1 during this adjustment. After making settings, tighten 13 mm lock nut and recheck readings.

c. Adjust compensator (see procedure on previous page)

Load the pump throughout its pressure range and observe that the electric motor doesn't draw more than rated current or the diesel doesn't lug down below rated speed. If it does by only a few percent, then available horsepower may have been over-estimated due to accessories or gearbox efficiencies (diesel) or electric motor efficiency. The calculated set point pressures may have to be lowered accordingly. If severely overloaded, troubleshoot the prime mover.

A10VS MAINTENANCE

The A10VS pump itself requires little or no maintenance. Long service life of the pump is dependent on good contamination control (filtration) and regular fluid changes.

The following maintenance intervals are suggested:

Filter Elements
Inspect and/or replace:

a. After commissioning
b. After 500 operating hours
c. With each fluid change

NOTE:
Suction filters should never cause a vacuum worse than -3.0 psig (0.8 bar absolute) with fluid at running temperature.

CAUTION:
Use only 10 micron or better filter elements.

NOTE:
Paper inserts are not cleanable. Maintain a stock of throw-away elements.

Fluid Change

a. After 500 operating hours
b. After 2000 operating hours
c. Every 2000 operating hours or once a year

Changes may become necessary in shorter periods depending on contamination and thermal load. Outdoor applications may require seasonal changes if the viscosity range of the oil cannot bridge the winter/summer temperature extremes experienced.

Common errors made during oil changes:

a. Inadequate cleanliness (allowing dirt into system)
b. Tank clean out neglected
c. Filling the tank without filter

Inspection for Leaks

a. After commissioning
b. At regular intervals (entire system)

Cleanliness Inspection
The oil tank breather should be cleaned of dirt and dust regularly. If an air cooler is used, it should be cleaned at the same time.

Fluid Level

a. Inspect after commissioning
b. Daily thereafter

Troubleshooting Procedure

I. **No Flow Output**
   A. Pump and System
      Check:
      a. Direction of rotation
      b. Fluid level in reservoir
      c. Suction lines connected
         If vacuum gauge in suction port reads a high vacuum, check:
      d. Suction line shut-off valve open
      e. Suction screen or filter plugged
      f. Suction line undersized
      g. Reservoir breather blocked
   B. Control - DR Pressure Compensator
      Check:
      a. Compensator (DR) setting backed all the way out
      b. Compensator spring damaged or broken
      c. Spool stuck
   C. Control FR-Flow Regulating or Load Sensing
      a. Regulator setting backed out
      b. Regulator spring damaged or broken
      c. Spool stuck
      d. Sensing line not connected to "X" port
      e. Sensing line not connected properly to register load pressure
      f. Sensing line kinked or broken
      g. *Air lock in the sensing line*

II. **Functions Sluggish or Erratic**
   A. System
      Check:
      a. Viscosity of the oil (too heavy for application)
      b. Temperature (cold startup)
      c. Air trapped in lines and cylinders

III. **System is Unstable**
   Check over the following:
   A. System
      a. Air entrained in fluid
      b. Directional valves (pressure compensated especially) working properly. (Check compensator spools for sticking)
   B. Control
      a. Load sense (FR spool) Δ P setting (min 200 psi)

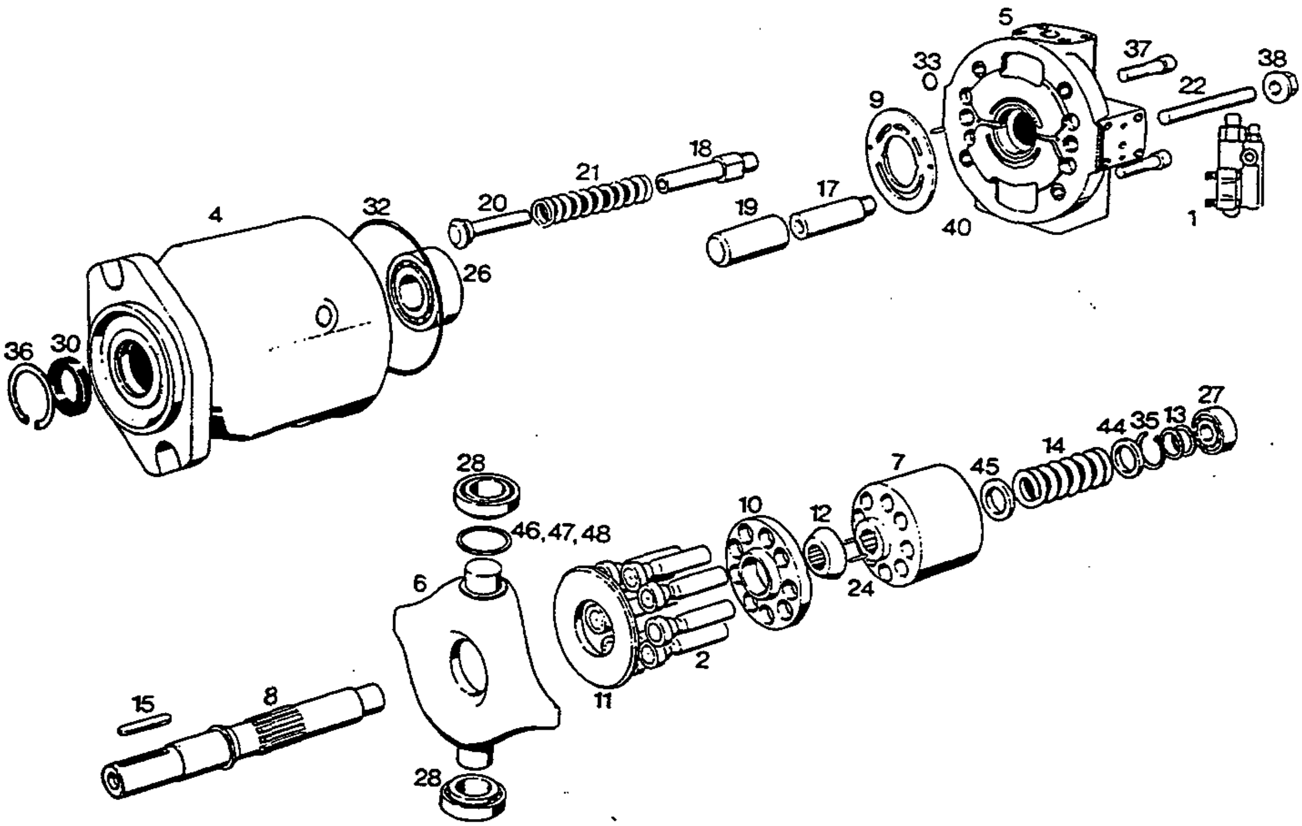
         NOTE:
         Some pressure compensated directional valves may require the control to be set at a higher Δ P.

      b. Check for contamination and scoring on FR spool. Replace control if badly scored.
      c. Remote, proportional electric, or dual compensators should have proper size orifice in sensing line (0.8 mm)
      d. Controls with horsepower limiting should have 1.0 mm orifice in sensing line

IV. **Pump Operates at High Noise Level**
   A. System
      Check over the following:
      a. Air leaks in the suction line
      b. Drive coupling alignment
      c. High vacuum in suction line
      d. Pump mounted without shockmounts
      e. Pump connected with rigid piping
      f. Air entrained in hydraulic fluid (milky or foaming oil)
      g. High case pressure (more than 7 psi over suction port)
   B. Control
      Check over the following:
      a. Air trapped in either compensator or load sensing spring chamber
      b. Air trapped in load sensing line

V. **System Operates at Higher than Normal Temperature**
   Check over the following:
   a. Relief valve settings (should be at least 200-300 psi higher than compensator pressure setting)
   b. High oil cooler backpressure (by-passing)
   c. Air/oil cooler fins clogged with dirt
   d. Cooler is undersize - review duty cycle
   e. Adequate water supply to water/oil cooler
   f. Pump case drain flow too high

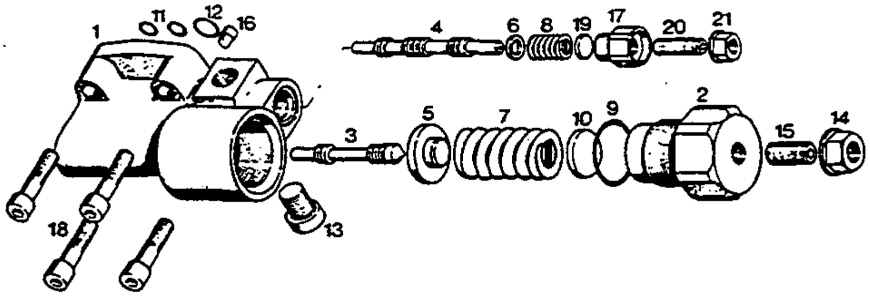
Pump, Type A10VS



Item No.	Description	Item No.	Description	Item No.	Description
1	Control valve	15	Shaft key	33	O-ring
2	Piston	17	Piston guide	35	Retaining ring
4	Pump housing	18	Piston guide	36	Snap ring
5	Port plate	19	Control piston	37	Socket head cap screw
6	Swashplate	20	Return piston	38	Seal lock nut
7	Cylinder barrel	21	Spring	40	Pin
8	Drive shaft	22	Set screw	42	Manufacturing plug
9	Control plate	24	Hold-down pins	44	Support washer
10	Retaining plate	26	Roller bearing	45	Support washer
11	Wear plate	27	Roller bearing	46	Shim
12	Retaining bail	28	Tapered roller bearing	47	Shim
13	Spacer shim	30	Shaft seal ring	48	Shim
14	Spring	32	O-ring		

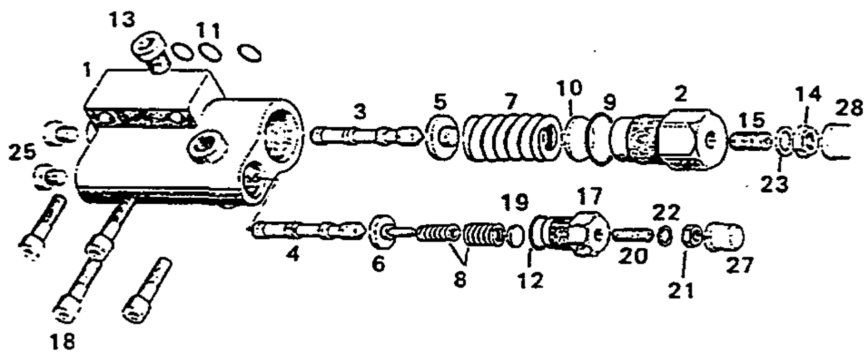
DFR Control Valve

SERIES 1



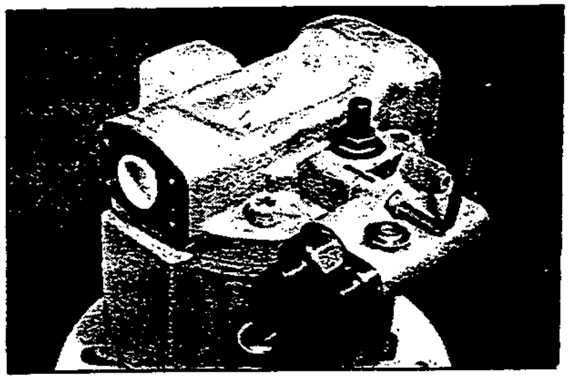
Item No.	Description				
1	Valve housing	12	O-ring	23	Seal ring
2	Cap	13	Plug	24	Orifice plug
3	(DR) spool	14	Seal lock nut	25	Plug
4	(FR) spool	15	Set screw	27	Cap
5	Spring cup	16	Plug	28	Cap
6	Support washer	17	Threaded plug		
7	Spring	18	Socket screw		
8	Spring	19	Spring plates		
9	O-ring	20	Set screw		
10	Spring plates	21	Seal lock nut		
11	O-ring	22	Seal ring		

SERIES 2

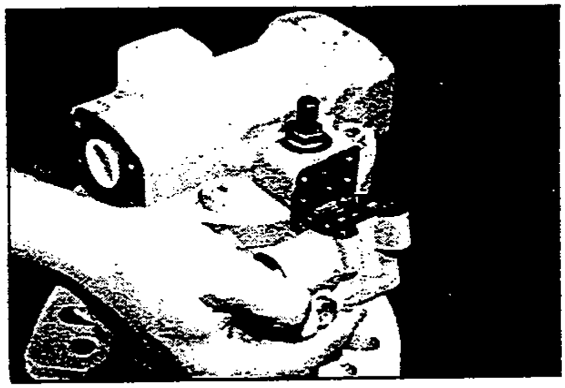


CONTROL VALVE REPLACEMENT

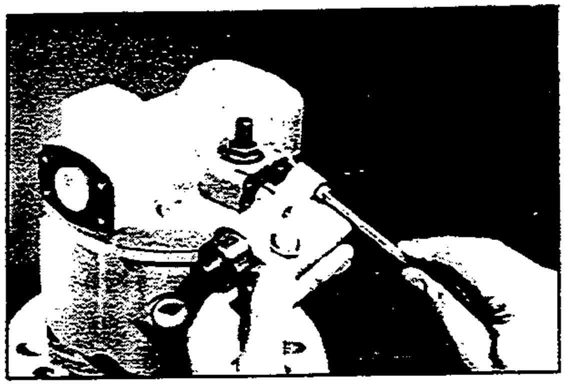
1. Mark position of control valve. Using 5 mm wrench, remove the four socket head cap screws while holding the control valve.



2. With control valve removed, inspect sealing surface on pump port plate, O-rings and grooves.
   Install new O-rings with a little grease to hold in place.

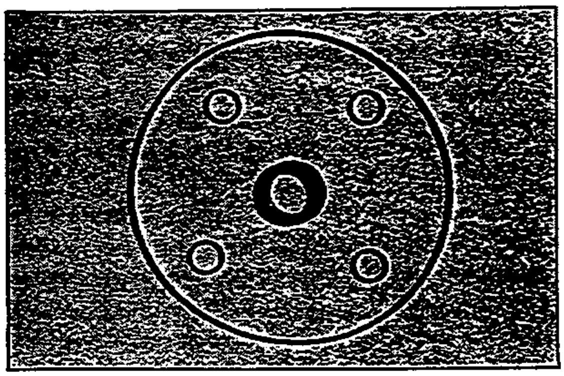


3. Reassemble in the correct position.



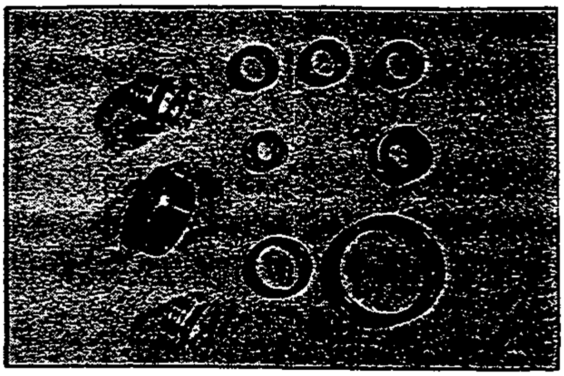
SEAL KITS

1. Seal kit for pump

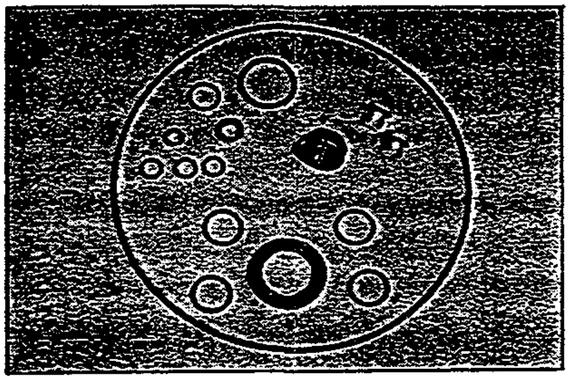


SEAL KITS

2. Seal kit for control valve.

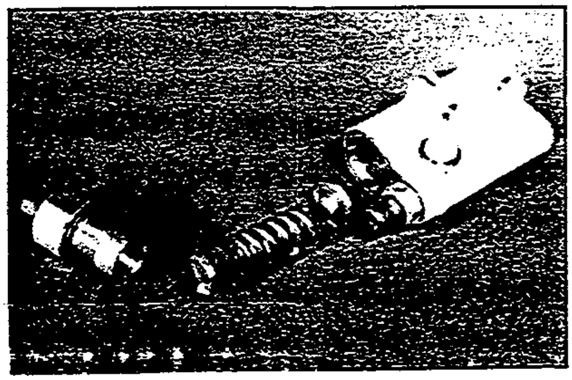


3. Complete seal kit, pump and valve.
   For detailed seal kit information, consult factory.

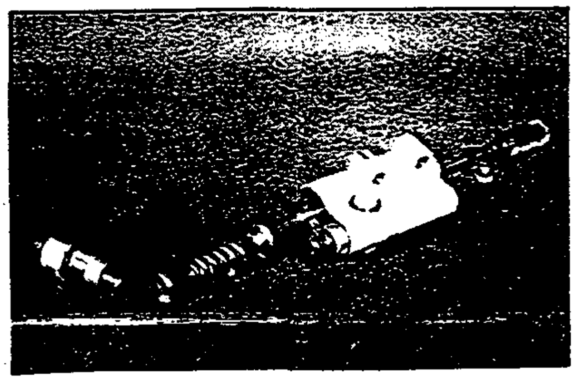


DR & FR COMPENSATOR SPOOL AND SEAL REPLACEMENT

1. Remove end cap and spring package without disturbing the pressure adjustment set screw.

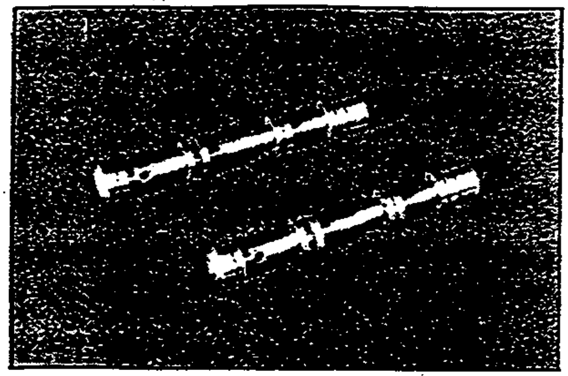


2. Remove plug on opposite end of valve and push out the control spool.
   The FR end cap and spool are removed in the same way.

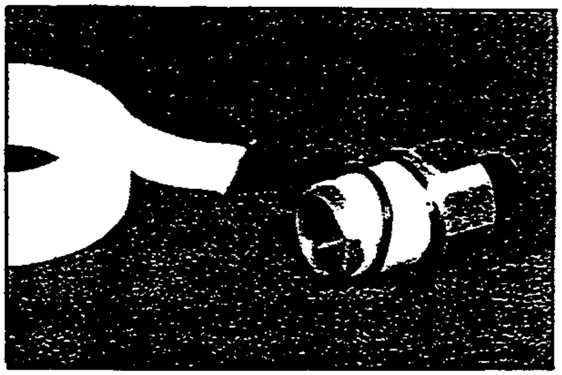


DR & FR COMPENSATOR SPOOL AND SEAL REPLACEMENT

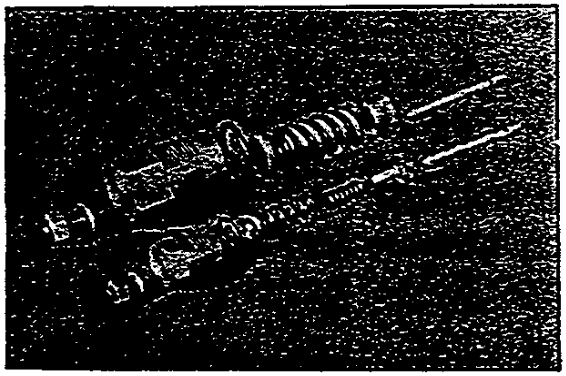
3. Inspect control spool for scoring or excessive wear. Control lands should be sharp-edged.
   Check to see that orifice passages in front-end of the spools are free of contamination.



4. Before installing new O-rings on both caps tape up threads to protect against damage.

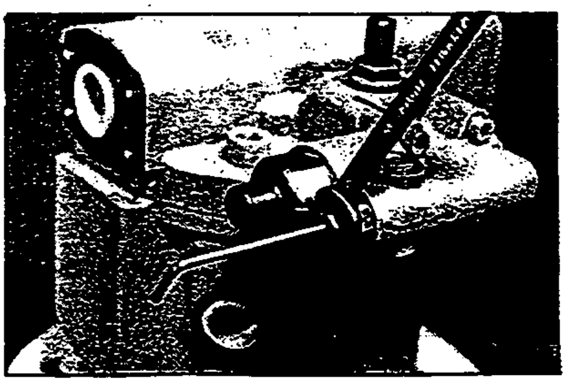


5. Complete parts arrangement for both controls



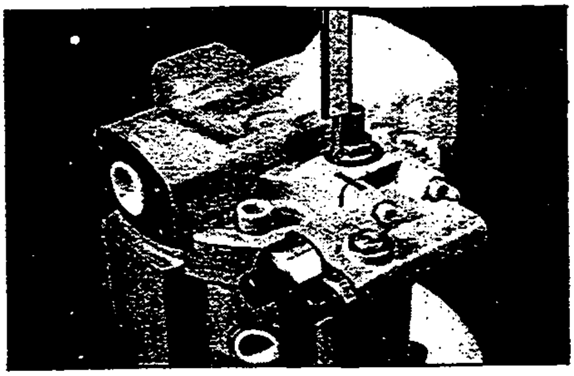
SETSCREW SEAL REPLACEMENT

1. If there is evidence of leakage from under the locknut, remove protective cap and loosen the locknut without turning the set screw. As a precaution the set length of the screw should be measured before starting. Remove and replace thread seal washer, after inspecting sealing surfaces. Reinstall locknut with setscrew at the same height as previously measured.

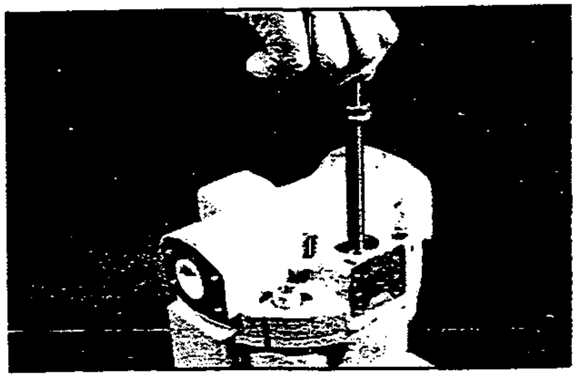


SEAL NUT REPLACEMENT, MECHANICAL STROKE LIMITER

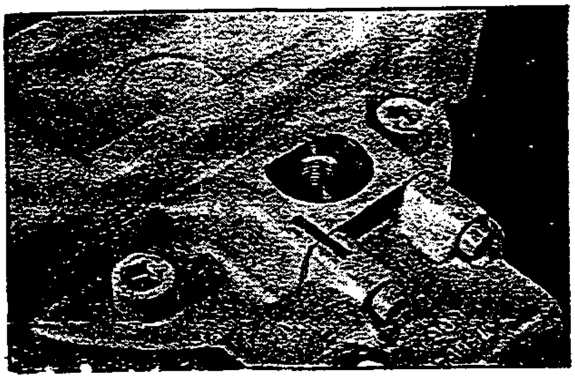
1. If leakage is noticed from under the seal nut, prepare for replacement by first measuring the set length of the limiter screw.



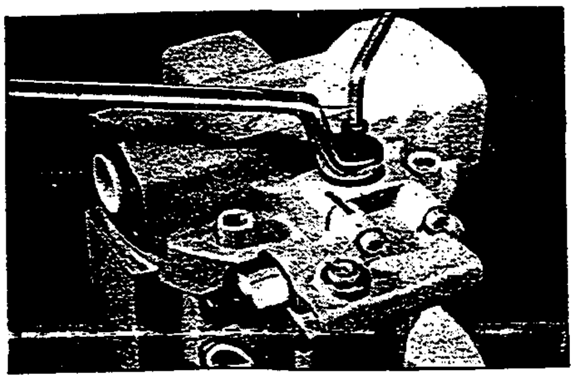
2. Remove setscrew and nut.



3. Inspect sealing surface for damage, rectify.

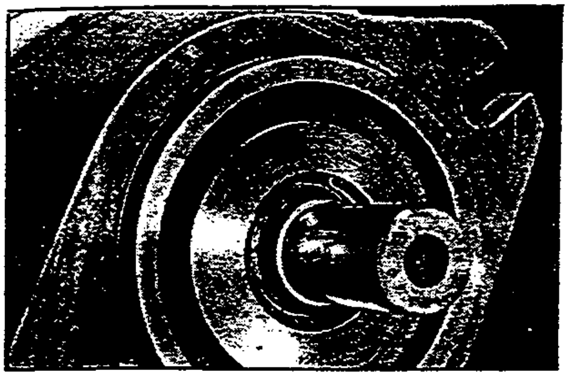


4. Use new seal nut, reinstall setscrew to the correct height and lock in position.

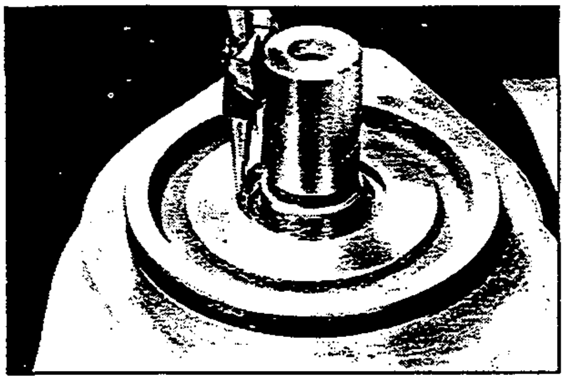


SHAFT SEAL REMOVAL & REPLACEMENT

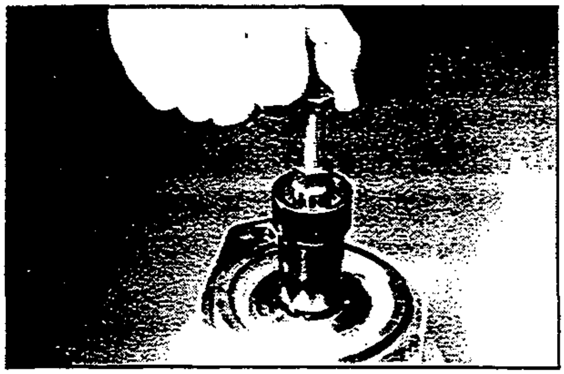
1. Remove key from drive shaft.



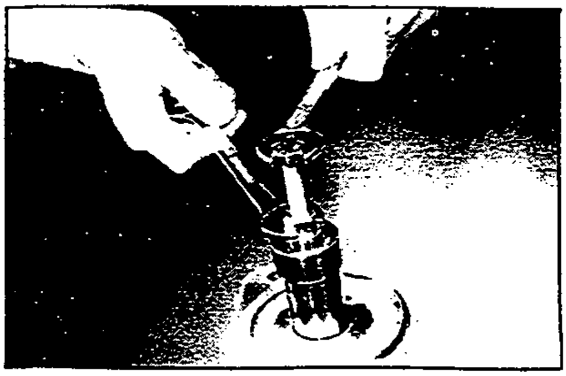
2. Remove retaining ring.



3. Fit seal removal tool to drive shaft.

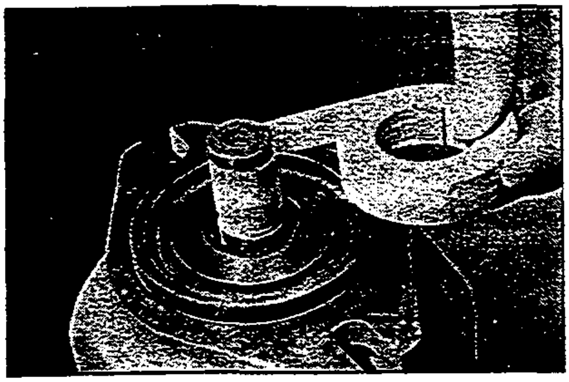


4. Force cutting edge of tool into shaft seal, then pull out tool with seal.

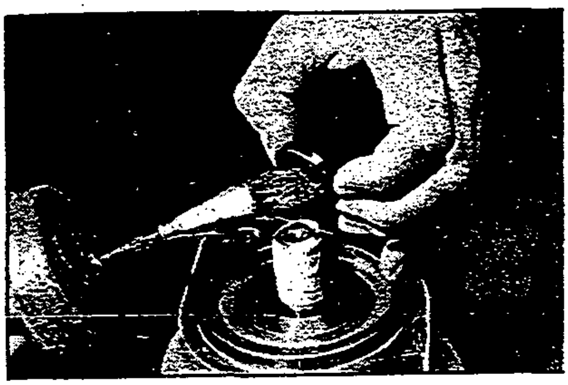


SHAFT SEAL REMOVAL & REPLACEMENT

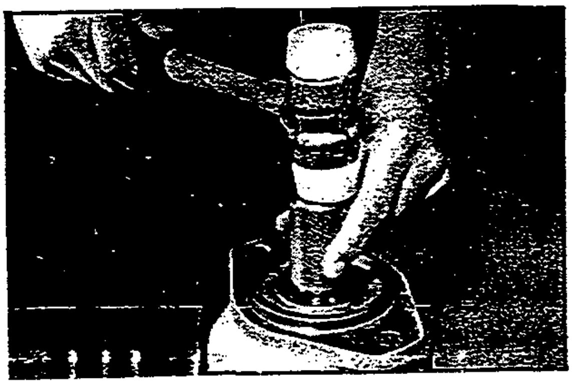
5. Tape up drive shaft.



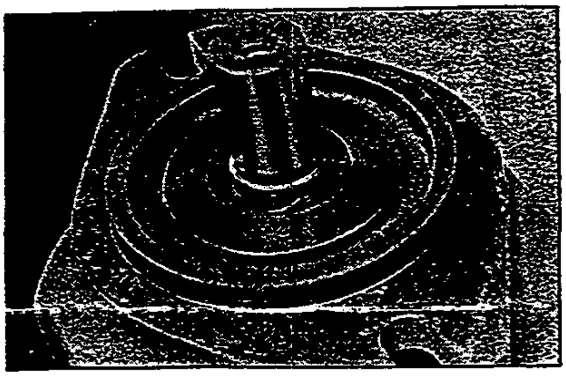
6. Grease sealing and dust lip of new shaft seal.



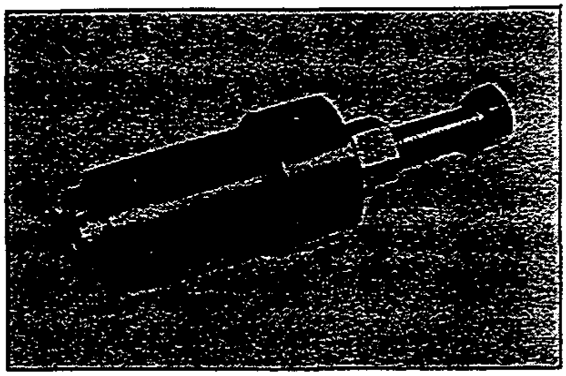
7. After placing shaft seal in position, remove tape and then drive the seal into place using seal driver shown.
   This driver has a stop that rests on the housing when seal is at correct depth.
   DO NOT DRIVE SEAL IN TOO FAR.
   If not using the special driver, take care to drive the seal only until it is just past the retaining ring groove.



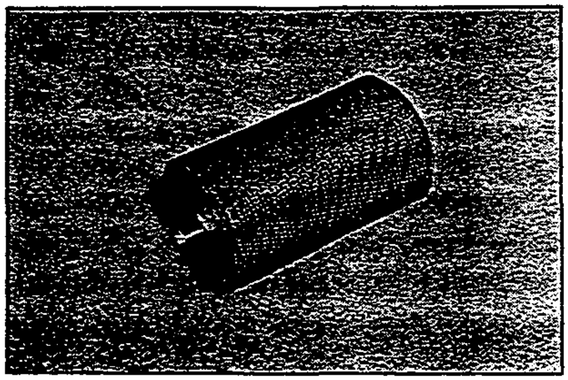
8. Reinstall retaining ring, making sure it is properly seated all around.



1. Shaft seal removal tool.



2. Shaft seal driver.



Notes:

THE REXROTH CORPORATION

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V73047

Fairfield Manufacturing

U.S. 52 South

Lafayette, IN 47902

TORQUE-HUB®

Final Drives

Our FMC Part No. 620-3641

05-16-86

Assy #W2B2F0337N

ASSEMBLY-DISASSEMBLY MANUAL

FOR THE

W2B

UNIT

Fairfield Manufacturing Company Inc.

INTRODUCTION

This manual is a step-by-step guide to assembly and disassembly of torque-hub units. It is designed for the customer or shop mechanic who is repairing a particular model of torque-hub final drive. Users of this manual should note that each part mentioned is followed by an indentification number enclosed in parentheses. These part numbers may be referred to in the Parts List section of this manual and on the cross-sectional view of this unit. A print of each tool discussed in this manual is shown in the Tooling section. Users should familiarize themselves with the procedures for roll and leak testing and bolt tightening and torquing found on the following two pages before getting started.

This manual includes the following sections.

1. Roll and Leak Testing Procedures
2. Bolt Tightening and Torquing Procedures
3. Disassembly Procedures
4. Sub-Assembly Procedures
5. Main Assembly Procedure
6. Drawings of all Essential Tools
7. Parts List
8. Cross-Sectional View of the Unit

SAFETY

Standard safety practices should be followed during the disassembly and assembly procedures described. Safety glasses and safety shoes should be worn. Heavy, heat resistant gloves should be used when heated components are handled. Be especially alert when you see the word CAUTION. This indicates that a particular operation could cause personal injury if not performed properly or if certain safety procedures are not followed.

ROLL and LEAK TESTING

Torque-hub units should always be roll and leak tested before disassembly and after assembly to make sure that the unit's gears and sealants are working properly. The following information briefly outlines what to look for when performing these tests.

THE ROLL TEST

The purpose of a roll test is to determine if the unit's gears are rotating freely and properly. You should be able to rotate the gears in your unit by applying a constant force to the roll checker. If you feel more drag in the gears only at certain points, then the gears are not rolling freely and should be examined for proper installation or defects. Some gear packages roll with more difficulty than others. Do not be concerned if the gears in your unit seem to roll hard as long as they roll with consistency.

THE LEAK TEST

The purpose of a leak test is to make sure that the unit is air tight. You can tell if your unit has a leak if the pressure gauge reading on your air checker starts to fall once the unit has been pressurized. Leaks will most likely occur at the main seal or wherever "O" rings or gaskits are located. The exact location of a leak can usually be detected by brushing a soap and water solution around the main seal and where "O" rings or gaskits meet the exterior of the unit then checking for air bubbles. If a leak is detected in a seal, "O" ring, or gaskit, the part must be replaced.

TIGHTENING and TORQUING BOLTS

If an air impact wrench is used to tighten bolts, extreme care should be taken to insure that bolts are not tightened beyond their indicated torque specification. Never use an impact wrench to tighten shoulder bolts, all shoulder bolts should be tightened by hand.

The following steps describe the proper procedure for tightening and torquing bolts or socket head cap screws in a bolt circle.

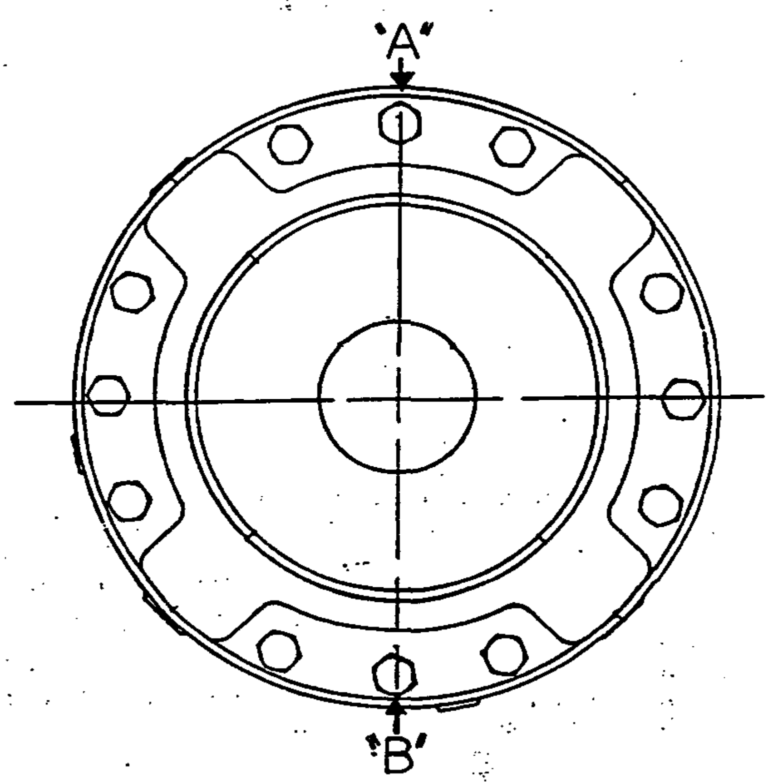
1. Tighten (but do not torque) bolt "A" until snug.

2. Go to the opposite side of the bolt circle and tighten bolt "B" until equally snug.

3. Continue around the bolt circle and tighten the remaining bolts.

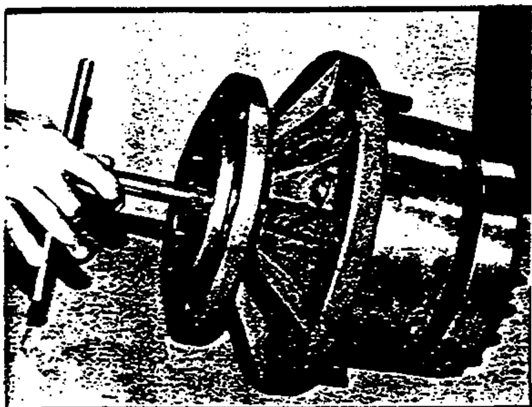
4. Now use a torque wrench to apply the specified torque to bolt "A".

5. Continue around the bolt circle and apply an equal torque to the remaining bolts.

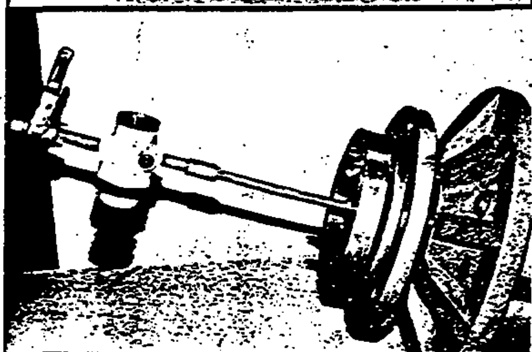


MAIN DISASSEMBLY

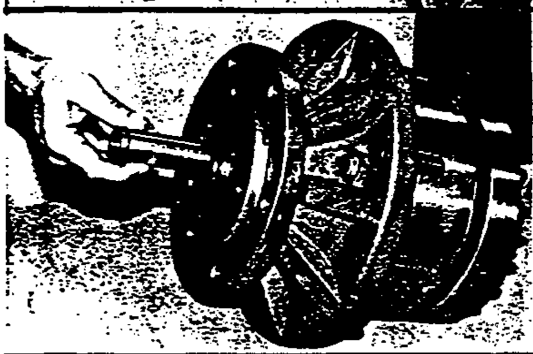
1. Remove pipe plugs(6H) from cover(6A) and drain the oil from the unit.



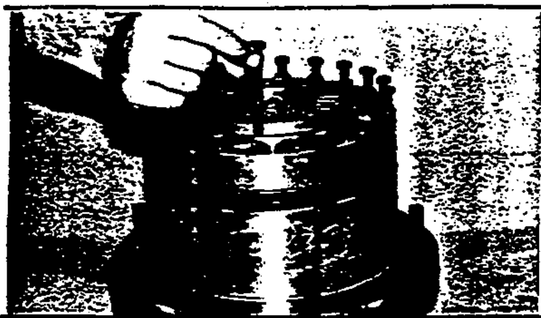
2. Roll test the unit in both clockwise and counterclockwise directions. Perform the same number of turns in each direction as the ratio of the unit. The ratio number is the same as the last two digits in the model number found on the ID tag of the unit.



3. Leak test the unit at a pressure of 5 psi for 2-3 minutes.



4. Remove coupling sub-assembly(19) from spindle(1A).

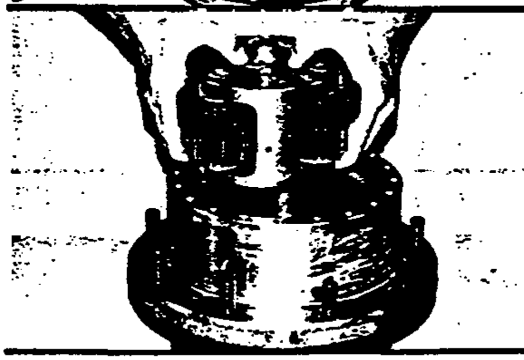


5. Remove the 20 bolts(12) and lockwashers(13) from cover(6A).

6. Remove cover sub-assembly(6) from hub(1G).

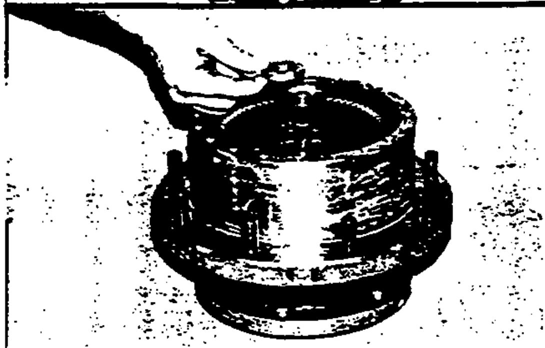
7. Remove input gear(8) from mesh with input shaft(7).

8. Remove ring gear(4) from mesh with carrier sub-assembly(3).

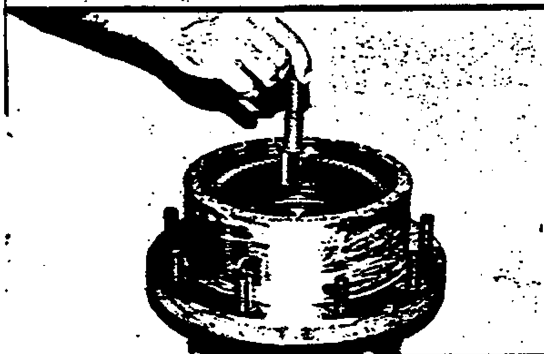


9. Remove carrier sub-assembly(3) from hub(1G).

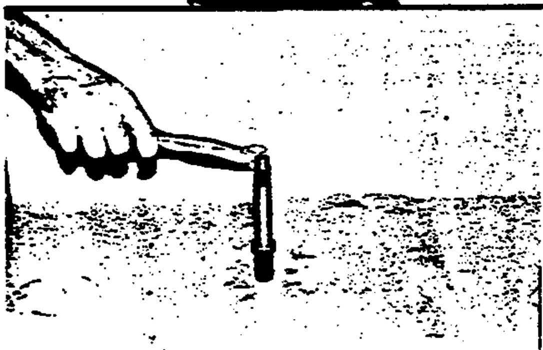
10. Remove thrust spacer(10) from input shaft(7).



11. Remove thrust spacer(9) from input shaft(7).

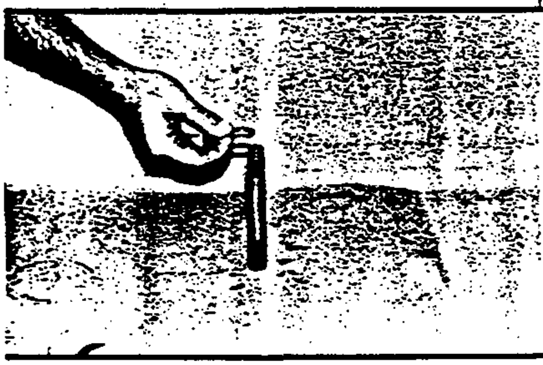


12. Remove input shaft(7) from spindle(1A).

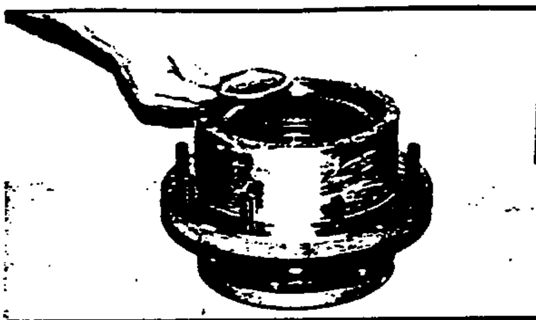


13. Using retaining ring pliers, remove retaining ring(14) from the groove on input shaft(7). Discard the retaining ring.

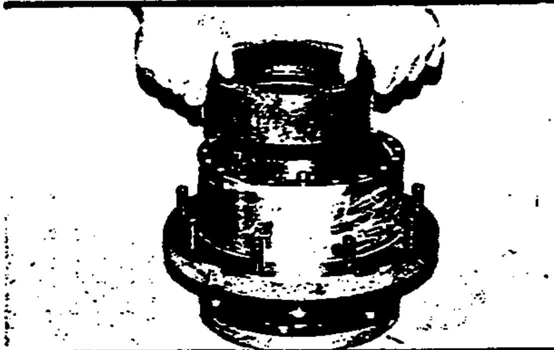
CAUTION: Safety glasses should be worn during this procedure.



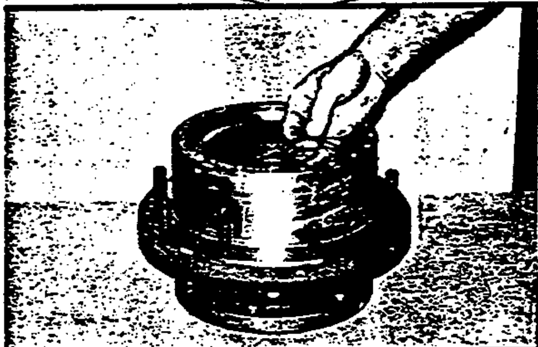
14. Remove washer(15) from input shaft(7).



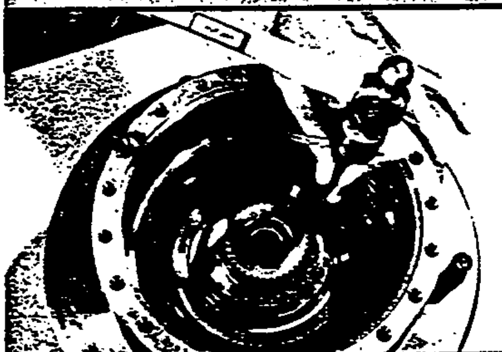
15. Remove thrust washer(11) from the bottom of internal gear(2).



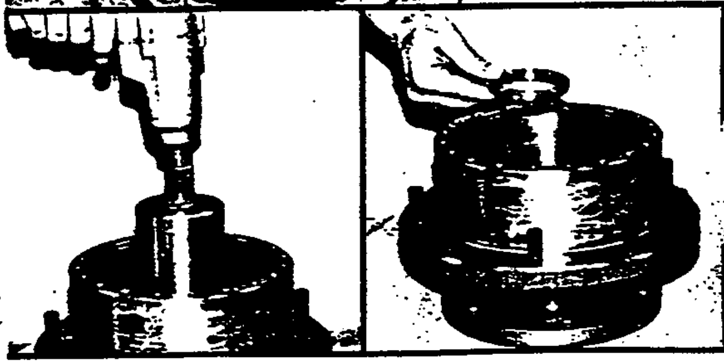
16. Remove internal gear(2) from hub(1G).



17. Remove "O" ring(5) from the counterbore of hub(1G) and discard.



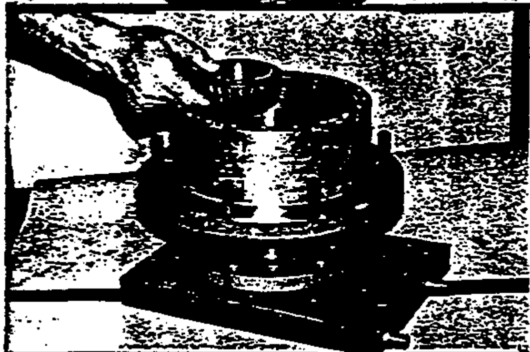
18. Using a screwdriver or chisel and hammer, straighten out the tang on lockwasher(1I) which has been bent into the notch on locknut(1J).



19. Using an N-12 locknut wrench (tool no. T-136699), loosen lock-nut(1J). Remove the locknut from spindle(1A) and discard.

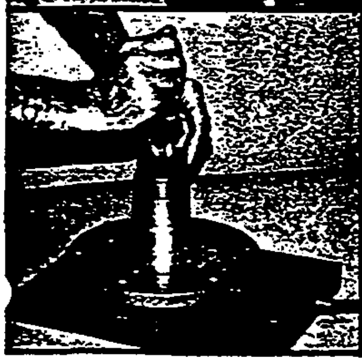
20. Remove lockwasher(1I) from spindle(1A) and discard.

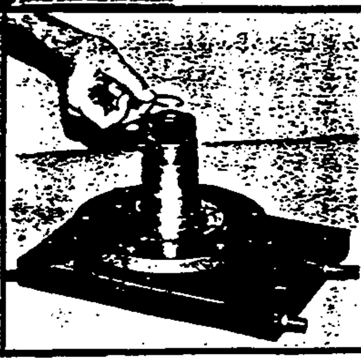
21. Remove tanged washer(1H) from spindle(1A).



22. Lift bearing cone(1F) out of hub(1G).

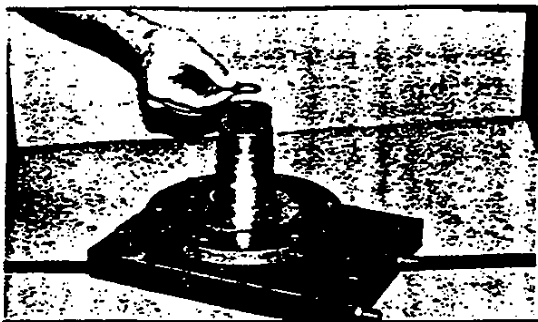
23. Lift hub(1G) off of spindle(1A).



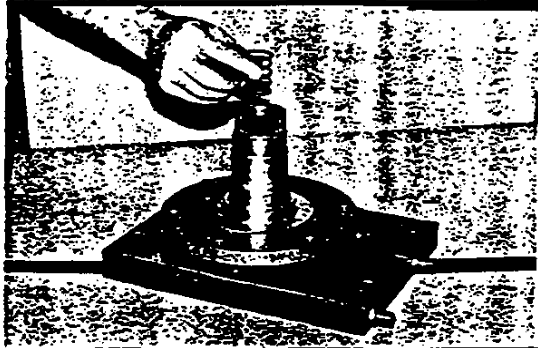


24. Using retaining ring pliers, remove retaining ring(17) from the groove inside spindle(1A). Discard the retaining ring.

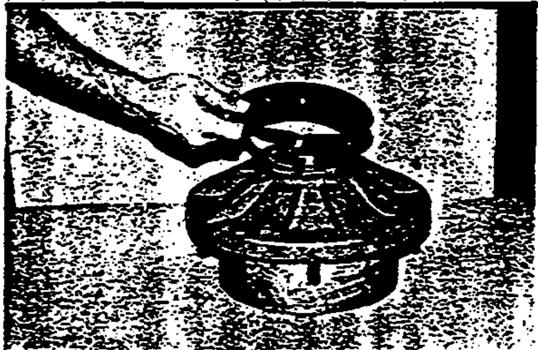
CAUTION: Safety glasses should be worn during this procedure.



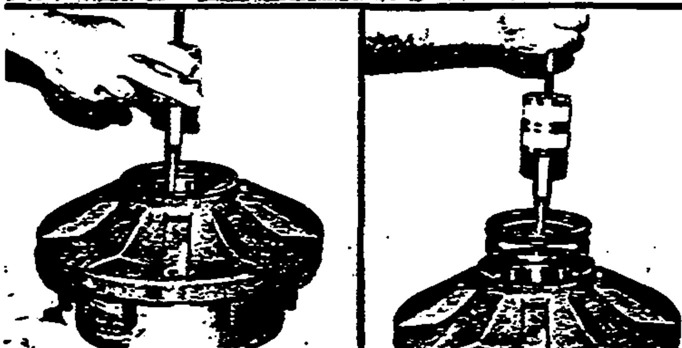
25. Remove spacer(16) from the top of spring(18).



26. Remove spring(18) from inside spindle(1A).

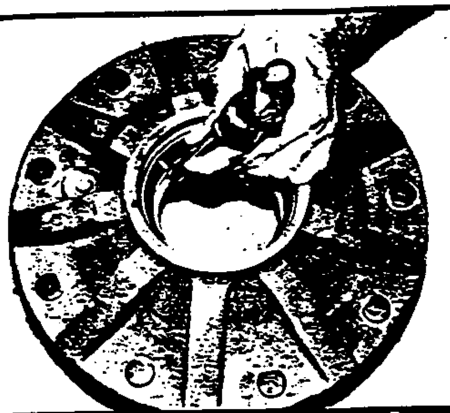


27. Remove seal boot(1Q) from the small diameter end of hub(1G).



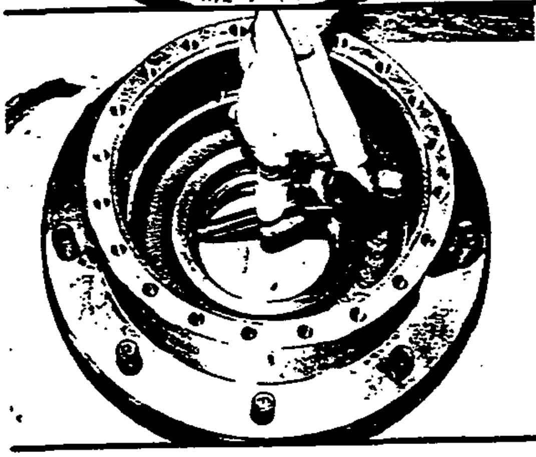
28. Set hub(1G) on its large diameter end. Using a slide hammer, remove seal(1B) and discard.

29. Lift bearing cone(1D) out of the small diameter end of hub(1G).



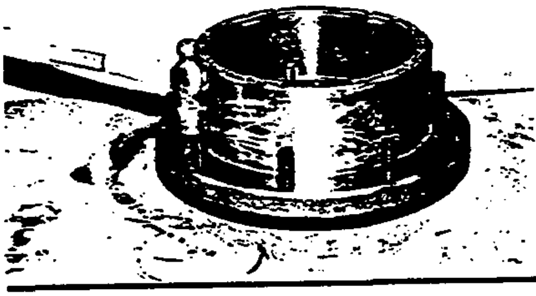
30. Using a soft punch and hammer, remove **bearing cup(1E)** from the large diameter end of **hub(1G)**.

NOTE: Be very careful not to strike the counterbore of the hub when using the punch.



31. Turn **hub(1G)** over so that it rests on its small diameter end. Using a soft punch and hammer, remove **bearing cup(1C)** from the small diameter end of the hub.

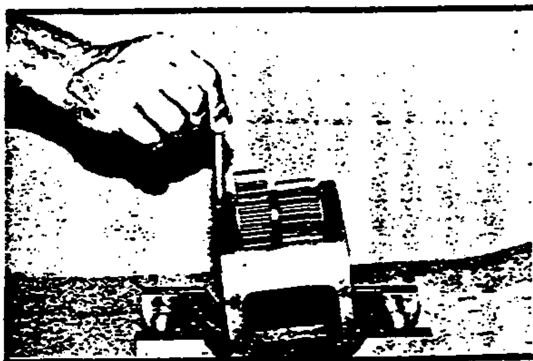
NOTE: Be very careful not to strike the counterbore of the hub when using the punch.



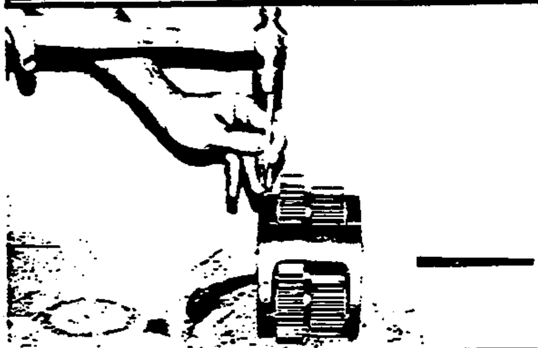
32. Hammer out the nine studs(1N).

33. At this point the main disassembly is complete.

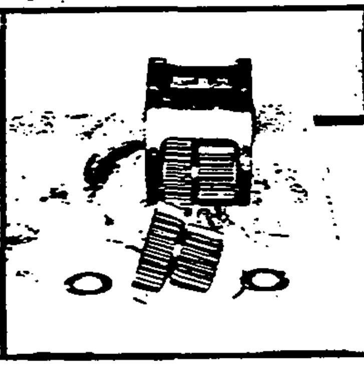
CARRIER DISASSEMBLY



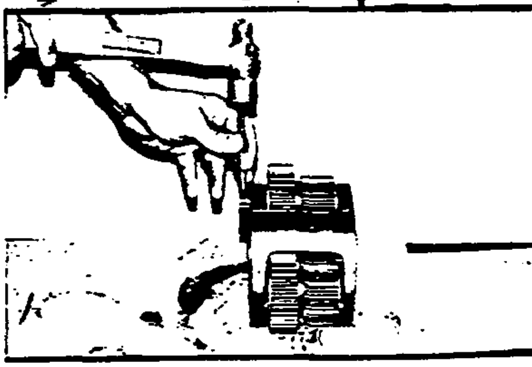
1. Locate roll pin(3G) which holds planet shaft(3E) in carrier housing(3A).



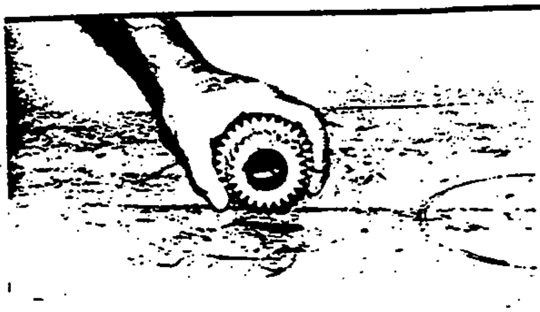
2. Drive the roll pin(3G) down into planet shaft(3E) until it bottoms against the carrier housing. If the roll pin is not completely driven into the planet shaft, damage to the carrier could occur when the shaft is removed.



3. Remove planet shaft(3E) from carrier housing(3A). The two thrust washers(3B) and cluster gear(3F) will slide off.



4. Drive roll pin(3G) out of planet shaft(3E). The roll pin should come out through the end of the roll pin hole that it originally went into.

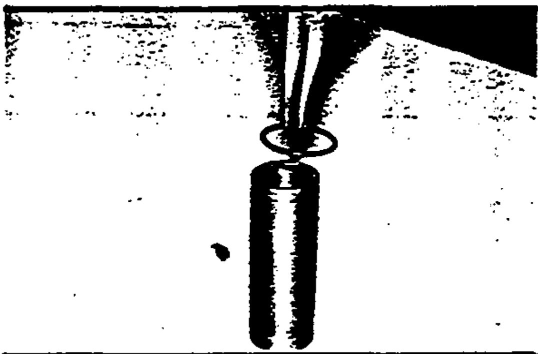


5. Remove needle rollers(3C) and spacer(3D) from inside cluster gear(3F).

6. Repeat steps 1-5 to remove the two remaining cluster gears.

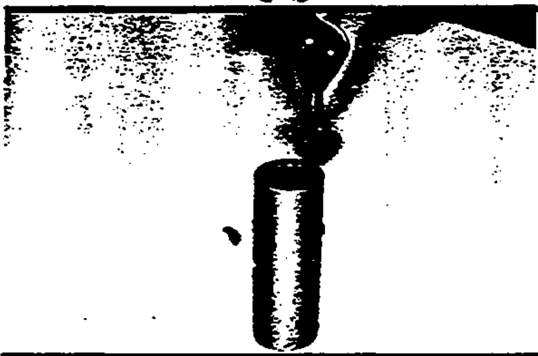
7. At this point the carrier disassembly is complete.

COUPLING DISASSEMBLY



1. Using retaining ring pliers, remove retaining ring(19C) from the groove around the outside of coupling(19).

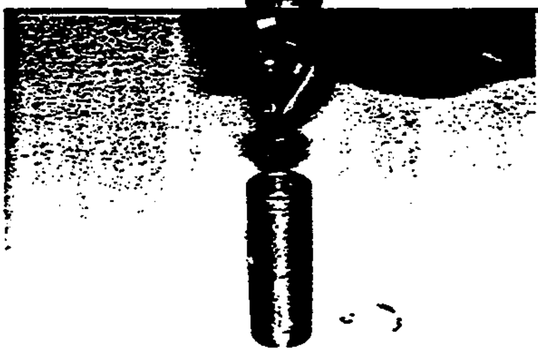
CAUTION: Safety glasses should be worn during this procedure.



2. Using a chisel and hammer make a break in one of the two retaining rings(19B) inside coupling(19A). Remove the retaining ring and discard.

CAUTION: Safety glasses should be worn during this procedure.

3. Remove anti-disengage spacer(19D) from the inside of coupling(19A).

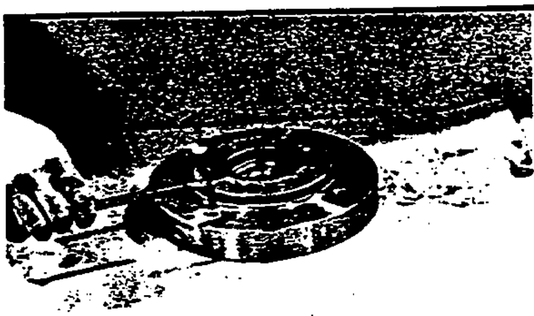


4. Using the same procedure in step 2, remove the remaining retaining ring(19B) from the inside of coupling(19A).

CAUTION: Safety glasses should be worn during this procedure.

5. At this point the coupling disassembly is complete.

COVER DISASSEMBLY

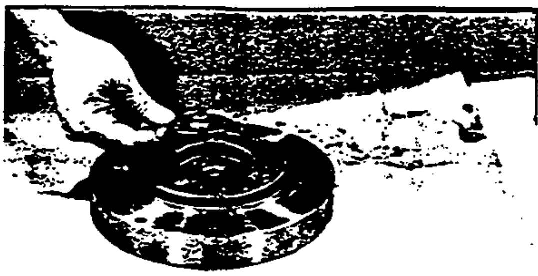


1. Remove pipe plugs(6H) from the two pipe plug holes in cover(6A) if they have not already been removed.

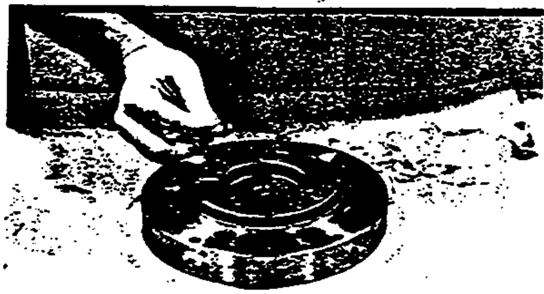
2. Set cover(6A) onto your work surface so that its disconnect cap faces down. Remove "O" ring(5) from the counterbore near the outside edge of the cover. Discard the "O" ring.

3. Remove thrust washer(11) from the counterbore near the center of cover(6A).

4. Turn cover(6A) over so that its disconnect cap faces up. Remove the two bolts(6C) that hold disconnect cap(6D) in place.



5. Remove disconnect cap(6D) from cover(6A).



6. Remove the two remaining bolts(6C) that hold cover cap(6B) in place.

7. Remove cover cap(6B) from cover(6A).

8. Remove disconnect rod(6E) from cover cap(6B).

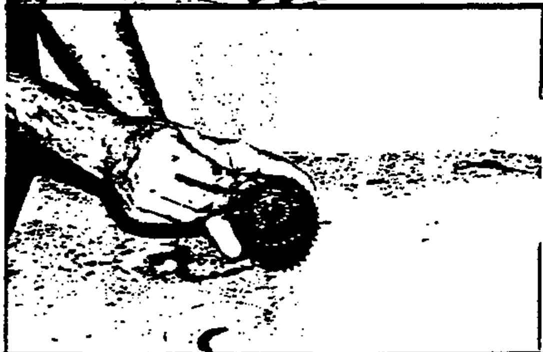
9. Remove "O" ring(6F) from the groove around the inside of cover cap(6B).

10. Remove "O" ring(6G) from around the outside of cover cap(6B) and discard.

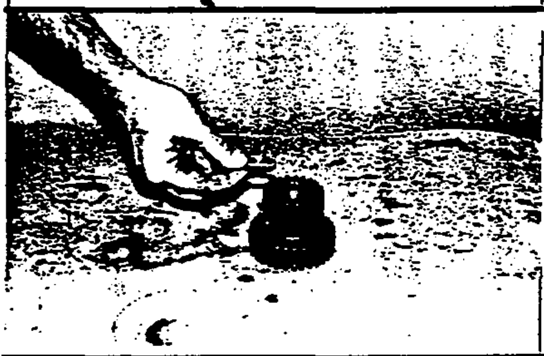
11. At this point the cover disassembly is complete.

CARRIER SUB-ASSEMBLY

1. Apply grease to the inside of one cluster gear(3F).



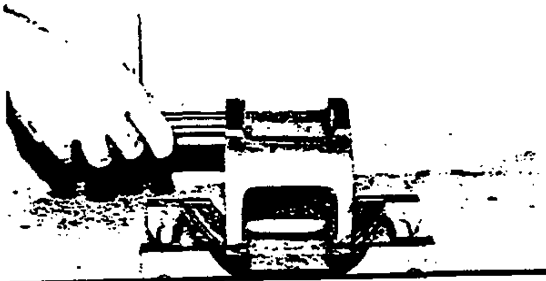
2. Line one half of cluster gear(3F) with 19 needle rollers(3C).



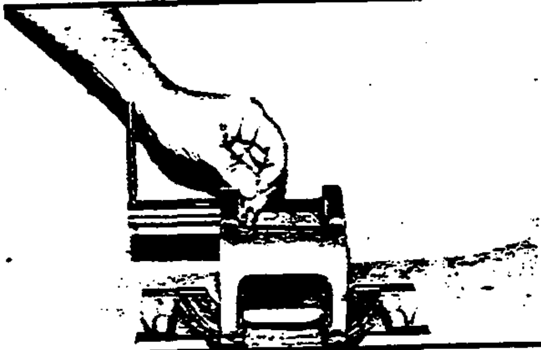
3. Place one spacer(3D) inside cluster gear(3F) so that it rests on top of the needle rollers(3C).

4. Line the remaining half of cluster gear(3F) with 19 needle rollers(3C).

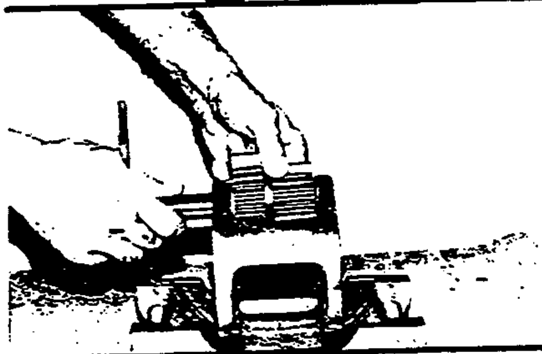
5. Stand carrier housing(3A) in an upright position.



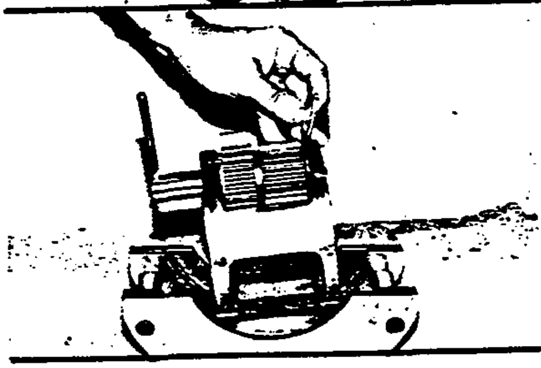
6. Insert a **planet shaft(3E)** into one of the planet shaft holes which has a roll pin hole on carrier housing(3A). The end of the planet shaft that does not have the roll pin hole should be inserted into the carrier housing first.



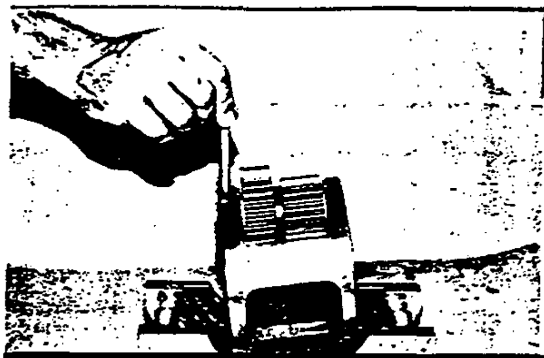
7. Place one **thrust washer(3B)** onto the end of **planet shaft(3E)** which has been inserted through the planet shaft hole. Notice that the thrust washer has a tang on it. The tang should point straight up so as to fit in the slot on the inside edge of the planet shaft hole.



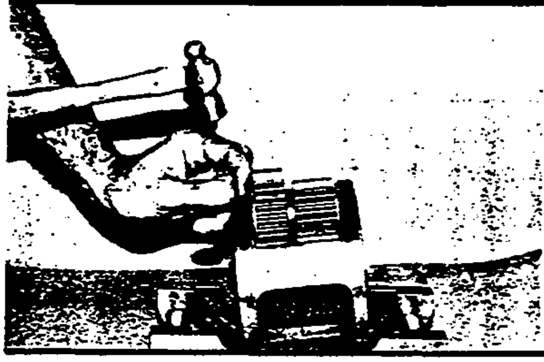
8. Following the thrust washer, place **cluster gear(3F)**, with needle rollers, onto **planet shaft(3E)**. The large diameter end of the cluster gear should go onto the shaft first.



9. Following the cluster gear, place one more **thrust washer(3B)** onto **planet shaft(3E)**. Align the thrust washer in the same manner described in step 7.

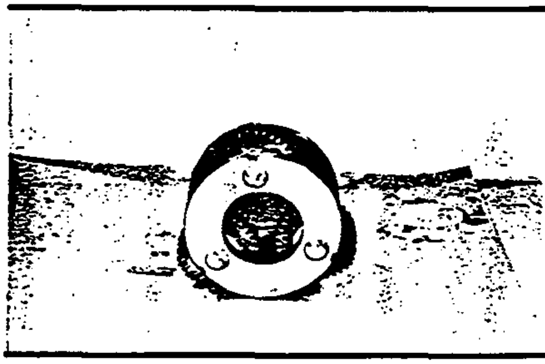


10. Now insert planet shaft(3E) through the opposite planet shaft hole on carrier housing(3A). Use an alignment punch or similar tool to align the roll pin holes on carrier housing(3A) and planet shaft(3E).



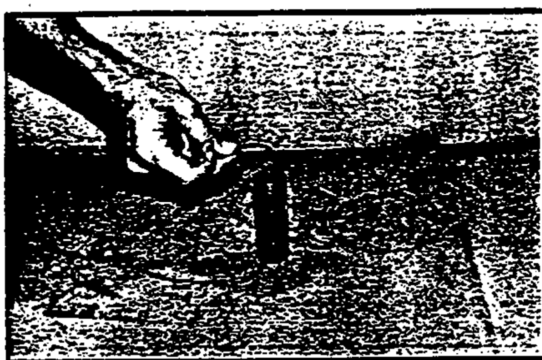
11. Drive roll pin(3G) down into the aligned roll pin holes.

12. Repeat the procedure in steps 1-11 for the installation of the two remaining cluster gears(3F).



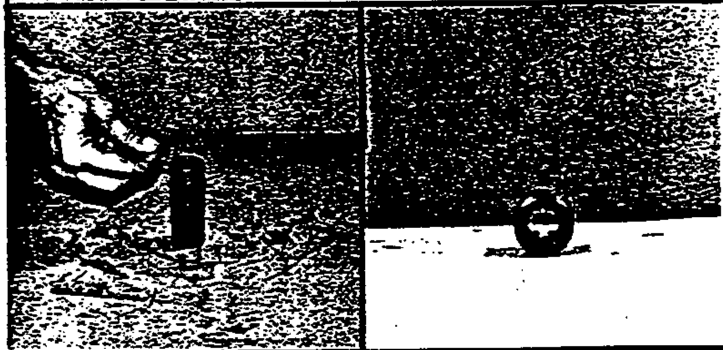
13. At this point the carrier sub-assembly is complete.

COUPLING SUB-ASSEMBLY



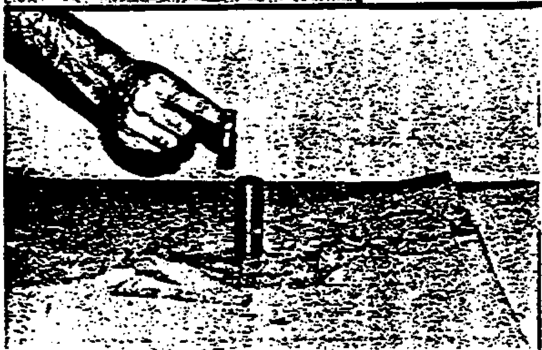
1. Using retaining ring pliers, insert retaining ring(19C) into the groove around the outside of coupling(19A).

CAUTION: Safety glasses should be worn during this procedure.

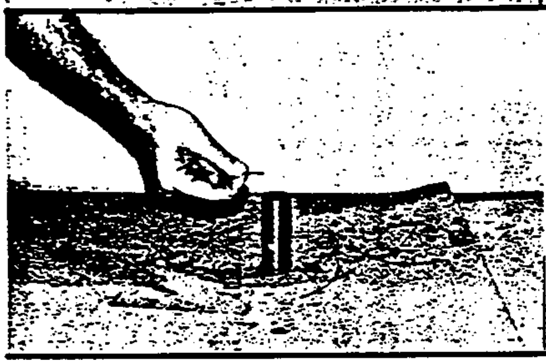


2. Set coupling(19A) on your work surface so that the outer retaining ring is located at the top of the coupling. Start one half of retaining ring(19B) into the inside groove located closest to the outer retaining ring. Use a punch to seat the other half of retaining ring(19B).

CAUTION: Safety glasses should be worn during this procedure.



3. Turn coupling(19A) over so that the outer retaining ring is located at the bottom of the coupling. Insert anti-disengage spacer(19D) into coupling(19A) so that it rests on top of the inner retaining ring.



4. Start one half of the other retaining ring(19B) into the remaining groove inside coupling (19A). Use a punch to seat the other half of the retaining ring.

CAUTION: Safety glasses should be worn during this procedure.

5. At this point the coupling sub-assembly is complete.

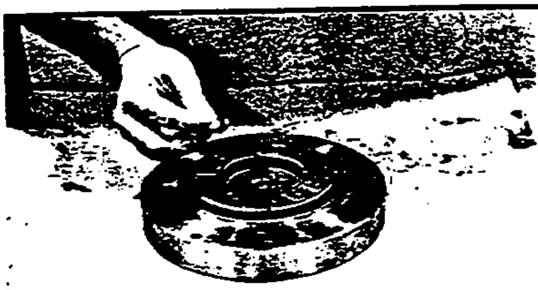
COVER SUB-ASSEMBLY

1. Place "O" ring(6G) onto cover cap(6B) so that it rests against the flange of the cover cap.

2. Place "O" ring(6F) into the groove inside cover cap(6B).

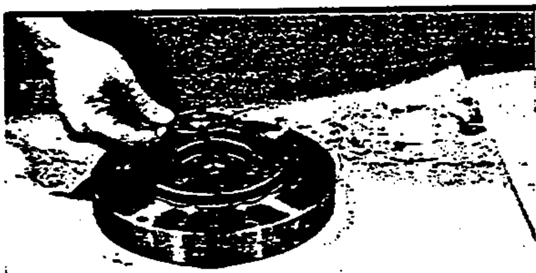
3. Insert disconnect rod(6E) into cover cap(6B).

4. Place cover cap(6B) into cover(6).



5. Place two of the cover cap bolts(6C) into any two bolt holes that are located 180° apart on cover cap(6B) and tighten.

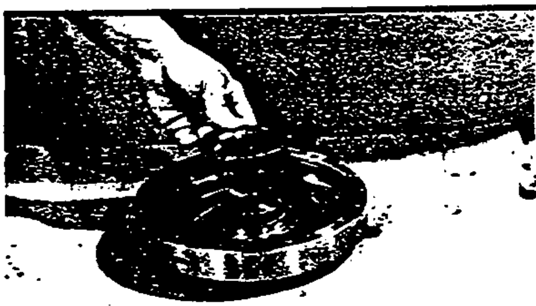
6. Using a torque wrench, apply 70-80 in.-lbs. of torque to both bolts(6C).



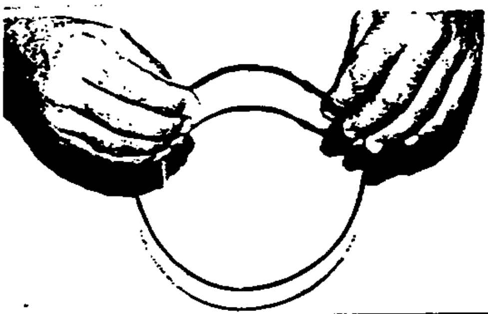
7. With large diameter end down, place disconnect cap(6D) onto cover cap(6B).

8. Place the two remaining bolts(6C) into the bolt holes on disconnect cap(6D) and tighten.

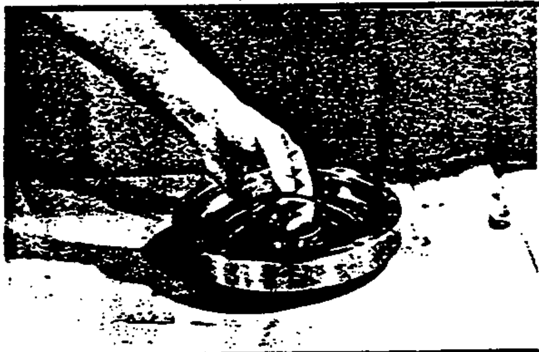
9. Using a torque wrench, apply a torque of 70-80 in.-lbs. to both bolts.



10. Grease one side of thrust washer(11) and place it greased side down over the counterbore in cover(6).

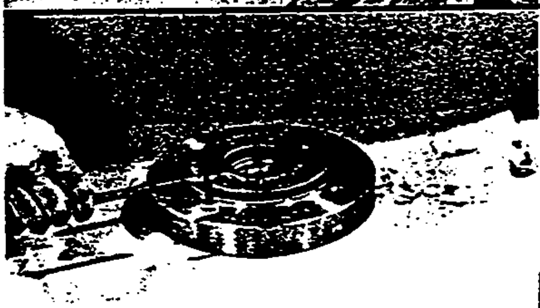


11. Grease "O" ring(5).



12. Place "O" ring(5) into the counterbore in cover(6A).

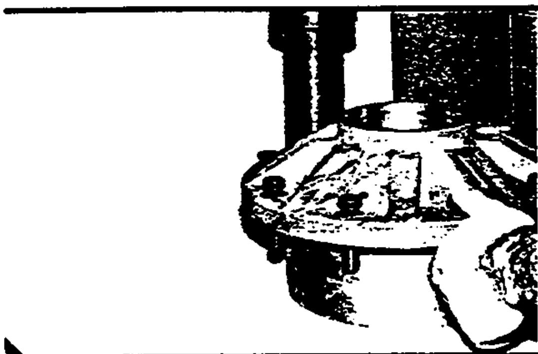
13. Apply a coat of "Never-Seize" to pipe plugs(6H).



14. Tighten pipe plugs(6H) into the two pipe plug holes in cover(6A).

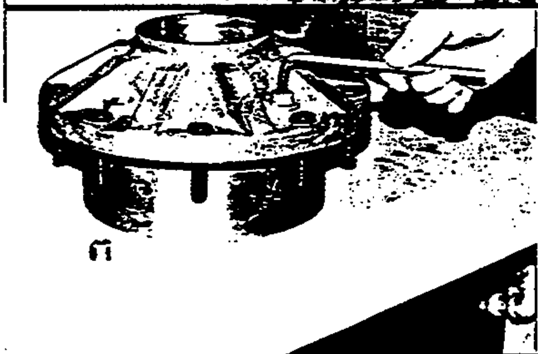
15. At this point the cover sub-assembly is complete.

HUB-SPINDLE SUB-ASSEMBLY

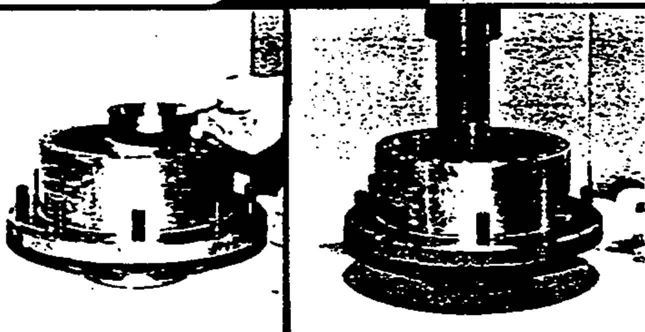


1. Place hub(1G) onto its large diameter end. Using a stud pressing fixture (tool no. T-157630), press the 9 studs(1N) into the stud holes in hub(1G).

2. Apply a light coat of "Never-Seize" to the two magnetic pipe plugs(1K).

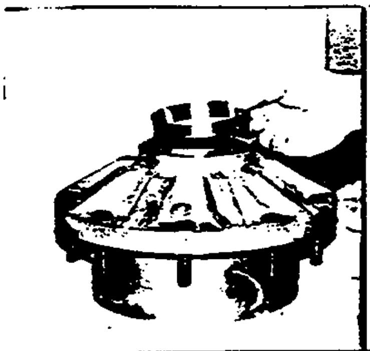
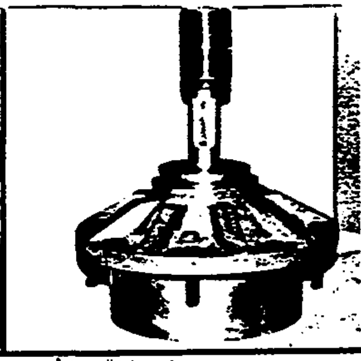


3. Tighten pipe plugs(1K) into the two pipe plug holes in hub(1G).



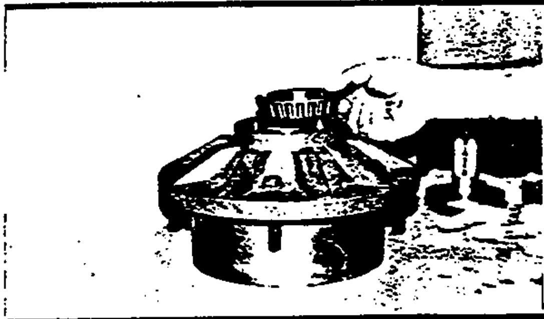
4. Place hub(1G) on its small diameter end. Using a bearing cup pressing fixture (tool no.T-146844), press bearing cup(1E) down into the large diameter end of hub(1G).

NOTE: Make sure that the cup sits square with the counterbore before pressing.

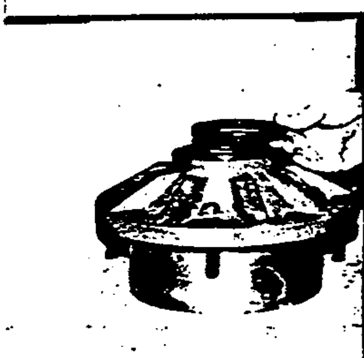
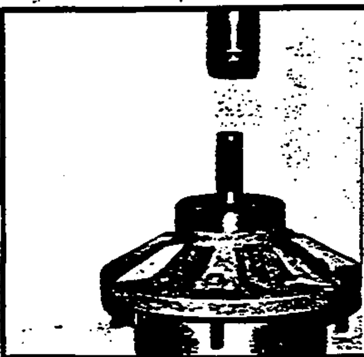



5. Turn **hub(1G)** over so that it rests on its large diameter end. Using a bearing cup pressing fixture (tool no. T-148912), press **bearing cup(1C)** into the small diameter end of **hub(1G)**.

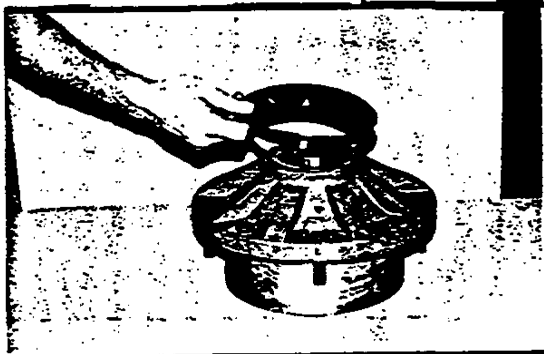
NOTE: Make sure that the cup sits square with the counterbore before pressing.



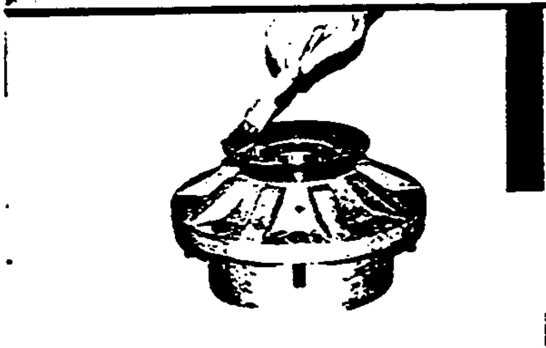
6. Place **bearing cone(1D)** into **bearing cup(1C)**.

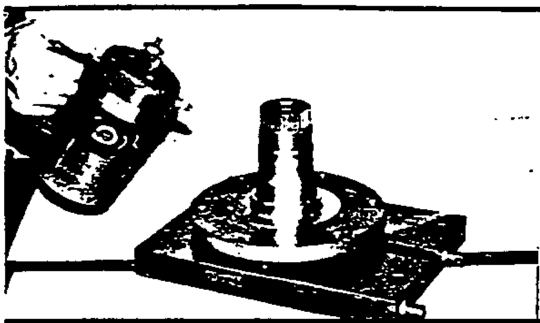
7. Using a seal pressing fixture (tool no. T-122937), press **seal(1B)** into the small diameter end of **hub(1G)**. Part of the seal will remain slightly above the hub after pressing.



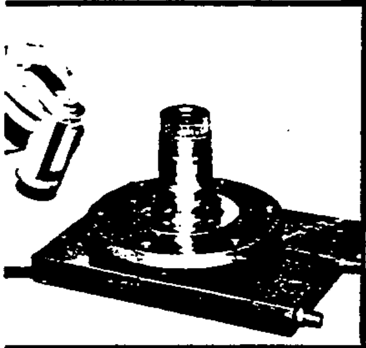
8. Place **seal boot(1Q)** over the small diameter end of **hub(1G)**..

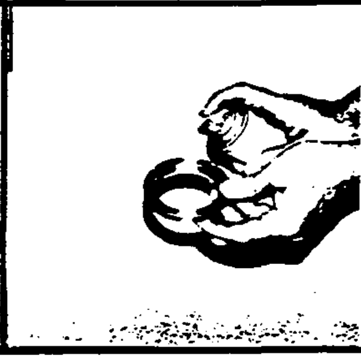


9. Apply a liberal coat of grease to the bottom of **seal boot(1Q)**.

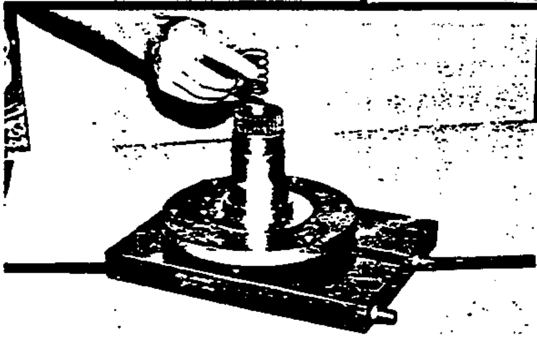


10. Spray spindle(1A) with oil.

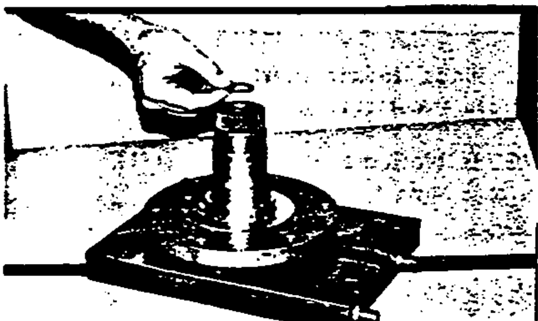




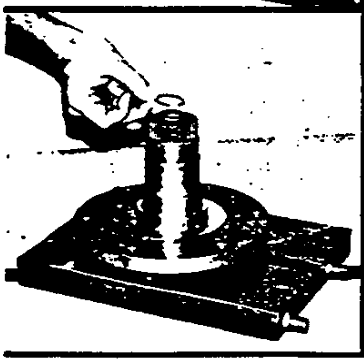
11. Spray Locquic Primer T on spindle(1A) and Locknut(1J). Allow two minutes drying time.

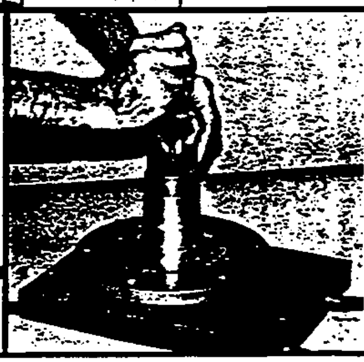


12. Insert spring(18) into the counterbore of spindle(1A).



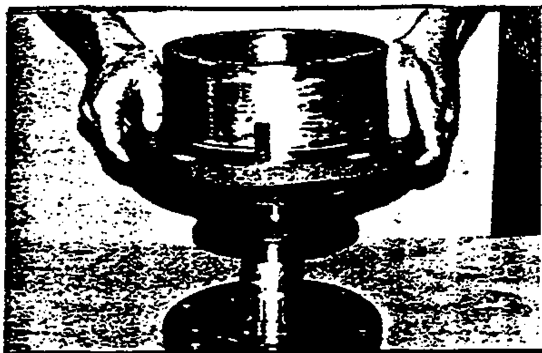
13. Place spacer(16) on top of spring(18).



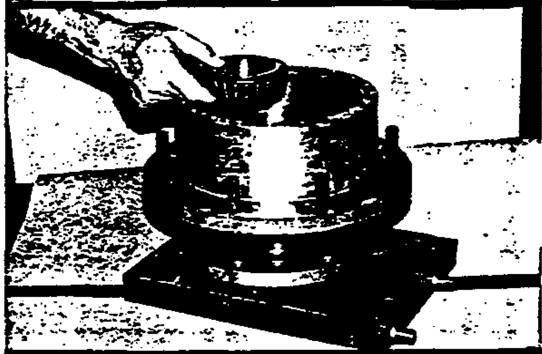


14. Using retaining ring pliers, insert retaining ring(17) into the groove inside spindle(1A) by compressing spacer(16) and spring(18) together.

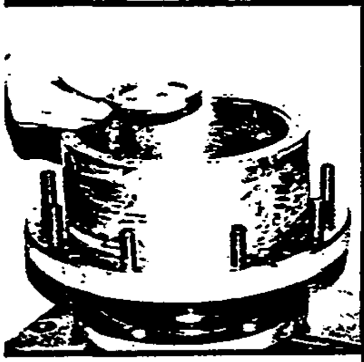
CAUTION: Safety glasses should be worn during this procedure.

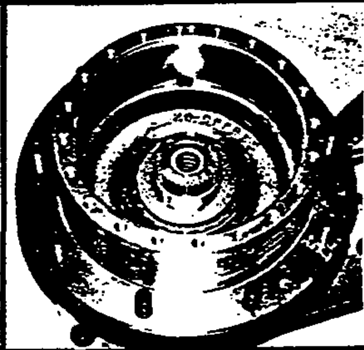


15. Lower hub(1G) onto spindle(1A).

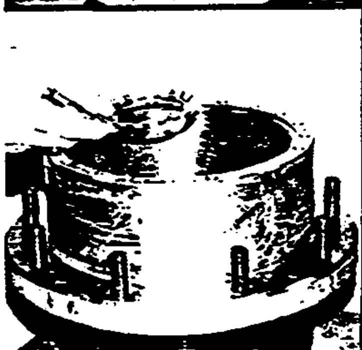


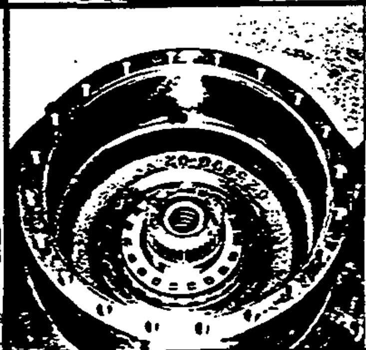
16. Place bearing cone(1F) onto spindle(1A).





17. Place tanged washer(1H) on top of bearing cone(1F).



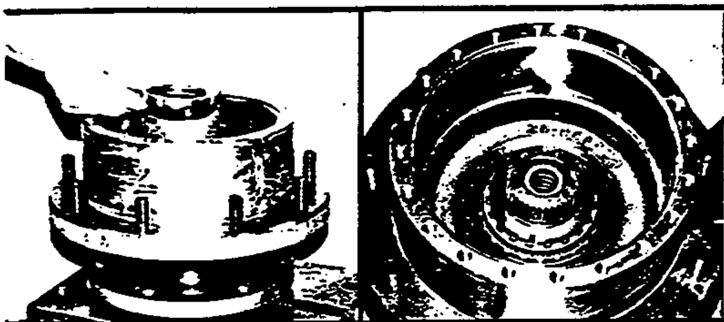


18. Place lockwasher(1I) on top of tanged washer(1H).

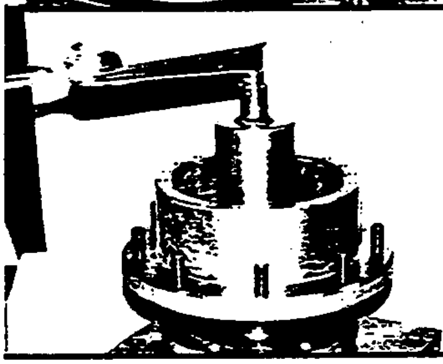
NOTE: Notice that lockwasher(1I) has tangs and tanged washer(1H) does not.

19. Apply Loctite 277 to the second screw thread from the bottom of locknut(1J). The bottom of locknut(1J) has a chamfered or sloped edge.

NOTE: Loctite 277 is an anaerobic adhesive. Once it has been removed from contact with the air, it sets. Therefore, once the locknut has been placed on the spindle it must be tightened and torqued immediately or the adhesive will make it difficult to turn.

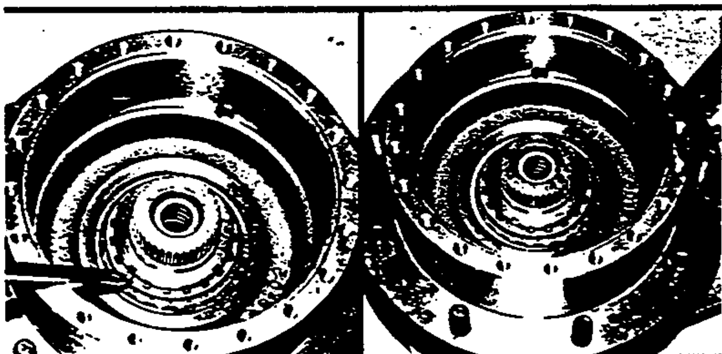


20. Place locknut(1J) onto spindle(1A). Use an N-12 locknut wrench (tool no. T-136699) to tighten the locknut.

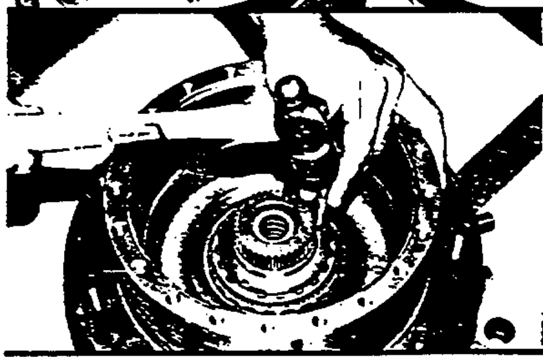


21. Using a torque wrench, apply 50 ft.-lbs. of torque to locknut(1J) then rotate the hub in both clockwise and counterclockwise directions. Repeat the procedure in this step two more times.

NOTE: One tang on lockwasher(1J) must line up with one notch on locknut(1J). If this is not the case, apply sufficient <u>increased</u> torque until one tang and notch are aligned. <u>Never loosen the locknut</u>.



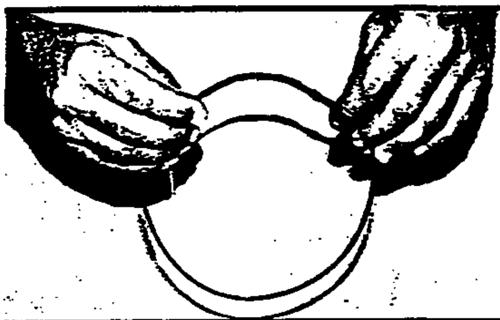
22. Bend the aligned tang on lockwasher(1I) up into the notch on locknut(1J).



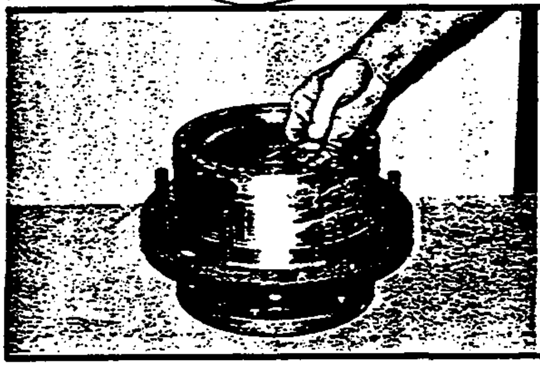
23. Using a center punch and hammer, stake locknut(1J) at four equally spaced points at a distance of 1/8 in. from the inside edge of the locknut.

24. At this point the hub-spindle sub-assembly is complete.

MAIN ASSEMBLY

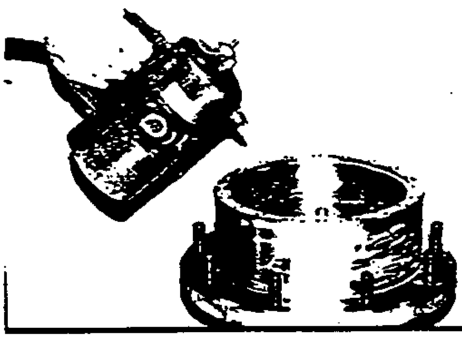


1. Grease "O" ring(5).

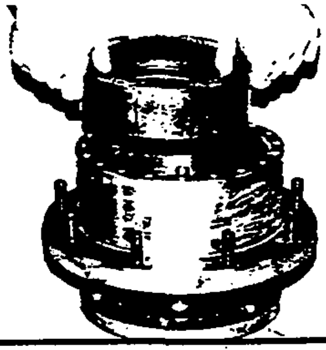


2. Place "O" ring(5) into the counterbore of hub(1G).

NOTE: "O" rings may be stretched to fit counterbore. If an "O" ring has been stretched too much, simply squeeze the "O" ring together bit by bit as you place it around the counterbore. It can be made to fit exactly.

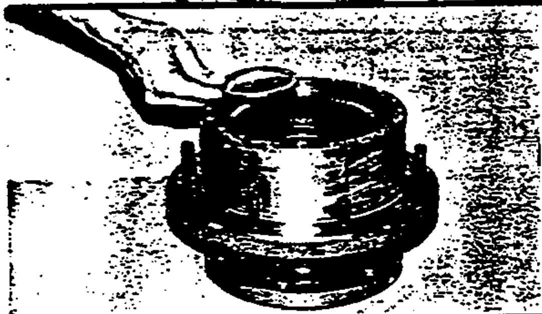


3. Oil all exposed surfaces inside hub(1G).

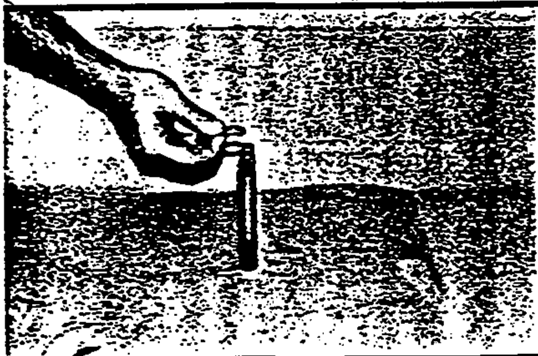


4. Place internal gear(2) into hub(1G) so that its internal splines mesh with the external splines of spindle(1A).

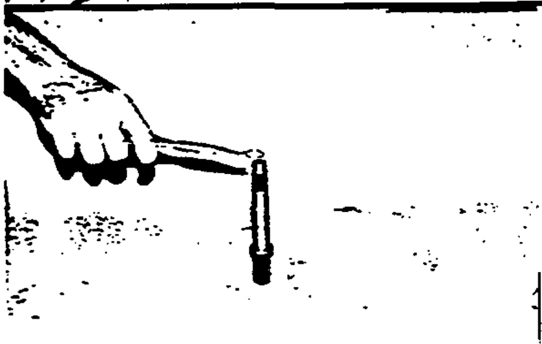
5. Oil internal gear(2).



6. Place thrust washer(11) onto spindle(1A) so that it rests on the bottom of internal gear(2).

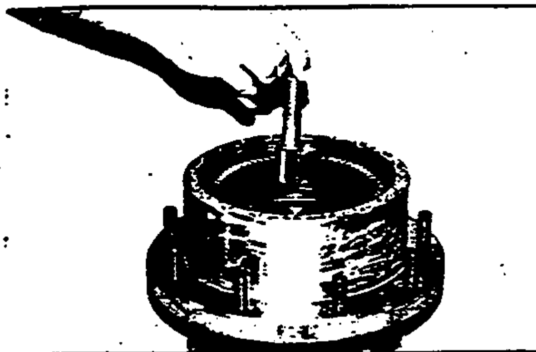


7. Place washer(15) onto input shaft(7).

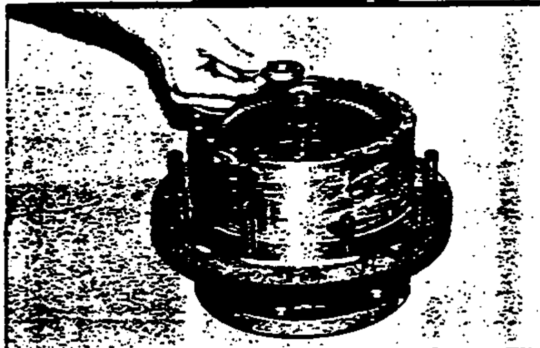


8. Using retaining ring pliers, insert retaining ring(14) into the groove on input shaft(7).

CAUTION: Safety glasses should be worn during this procedure.

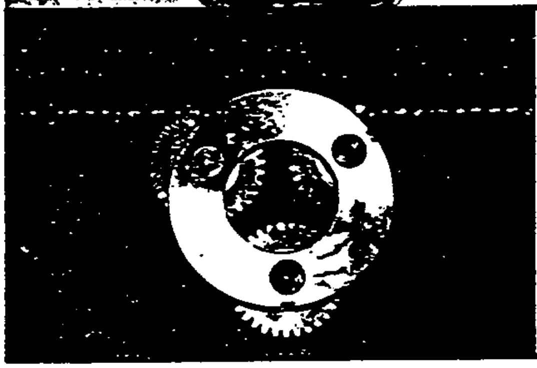


9. With large diameter splined end down, place input shaft(7) into spindle(1A) so that its retaining ring(14) rests against spacer(16).



10. Place thrust spacer(9) down over input shaft(7).

11. Place thrust spacer(10) down over input shaft(7) so that it rests on thrust spacer(9).



12. Set carrier sub-assembly(3) on your work surface so that the large diameter end of cluster gears(3F) face up. Locate the punch marks on the face of each cluster gear(3F) and position them all at 12 o'clock relative to yourself. See figure 1.

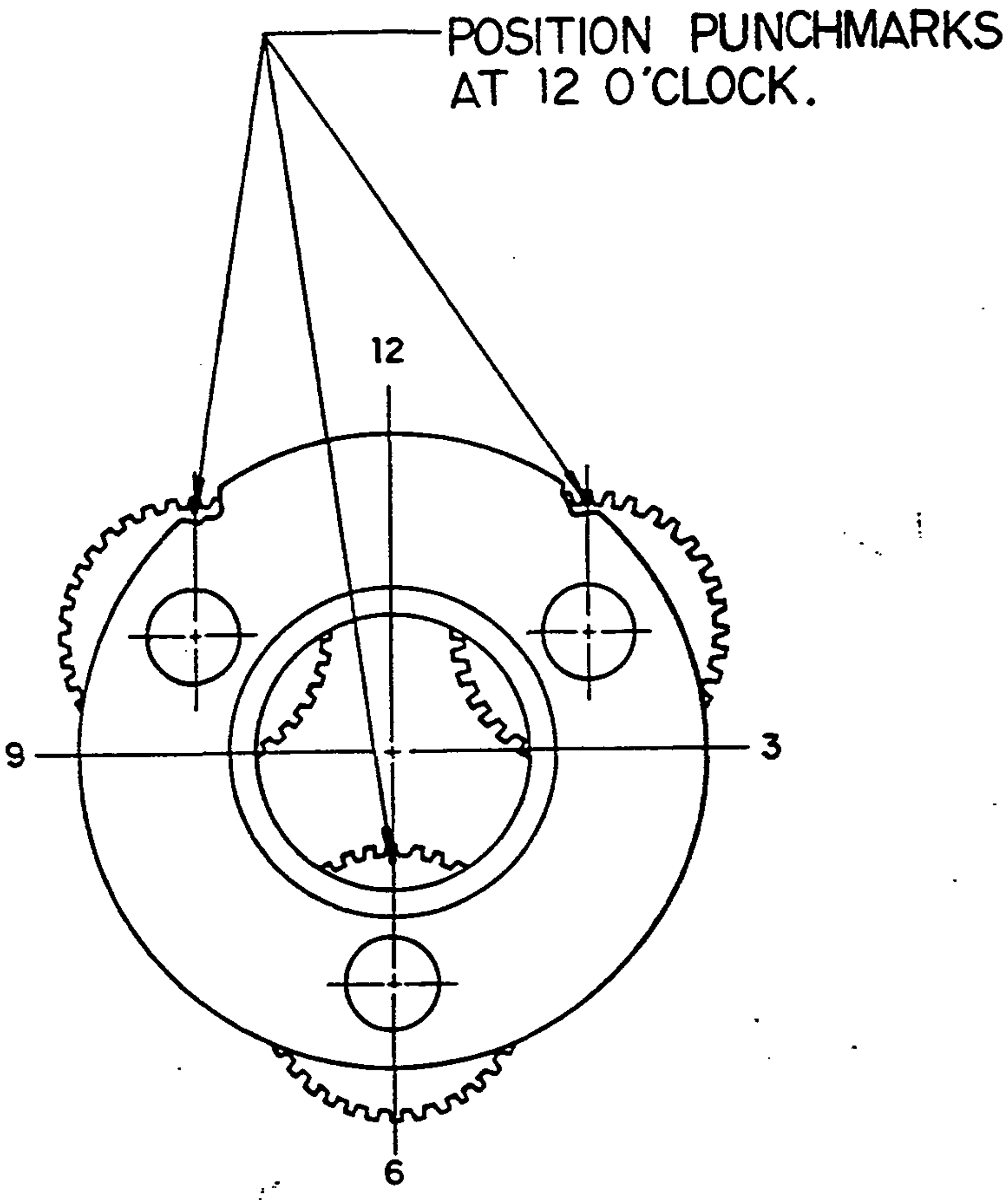
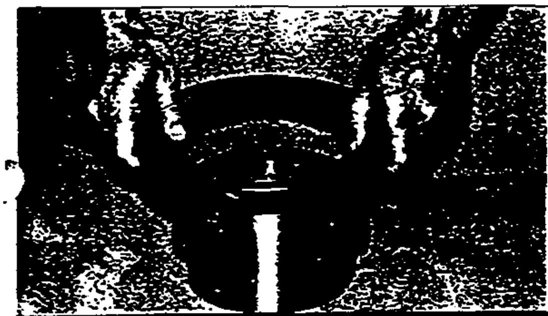
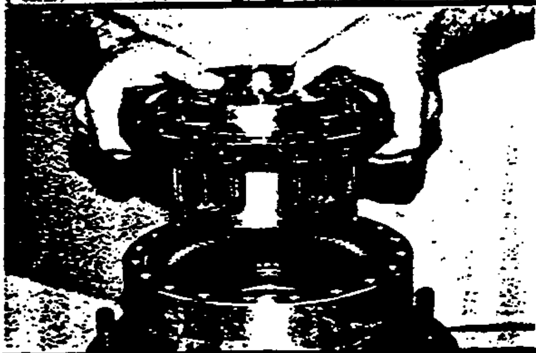


Figure 1.

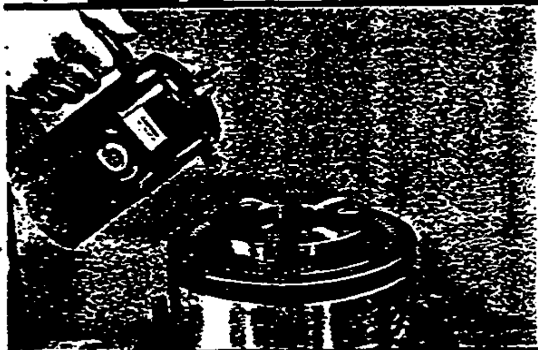


13. With squared shoulder side down, place ring gear(4) into mesh with the large diameter end of cluster gears(3F).

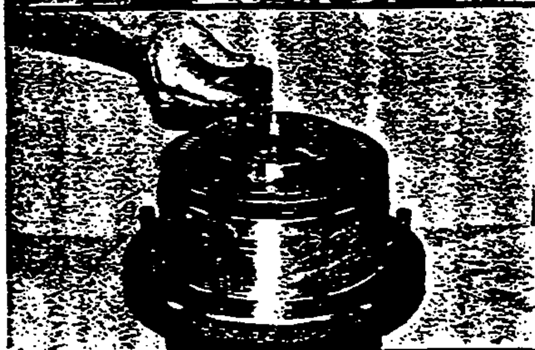
NOTE: Make sure that the punch marks remain in their correct positions when installing the ring gear.



14. Place carrier sub-assembly(3) and ring gear(4) together into mesh with internal gear(2). Align the bolt holes in ring gear(4) with the bolt holes in hub(1G).

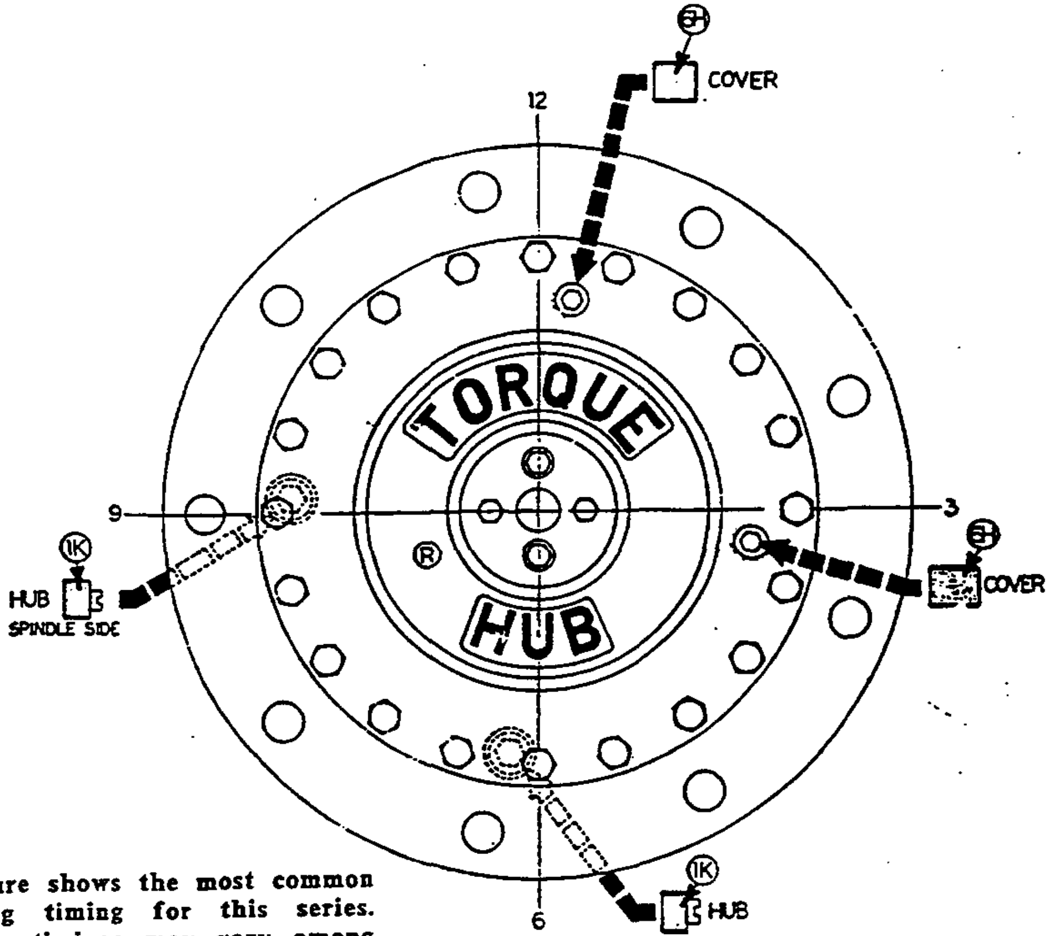


15. Oil all exposed surfaces inside hub(1G).



16. With counterbore end down, place input gear(8) into mesh with input shaft(7).

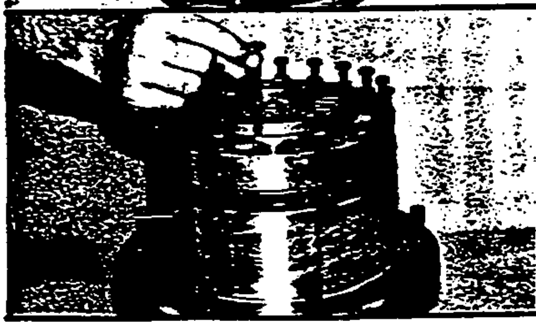
17. Place cover sub-assembly(6) onto ring gear(4). Make sure that the two pipe plug holes in the cover are in time with the two pipe plug holes in hub(1G) as shown in figure 2.



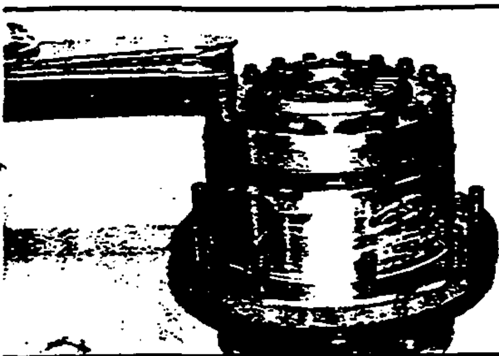
This figure shows the most common pipe plug timing for this series. Pipe plug timings may vary among units with different model numbers. Refer to an original assembly print for your particular unit to determine its correct pipe plug timing.

Figure 2.

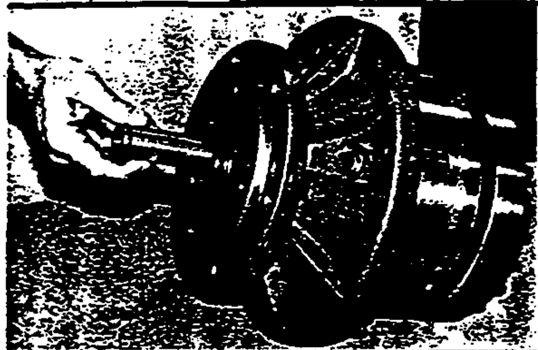
18. With flat sides down, place the 20 lockwashers(13) on top of the bolt holes in cover sub-assembly(6).



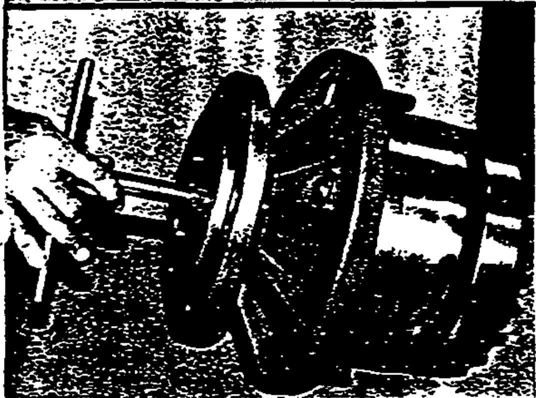
19. Place the 20 bolts(12) into cover sub-assembly(6) and tighten.



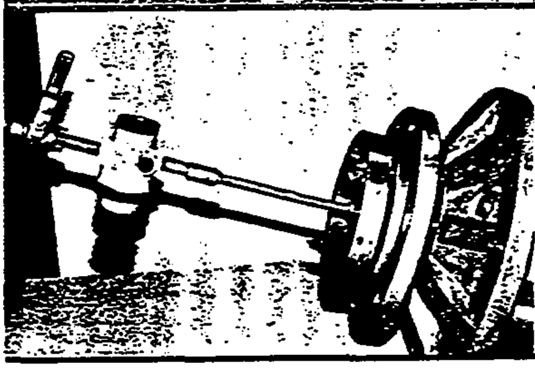
20. Apply 34-45 ft.-lbs. of torque to each bolt(12).



21. Set the unit on its side and insert coupling sub-assembly(19) into the counterbore of spindle(1A).



22. Roll test the unit in both clockwise and counterclockwise directions. Perform the same number of turns in each direction as the ratio of the unit. The ratio number is the same as the last two digits in the model number found on the ID tag of the unit.



23. Leak test the unit at a pressure of 5 psi for 2-3 minutes.

24. At this point the main assembly is complete.

TOOLING

The following specialized tools are used in the assembly of this unit. The tool diagrams included in this manual are intended for the customer who may wish to have a tool made. All tools exist as one piece and must be made from mild steel. All dimensions are given in inches.

OPTIONAL: In order to improve tool life, tools may be carborized and hardened. If this is done, however, the tools must be ground on all surfaces labeled with a "G" on the tool diagram.

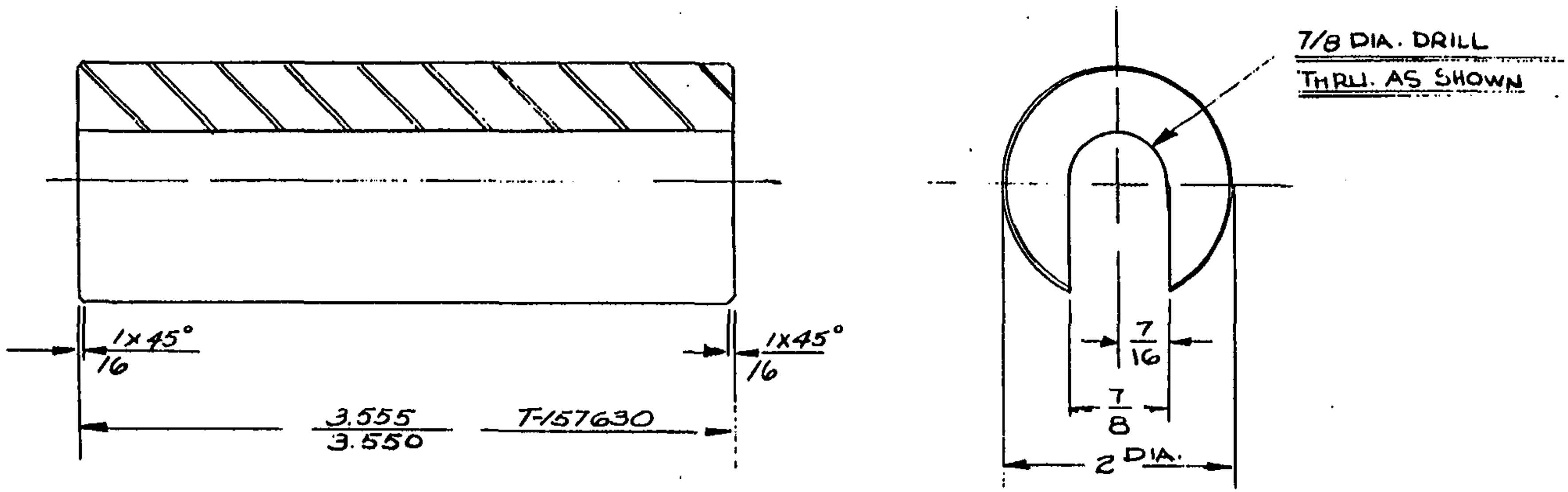
1. TOOL NO. T-157630
   STUD PRESSING FIXTURE

2. TOOL NO. T-146844
   BEARING CUP PRESSING FIXTURE for CUP(1E)

3. TOOL NO. T-148912
   BEARING CUP PRESSING FIXTURE for CUP(1C)

4. TOOL NO. T-122937
   SEAL PRESSING FIXTURE

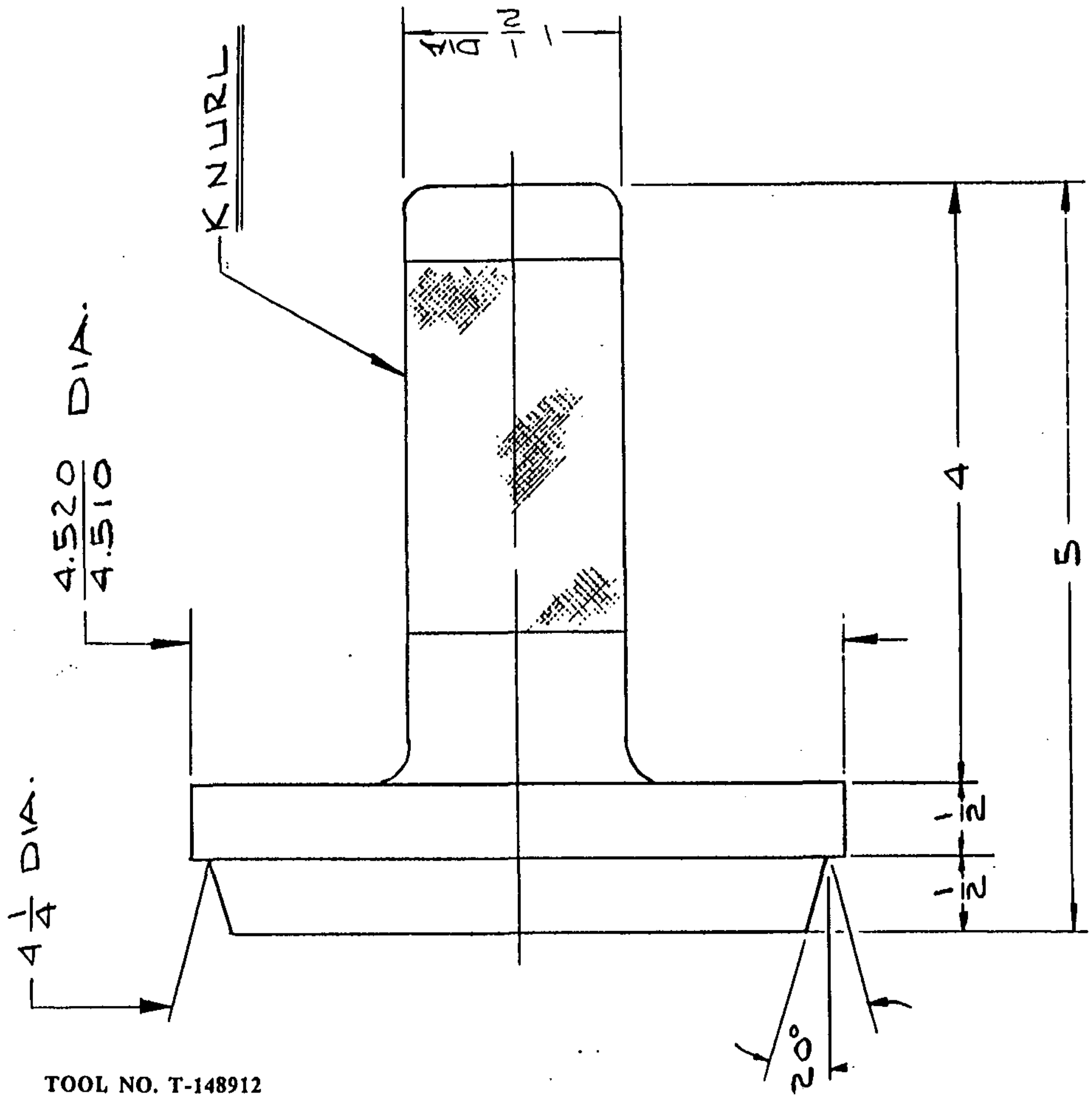
5. TOOL NO. T-136699
   N-12 LOCKNUT WRENCH



TOOL NO. T-157630

STUD PRESSING FIXTURE

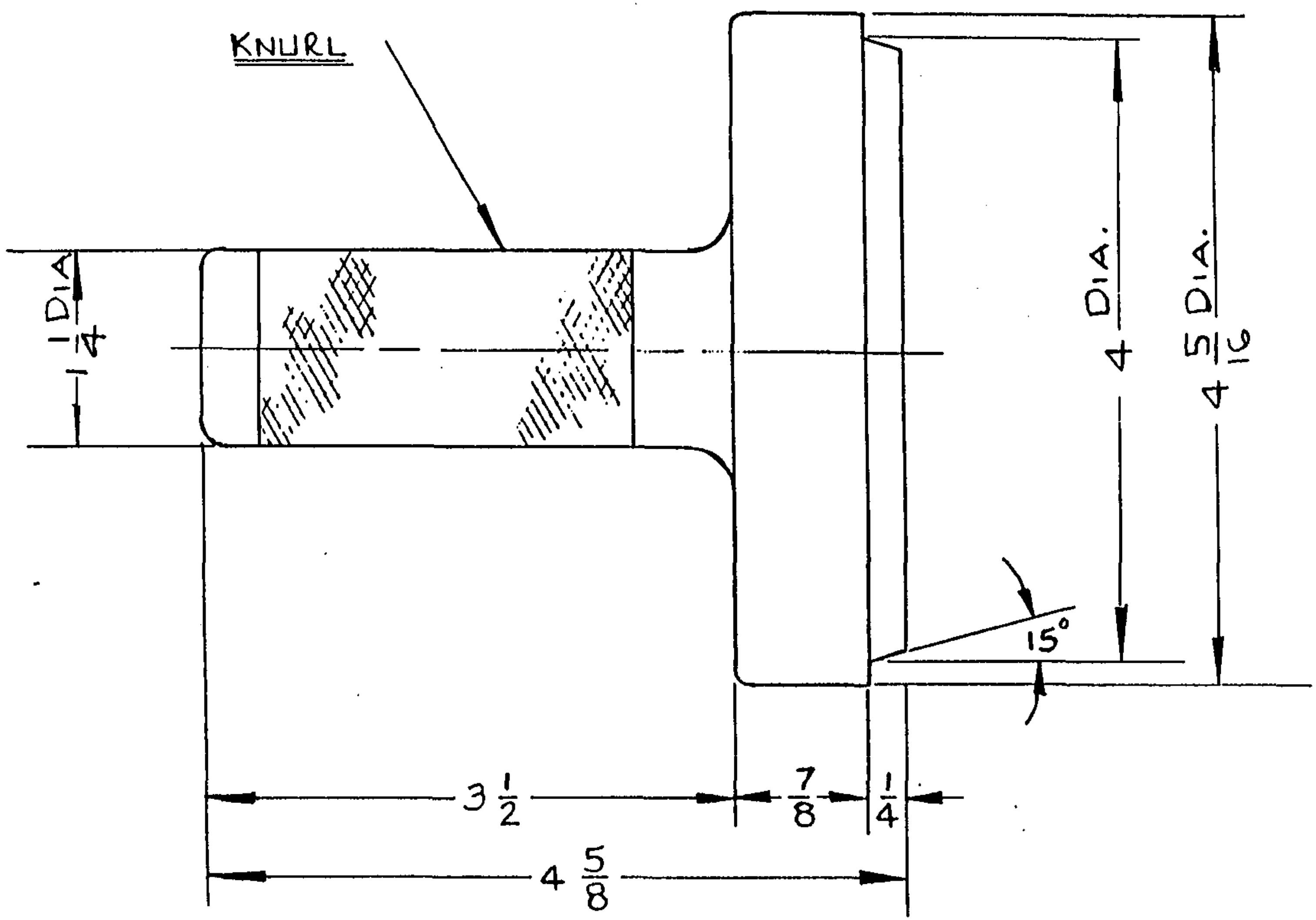
SCALE: 3/4



TOOL NO. T-148912

BEARING CUP PRESSING FIXTURE for CUP(1C)

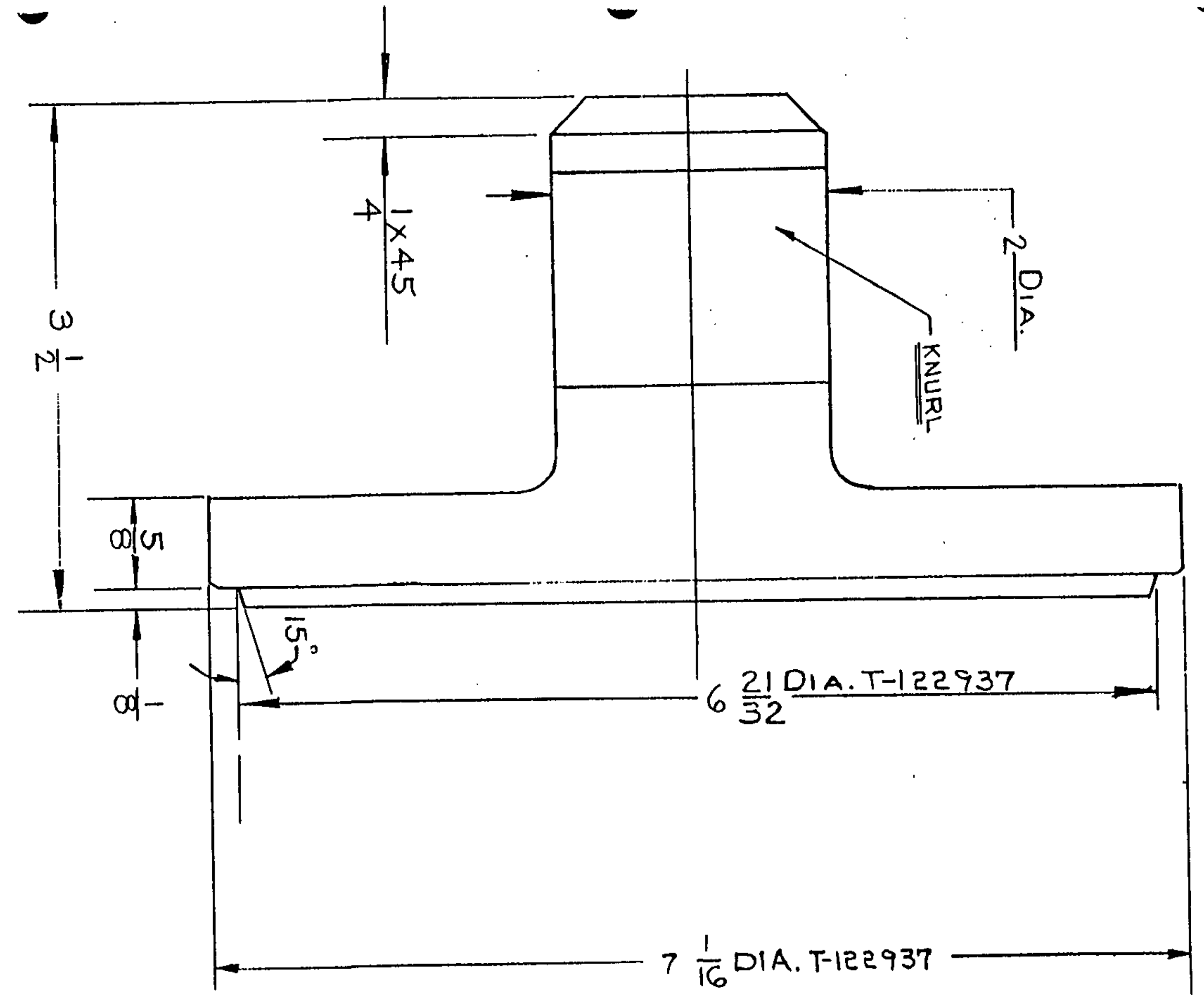
SCALE: FULL



TOOL NO. T-146844

SCALE: FULL

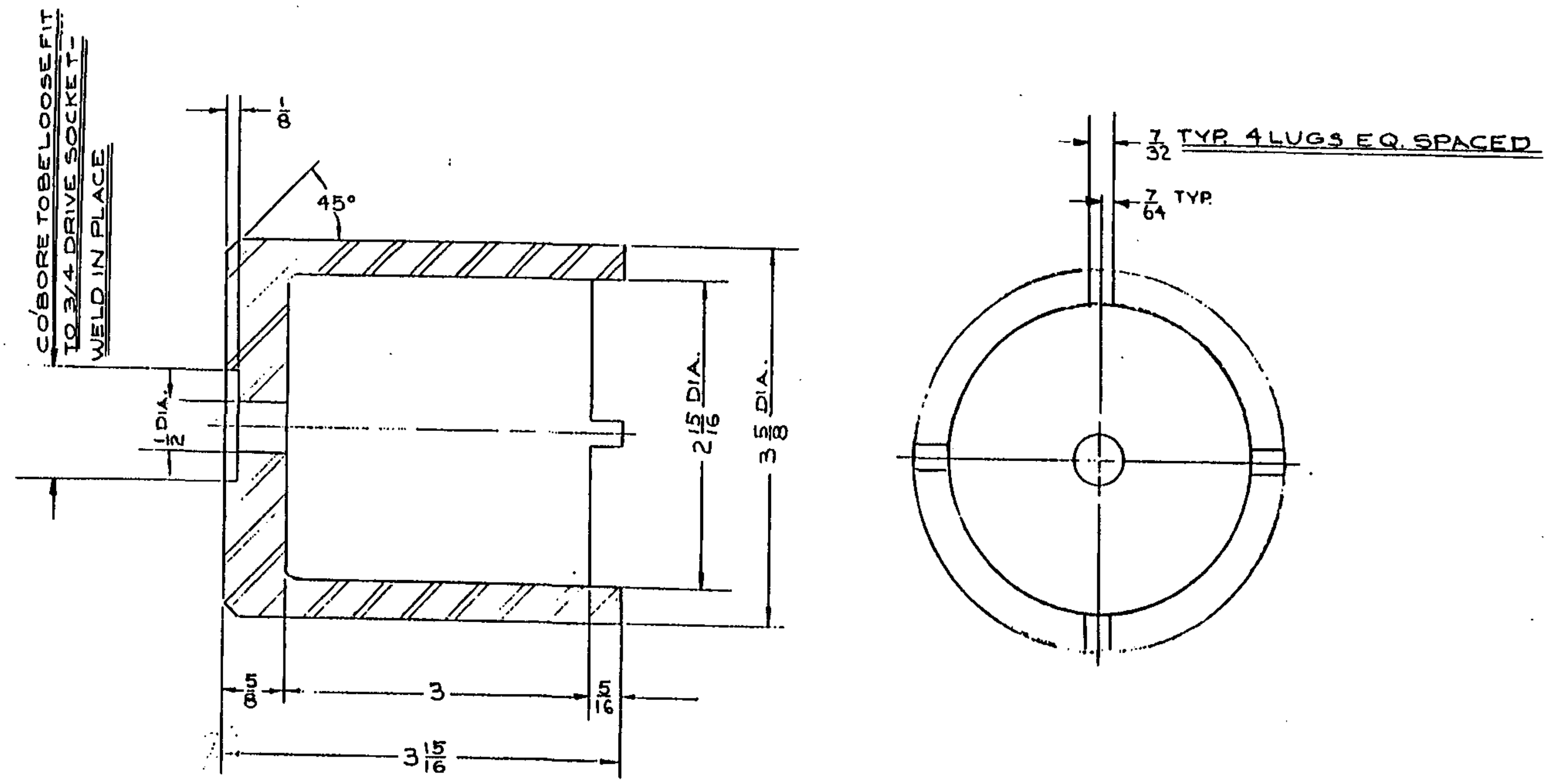
BEARING CUP PRESSING FIXTURE for CUP(1E)



TOOL NO. T-122937

SEAL PRESSING FIXTURE

SCALE: FULL

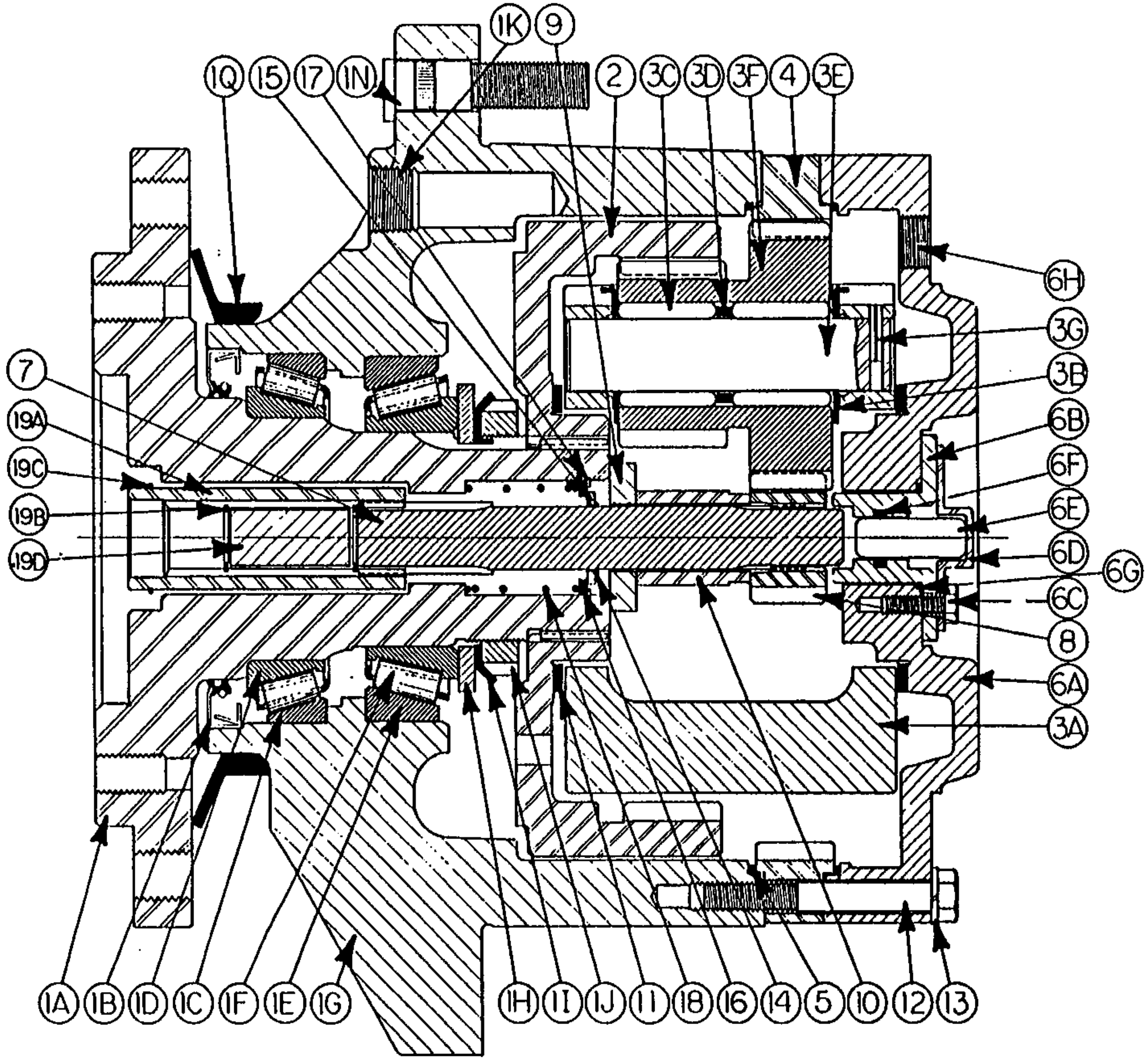


TOOL NO. T-136699

N-12 LOCKNUT WRENCH

SCALE: 2/3

USE 3/4 in. DRIVE SOCKET



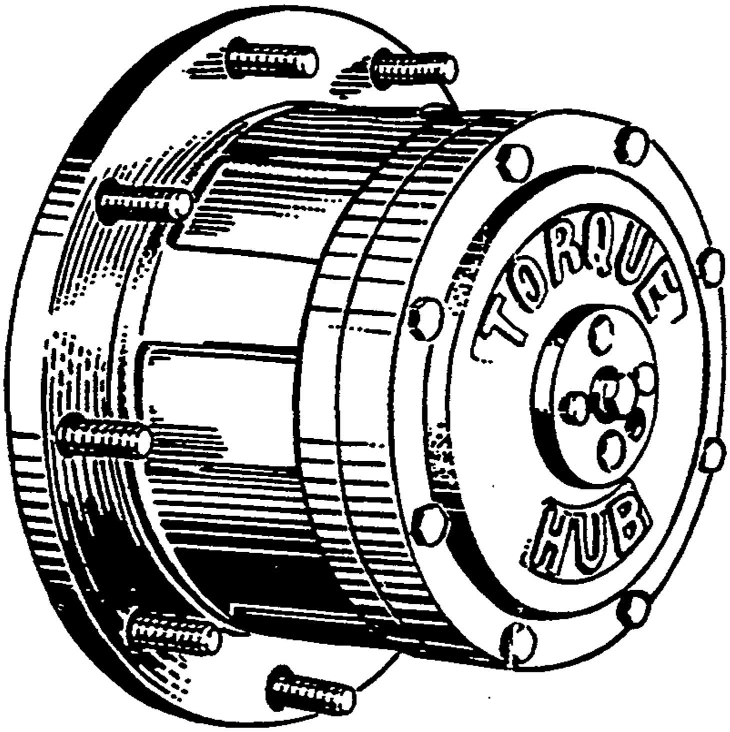
CROSS SECTIONAL VIEW of W2B

05-16-86 ASSEMBLY NO- W282F0337N (WHEEL DRIVE ASSEMBLY)

ITEM	PART NO.	QTY.	DESCRIPTION		STK FCT
1	W282F0	1	HUB-SPINDLE SUB-ASSY		
1A	2400702	1	SPINDLE	A	
**1B	1501308	1	SEAL	A	[illegible]
1C	1500815	1	BRG CUP(JLM714110)	A	[illegible]
1D	1500816	1	BRGCONE(JLM714149)	A	[illegible]
1E	2500803	1	BRG CUP (3920)	A	[illegible]
1F	2500804	1	BRG CONE (3984)	A	[illegible]
1G	2500602	1	HUB	A	[illegible]
1H	960301	1	TANGED WASHER	B	[illegible]
1I	9601H13	1	LOCKWASHER	B	[illegible]
1J	1980113	1	LOCKNUT	A	[illegible]
1K	950104	2	MAGNETIC PIPE PLUG	A	4
1N	97000F	9	STUD	B	9
2	2400003	1	INTERNAL GEAR	A	2
3	2200002	1	CARRIER SUB-ASSY		1
3A	2200501	1	CARRIER	A	1
3B	2200301	6	THRUST WASHER	A	18
3C	1200803	114	NEEDLE ROLLER	A	342
3D	2201001	3	SPACER	A	3
3E	2200101	3	PLANET SHAFT	A	9
3F	2300002	3	CLUSTER GEAR	A	6
3G	920002	3	ROLL PIN	A	3
4	2500076	1	RING GEAR	A	2
5	940021	2	O RING	B	10
6	2500401A	1	COVER SUB-ASSY		1
6A	2500401	1	COVER	A	1
6B	1900402	1	COVER CAP	A	1
6C	930004	4	BOLT	A	4
6D	1900401	1	DISCONNECT CAP	A	1
6E	1900101	1	DISCONNECT ROD	B	1
6F	940001	1	'O' RING	B	5
6G	940002	1	'O' RING	B	5
6H	950003	2	PIPE PLUG	B	4
6J	901201	1	ID PLATE	A	
6K	930301	4	DRIVE SCREW	A	
7	1100104	1	INPUT SHAFT	B	1
8	2100001	1	INPUT GEAR	A	2
9	2901007	1	THRUST SPACER	A	1
10	2901008	1	THRUST SPACER	A	1
11	3200301	2	THRUST WASHER	A	2
12	930103	20	BOLT	B	20
13	960008	20	LOCKWASHER	A	20
14	910007	1	RETAINING RING	B	5
15	2901006	1	WASHER	A	1
16	1901009	1	SPACER	A	1
17	910059	1	RETAINING RING	B	5
18	1901502	1	SPRING	A	1
19	2100206A	1	COUPLING SUB-ASSY		1
19A	2100206	1	COUPLING		2
19B	910043	2	RETAINING RING	A	10
19D	2101402	1	ANTI-DIS SPACER		1

*NOTE: AM1W20000 = Seal Kit

4



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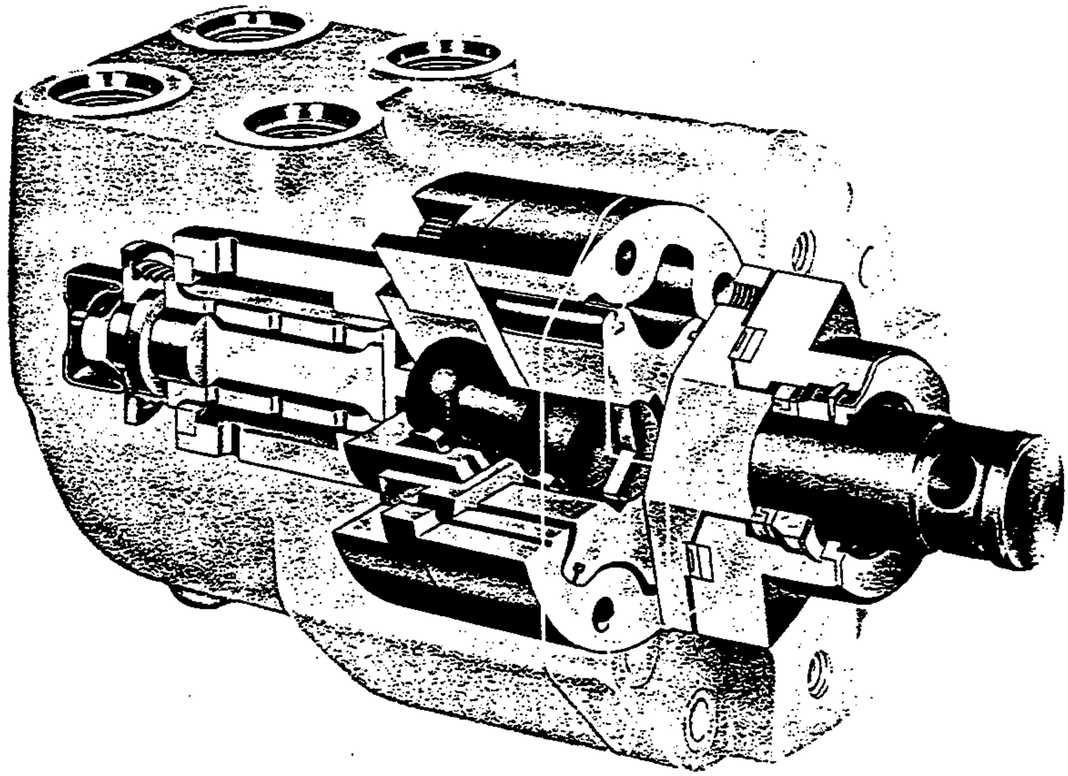
Hydraguide™

Hydrostatic Steering System

HGE Service Manual



HGE 16XXX.1275
620-0248

TRW
ROSS GEAR DIVISION

Hydraguide™

HGE Design Features

The model HGE Hydraguide™ power steering valve is Ross Gear's most recent addition to its series of hydrostatic steering units. The HGE combines several advanced features designed to meet industry's needs for improved steering of its construction, industrial, and agricultural vehicles.

For operation, the HGE system requires the following components:

- an engine-driven pump,
- a relief valve,
- a cylinder or cylinders,
- a reservoir and filter,
- suitable fluid lines or hoses, and
- the HGE hydrostatic unit.

The driver has power steering control at all times, so long as system components work together, system integrity is maintained, and adequate fluid is present. If there is a failure in the high-pressure circuit, a loss of power steering will result. The HGE, however, is designed to have some manual steering capability, depending on the installation. If you can't manually steer the vehicle without using extraordinary measures, such as leaving your seat, or pushing with your legs, don't try it. Repair the failure in the power circuit. Some vehicles may be impossible to steer manually because of their weight and size.

WARNING: SUCH EXTRAORDINARY MEASURES SHOULD NOT BE USED IN ATTEMPTING TO MANUALLY STEER THE VEHICLE, AS THEY MAY GENERATE FORCES IN EXCESS OF 125 FT. LBS., THEREBY DAMAGING THE UNIT INTERNALLY, WHICH COULD RESULT IN A COMPLETE LOSS OF STEERING.

Definitions

NOTE: **A NOTE provides key information to make a procedure easier or quicker to complete.**

CAUTION: **A CAUTION refers to procedures that must be followed to avoid damaging the HGE or other system components.**

WARNING: A WARNING REFERS TO PROCEDURES THAT MUST BE FOLLOWED FOR THE SAFETY OF THE VEHICLE DRIVER AND THE PERSON INSPECTING OR REPAIRING THE HGE.

Patents

Ross products and systems described in this manual are protected by one or more of the following United States patents: 3,895,888; 3,277,833; 3,918,856; and 3,931,776. In addition, patent applications have been filed in Australia, Brazil, Canada, Denmark, France, Italy, Japan, Sweden, the United Kingdom, and West Germany.

WARNING: ALL STEERING MECHANISMS ARE LIFE AND LIMB ITEMS. AS SUCH, IT IS IMPERATIVE THAT THE INSTRUCTIONS IN THIS BOOKLET ARE FOLLOWED TO THE LETTER. FAILURE TO OBSERVE THE PROCEDURES SET OUT IN THIS PAMPHLET MAY RESULT IN LOSS OF STEERING.

Table of Contents

Introduction

Service Manual for Model HGE

This service manual has one purpose: to guide you in maintaining, troubleshooting, and servicing the HGE Hydraguide power steering valve.

Material in this manual is organized so you can work on the HGE and get results without wasting time or creating confusion. To get these results, you should read this entire manual before you begin any work on the HGE.

The next section of this manual, Design and Operation, treats the major parts of the HGE and explains how they function together. The knowledge you acquire from reviewing this section should assist you in solving your steering problem.

This manual also contains troubleshooting information and checklists. With them, you can diagnose a steering problem without pulling the HGE off of the vehicle. If you must service the HGE, the checklists will help you to determine where the problem may be.

The three-column format of the Disassembly and Inspection, and Assembly sections will make it easier for you to conduct major work on the HGE. Column 1 gives a brief key for each procedure. Column 2 explains in detail the procedure you should follow. Column 3 illustrates this procedure with photographs. Pay special attention to the notes, cautions, and warnings.

As you gain experience in servicing the HGE, you may find that some information in this manual could be clearer or more complete. If so, let us know about it. Don't try to second guess the manual; if you are stuck, call us. Servicing the HGE should be a safe and productive procedure, in order for the unit to deliver the reliable, long-life operation engineered into it.

HGE: Design and Operation

(See HGE Design Features and Oil Flow Illustrations, pp. 5 & 6.)

Satisfactory performance of the overall hydraulic system requires a well-engineered installation. The hydraulics must meet the design features of the vehicle and contribute to the operation for which the vehicle was built. Make no changes to the steering system without first consulting qualified factory service personnel. Ross Gear extends engineering advice and welcomes requests for assistance.

Engineering contacts can provide information on such hydraulic components as pumps, cylinders, and fluid lines. The HGE control unit works best with a balanced-area cylinder design.

HGE: Design

The HGE Hydraguide unit consists of a fluid control valve section and a fluid metering section. These are hydraulically and mechanically interconnected inside a single housing.

Control Valve Section: Operation

The HGE Hydraguide uses a servo-reactive (feedback control) valve which is centered by torsion blades. The valve regulates pressure and directs pump flow to the steering cylinder or cylinders. The valve is of the open-center type: when in the neutral position, it allows fluid to flow from the pump to the pressure port, through the HGE unit to the return port, and back to the reservoir.

The valve is available in open- or closed-cylinder configurations, each of which brings its own advantages to bear in the hydraulic system:

Open Cylinder: cylinder ports are open to the metering pump, allowing road or ground reaction to recenter the valve, provided the vehicle's front-end steering geometry allows recentering. When the driver completes a turn, the steering will recenter, as happens, for example, in most automobile power steering systems.

Closed Cylinder: cylinder ports are blocked to the metering pump, preventing road or ground reaction from recentering the valve. The driver recenters steering manually. This design is useful in a vehicle which must remain turned while the driver takes his hands off the steering wheel to operate other controls.

Metering Section: Operation

The metering section performs three duties:

- it meters (measures) fluid to the cylinder or cylinders;
- it maintains the ratio of hand wheel turns to the direction of the steered wheels; and
- it acts as a pump for manual steering in the event high-pressure fluid does not reach the HGE unit.

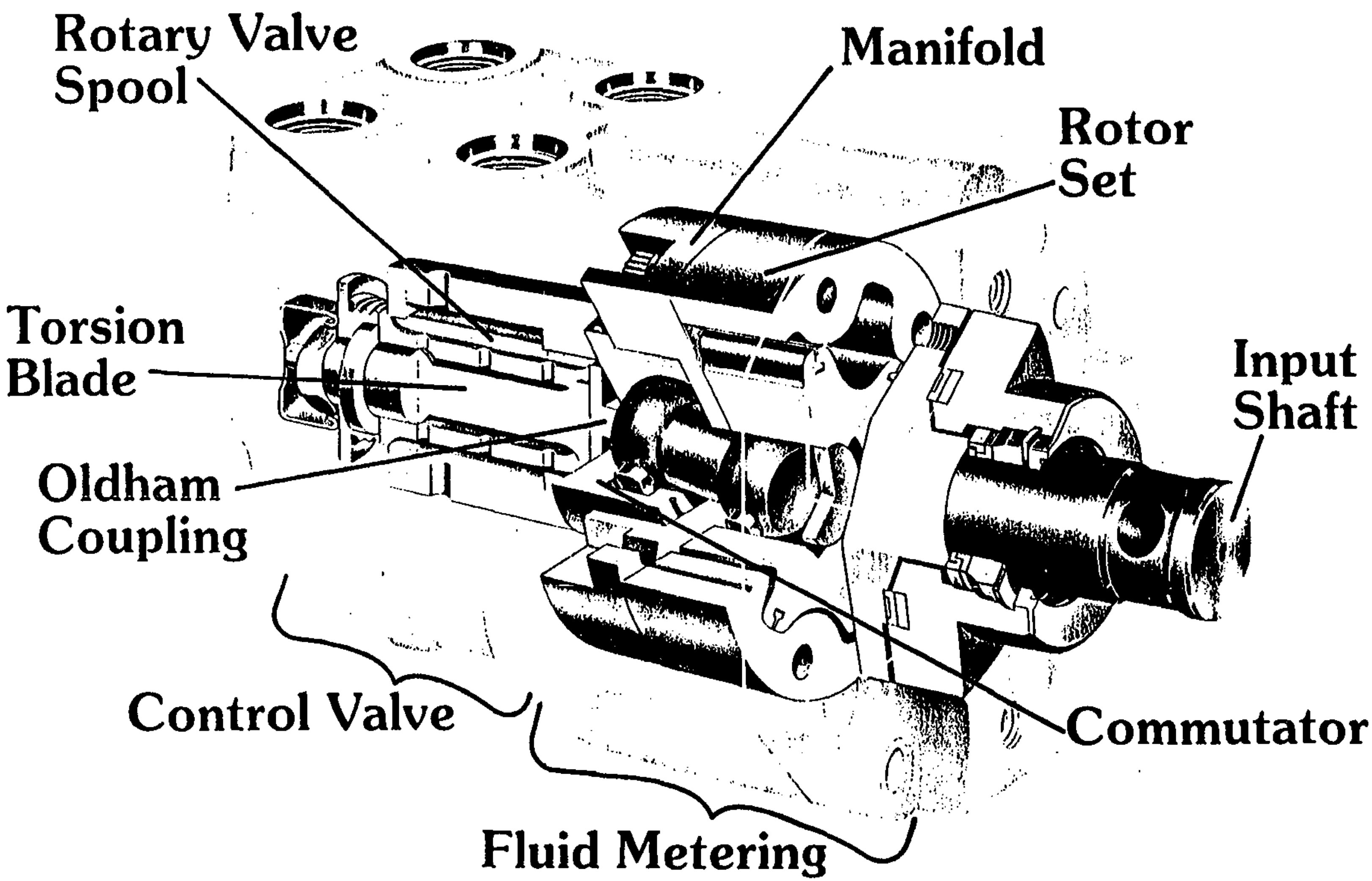
Two principal components make up the metering section:

- a commutator and manifold set, and
- a rotor and stator set.

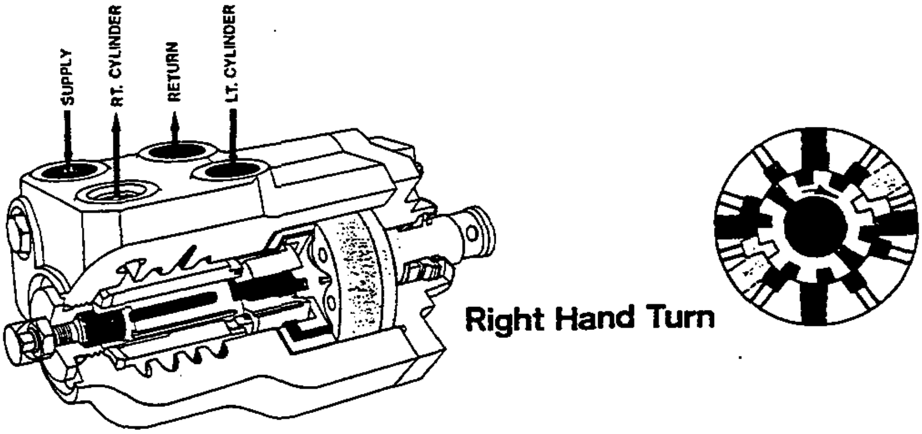
These fit inside a compact housing and are hydraulically and mechanically coupled with the control valve section.

The commutator and manifold are linked to a directional gerotor element. Within this element are a rotating stator and an orbiting rotor. The commutator is coupled to the valve with a drive coupling. The manifold, rotating at input shaft speed, channels fluid to and from the rotor set and valve section.

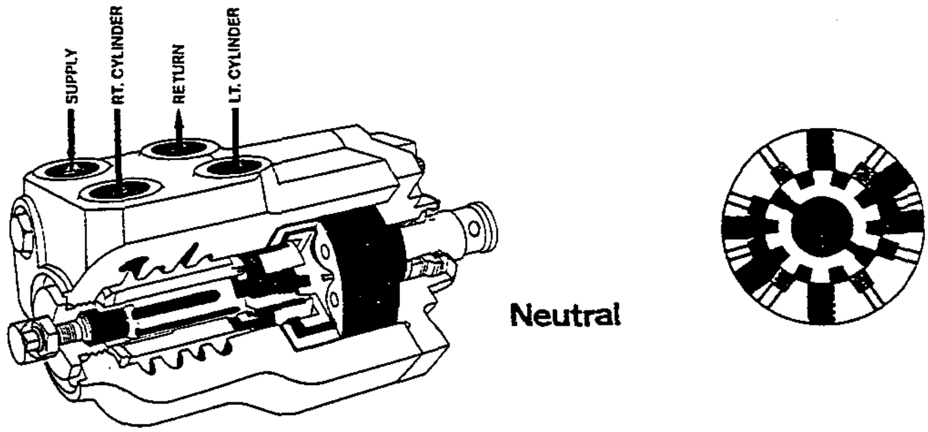
On some units the rotor also includes unique sealing vanes which are spring and hydraulically forced into sealing contact between the rotor and stator. The vanes reduce leakage across the metering section.


Rotary Valve Spool
Manifold
Rotor Set
Torsion Blade
Input Shaft
Oldham Coupling
Control Valve
Commutator
Fluid Metering

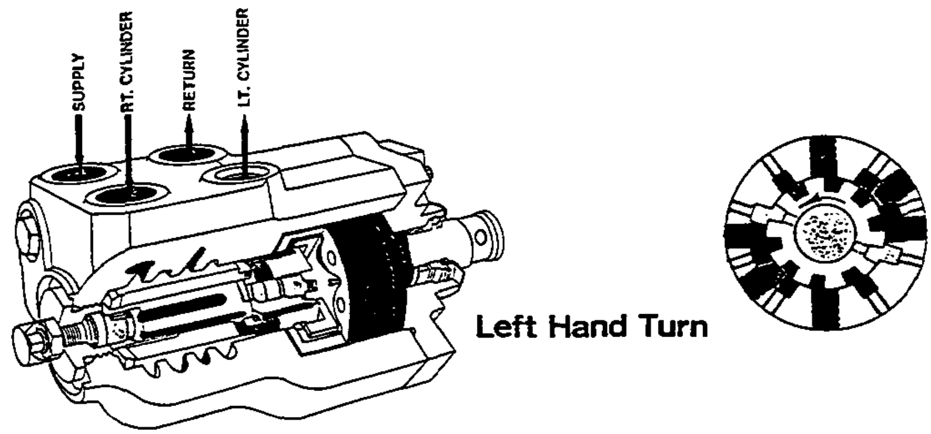
HGE OIL FLOW ILLUSTRATION



Right Hand Turn



Neutral



Left Hand Turn

SUPPLY PRESSURE (From Power Pump)

RETURN OIL FLOW (To Reservoir)

METERED OIL FLOW (To Cylinder)

Troubleshooting Guide

NOTE: Before troubleshooting a steering problem, check service literature published by the vehicle and component manufacturers. Follow their instructions, if given, for checking any component but the HGE Hydraguide unit.

preparation

Make your troubleshooting easier by preparing as follows:

- work in a clean, well-lighted place;
- have proper tools and materials nearby;
- have a space set aside where you can lay components, parts, and tools; and
- have an adequate supply of clean petroleum-based solvent.

WARNING: SINCE THEY ARE FLAMMABLE, BE EXTREMELY CAREFUL WHEN USING ANY SOLVENT. EVEN A SMALL EXPLOSION OR FIRE COULD CAUSE INJURY OR DEATH.

preliminary checks

For all their complexity, hydraulic systems are often trouble-free. The steering problem an operator complains of could be caused by something other than the hydraulic components.

Thus, once you have determined the problem and test driven the vehicle (if possible), start with the easy-to-check items.

On some vehicles, the conditions of the tires, especially on the steered wheels, may affect steering. Make sure pressures are at manufacturer's specifications. Make sure tires are balanced and that they show no signs of damage or severe wear. Check that they are mounted properly.

Check steering and front end linkage. Broken, loose, or binding parts could cause certain steering problems. See if something in the steering column is loose or binding.

If belts are present, check all of them. A tight belt could also be glazed, and a slipping belt doesn't always squeal.

In addition, the following could also contribute to a steering problem:

- an overloaded vehicle;
- parts damaged from impact not properly repaired, or that should have been replaced; and
- improperly spec'd replacement parts.

hydraulic components

If you think the problem is caused by a hydraulic component, start by checking the easy-to-reach items.

Check all hoses and lines for cracks, hardening, or other signs of wear. Reroute any useable hoses that are kinked, severely bent, or that rest against hot engine parts. Look for leaks, especially at couplings. Replace any hoses or lines that don't meet system flow and pressure ratings.

Next, go to the reservoir and filter or filters. Check fluid level and look for air bubbles. Examine the filter; if it's clogged, follow manufacturer's instructions for cleaning or replacing it. A filter with a minimum 25 micron filtration is recommended for the HGE system.

Visually check other components to see if they are loosely mounted, show signs of leaks, or other damage or wear.

It may be necessary that you run hydraulic tests on the performance of the hydraulic components. To do so, consult the manuals published by the vehicle or component manufacturers.

Troubleshooting Checklists

I. NOISE

NORMAL NOISE

—A low hissing from the HGE control valve section during a turn

—A noise from the system relief valve when it is actuated

—Pump growl from some types of power steering pumps

ABNORMAL NOISE

—A squealing noise during a turn may indicate that the belt or belts should be tightened or replaced.

—A clicking noise during a turn may indicate that some component is loose and shifting under load.

II. POSSIBLE STEERING PROBLEMS AND CAUSES

STEERING WANDER

—Different size tires

—Tire pressure incorrect or unequal left to right

—Loose or worn steering linkage parts

—Improperly adjusted or worn wheel bearings

—Unbalanced steering effort in HGE unit (See assembly step 41)

—In some vehicles, front end out of alignment

NO RECOVERY

—Tire pressure low

—Steering linkage parts binding

—Tight front axle kingpins

—Steering column binding or misaligned

—Unbalanced steering effort in HGE unit (See assembly step 41)

—If possible, check input shaft torque

SHIMMY

—Improperly mounted tire or wheel

—Components in steering linkage loose, worn, or out of adjustment

—Wheels or brake drums out of balance

—Wheel bearings improperly adjusted

—Air in the hydraulic system

HIGH STEERING EFFORT IN ONE DIRECTION

—Vehicle overloaded

—Low hydraulic system pressure

—Excessive system heat causing HGE valve spool to stick. See checklist under Excessive Heat.

—Unbalanced steering effort in HGE unit (See assembly step 41)

HIGH STEERING EFFORT IN BOTH DIRECTIONS

—Different size tires

—Vehicle overloaded

—Low hydraulic fluid level

—Low flow or pressure from pump

—Components in steering linkage binding

—Restriction in fluid return line, or line too small

LOST MOTION (LASH) AT THE STEERING WHEEL

—Steering wheel loose on column

—Components in steering linkage loose or worn

—HGE unit loose at mounting

—Air in hydraulic system

EXCESSIVE HEAT (200°F MAXIMUM)

—Undersized replacement hose or line

—Kinked or severely bent hose or line

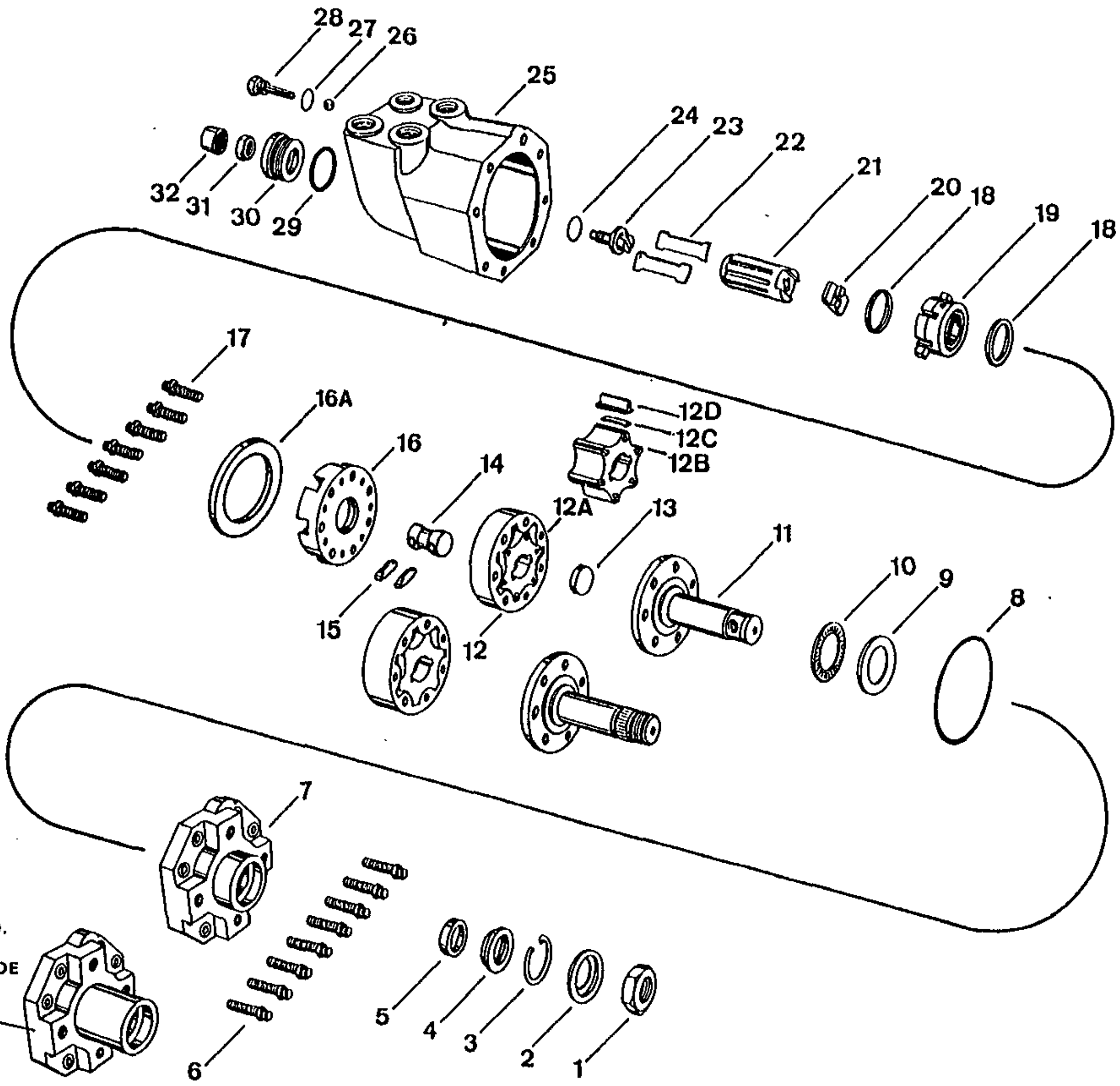
—Restricted oil coolers

—Restricted recentering of HGE unit

NOTE: For HGE units that are unbalanced for right and left turn steering efforts, follow assembly step 41.

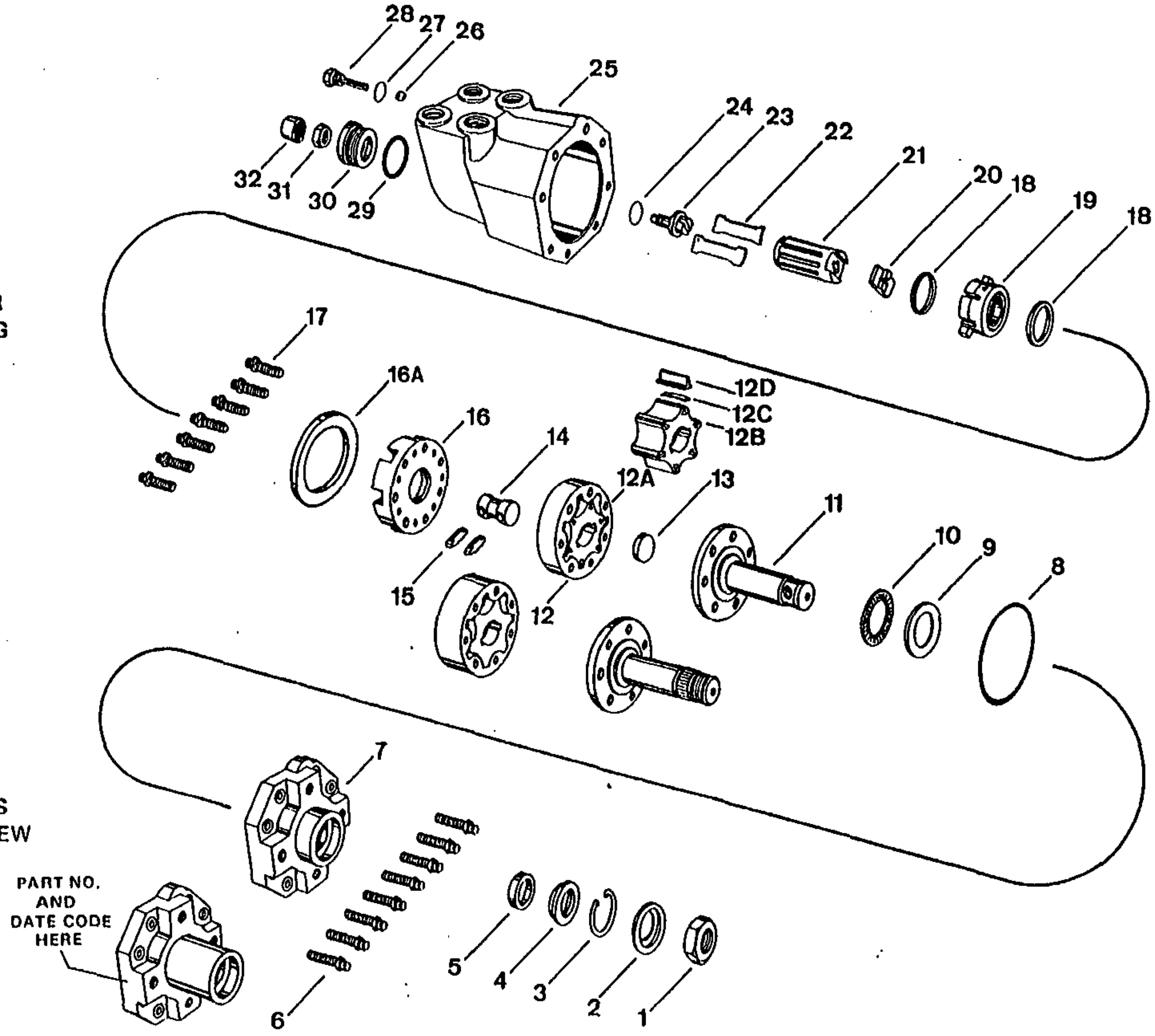
WARNING: IF THE HYDRAULIC SYSTEM FLUID BECOMES OVERHEATED (IN EXCESS OF 200°F), SEALS IN THE SYSTEM CAN SHRINK, HARDEN, OR CRACK, THUS LOSING THEIR SEALING ABILITY.

1 NUT
2 SEAL
3 RETAINING RING
4 BACK UP RING
5 SEAL
6 SCREW (8)
7 UPPER COVER
8 SEAL
9 THRUST WASHER
10 THRUST BEARING
11 INPUT SHAFT
12 ROTOR SET
12A STATOR
12B ROTOR
12C SPRING
12D VANE
13 SPACER
14 DRIVE LINK
15 LINK PINS
16 MANIFOLD
16A WASHER
17 SCREW (7)
18 SEAL (2)
19 COMMUTATOR
20 DRIVE RING
21 SPOOL
22 TORSION BLADES
23 ADJUSTING SCREW
24 "O" RING
25 HOUSING
26 CHECK BALL
27 "O" RING
28 PLUG
29 "O" RING
30 HEX PLUG
31 JAM NUT
32 CAP



HGE EXPLODED VIEW

1	NUT
2	SEAL
3	RETAINING RING
4	BACK UP RING
5	SEAL
6	SCREW (8)
7	UPPER COVER
8	SEAL
9	THRUST WASHER
10	THRUST BEARING
11	INPUT SHAFT
12	ROTOR SET
12A	STATOR
12B	ROTOR
12C	SPRING
12D	VANE
13	SPACER
14	DRIVE LINK
15	LINK PINS
16	MANIFOLD
16A	WASHER
17	SCREW (7)
18	SEAL (2)
19	COMMUTATOR
20	DRIVE RING
21	SPOOL
22	TORSION BLADES
23	ADJUSTING SCREW
24	"O" RING
25	HOUSING
26	CHECK BALL
27	"O" RING
28	PLUG
29	"O" RING
30	HEX PLUG
31	JAM NUT
32	CAP



HGE EXPLODED VIEW

Tools and Materials Required for Servicing

HGE service manual

Clean, petroleum-based solvent

Emery paper

Vise with soft jaws

Screw driver

Wire brush

Snap ring pliers

Breaker bar

Sockets: 1/4" (12 Point), 1/2", 9/16"

3/8" Allen wrench socket

7/8" Deep well socket

Clean grease

Light weight oil

Dial indicator and "V" block
(or ring compressor or hose clamps)

Torque wrenches: in. lb. and ft. lb.

Feeler gauge (.007 in.)

J 26910 Seal installation tool kit.*
- Seal Protector (long shaft)
- Seal Protector (short shaft)
- Seal Installer
- Seal Compressor Ring

*Tool kit available from:
Kent Moore
Tool Division
29784 Little Mack
Roseville, MI 48066
Phone: 313-774-9500

Torque Chart

Part Name	Number	Torque
plug and roll pin	28	10-14 ft. lbs.
hex plug	30	55-60 ft. lbs.
jam nut	31	20 ft. lbs.
manifold bolts	17	10-14 ft. lbs.
upper cover bolts	6	16-18 ft. lbs.

HGE: Disassembly and Inspection

Preparation before disassembly

Before you disassemble the HGE Hydraguide unit or any of its parts, read this entire manual. It provides important information on parts and procedures you will need to know to service the HGE.

When disassembling any of the parts, use a clean work bench. Wash all parts in clean petroleum based solvent and blow them dry. Keep each part separate to avoid nicks and burrs.

WARNING: SINCE THEY ARE FLAMMABLE, BE EXTREMELY CAREFUL WHEN USING ANY SOLVENT. EVEN A SMALL EXPLOSION OR FIRE COULD CAUSE INJURY OR DEATH.

Before you disconnect any hoses, clean off all outside dirt from around the fittings. Plug the port holes immediately after you disconnect the hoses and before you remove the HGE from the vehicle. This is to prevent foreign matter from entering the HGE and damaging it when you clean and reassemble it. Next, blow the unit dry and place it on a work bench. The tools and other items required to service the HGE are given on page 10C. Refer to the HGE exploded view (foldout) for parts identification. In the procedures described here and in the Assembly section, part numbers are in parentheses.

CAUTION: Do not force or abuse closely fitted parts, or you may damage them. Use only genuine Ross or OEM approved service parts.

clamp HGE in a vise

1. To avoid damaging or distorting the unit when it is in a vise, do the following: Insert an "O" ring tube fitting, with a nut or fitting cap attached, into one of the threaded housing port holes. Clamp this fitting in the vise so that the eight upper cover bolts (6) are in a horizontal position. See FIGURE 1.

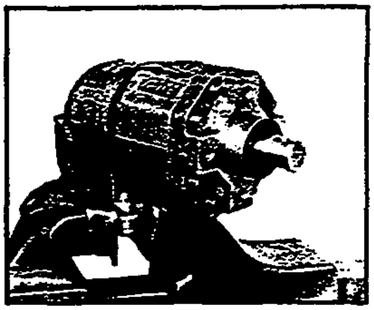


Figure 1

remove dust seal

2. Remove and discard the dust seal (2) from the upper cover by prying it out with a screw driver. See FIGURE 2.

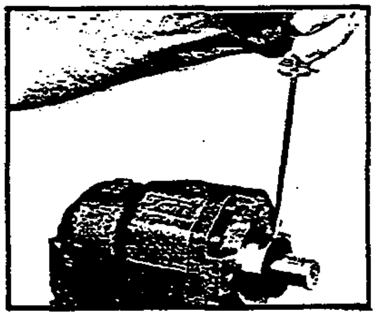


Figure 2

clean and inspect input shaft

3. Remove any paint or corrosion from the end of the input shaft (11).

NOTE

NOTE: Most input shafts have a pin hole for attachment to the steering column. However, if the input shaft you're inspecting has serrations, check to see if they are stripped or broken. If they are, replace the input shaft.

remove upper cover bolts

4. Prepare for some fluid to drain. Then, remove the eight upper cover bolts with a 1/4" 12-point socket (6). See FIGURE 3.

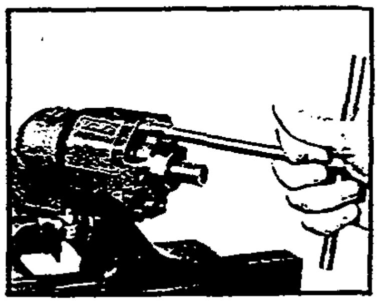


Figure 3

withdraw upper cover assembly

5. Grasp and withdraw the combined input shaft and upper cover assembly (11, 7) with attached parts. Place the assembly on the bench. See FIGURE 4.

CAUTION

CAUTION: Keep the shaft and its components in a horizontal position, or tilt the internal parts upward. Otherwise, the commutator (19) may fall out and become damaged.

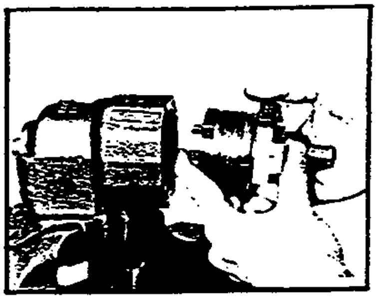


Figure 4

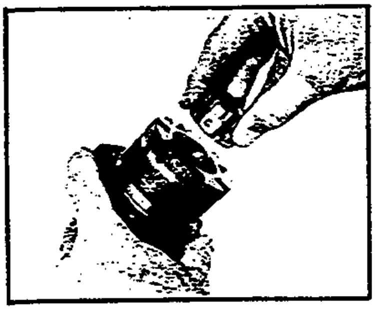


Figure 5

withdraw commutator

6. Grasp the commutator (19) with your fingers and withdraw it from the manifold (16). See FIGURE 5.

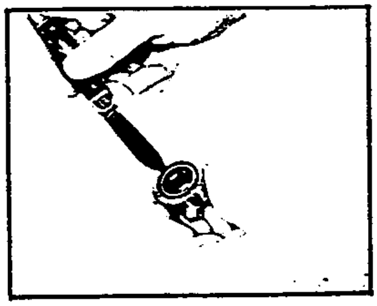


Figure 6

remove commutator seal

7. Remove and discard the cummutator seal (18) from the commutator (19). See FIGURE 6.

NOTE

NOTE: You may find a second part of the seal in the manifold. If so, remove and discard it.

Figure 7

inspect commutator

8. Inspect the commutator (19) at the ground O.D. surface. Inspect the drive link pin slot for wear. See FIGURE 7. Replace both the commutator and manifold (16) if wear is visually obvious in the commutator.

CAUTION

CAUTION: The commutator and manifold are a matched set. You must replace both together if either is worn or damaged.

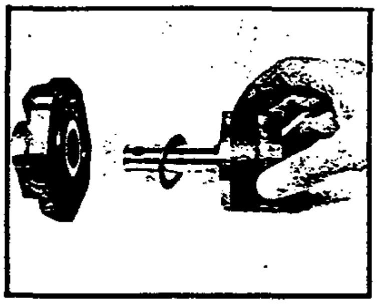


Figure 8

remove input shaft

9. Remove the input shaft (11) from the upper cover (7). Next, remove the thrust bearing (10) from the input shaft. See FIGURE 8. Inspect the thrust bearing for brinelling (dents) or spalling (flaking). See FIGURE 9. If either exists, or if one or more of the rolls is lost, replace the bearing.

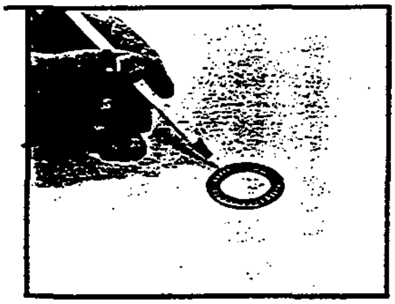


Figure 9

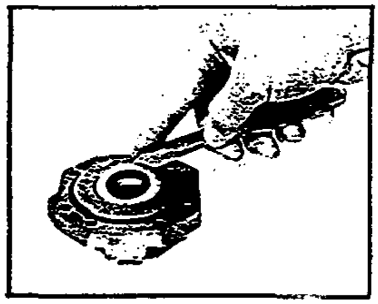


Figure 10

remove thrust washer

10. Remove and discard both the thrust washer (9) and the upper cover Tetra Seal* (8) from the upper cover (7). See FIGURES 10 and 11.

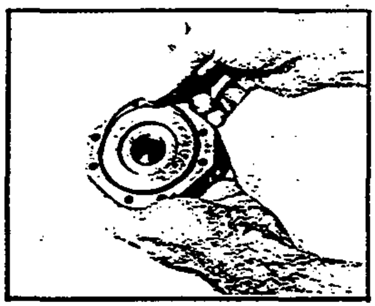


Figure 11

remove retaining ring

11. Using snap-ring pliers, remove the retaining ring (3) from the upper cover (7). See FIGURE 12.

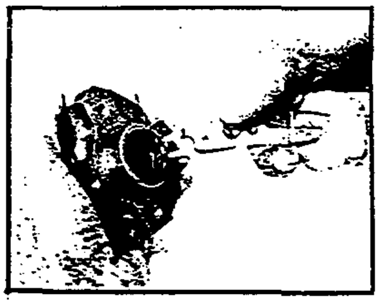


Figure 12

*Tetra Seal is a registered trademark of Goshen Rubber, Inc.

remove backup ring and seal

12. Remove and discard the backup ring (4) and seal (5) from the upper cover (7) with your fingers. See FIGURE 13. If the seal does not easily pull out, push it deeper into the bore to loosen it; then pull it out.

CAUTION

CAUTION: Be careful not to scratch the inside of the upper cover bore in the seal area. If you should do so, the new seal may leak.

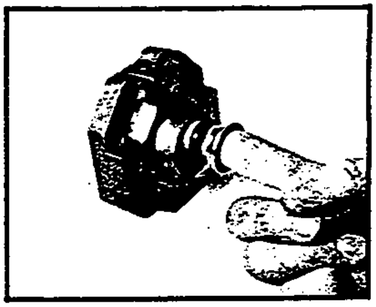


Figure 13

put input shaft in vise

13. Position the input shaft (11) assembly in a vise equipped with soft jaws. The jaws must grip only the first one inch of the input shaft length. See FIGURE 14.

CAUTION

CAUTION: Damage to the input shaft seal surface will cause the seal to leak.

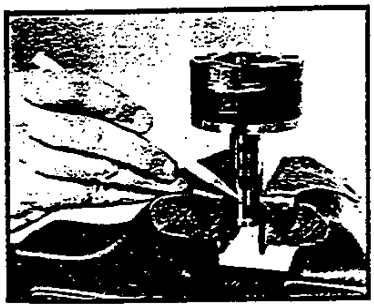


Figure 14

remove bolts

14. Remove the seven manifold bolts (17). See FIGURE 15.

WARNING

WARNING: IF IT IS NECESSARY TO REPLACE ANY OR ALL OF THE MANIFOLD BOLTS, USE ONLY THE SAME THREAD SIZE AND BOLT LENGTH AS THOSE YOU ORIG—INALLY REMOVED. IF YOU USE IMPROPER BOLTS, THE HGE UNIT MAY LOCKUP OR OTHERWISE MAL-FUNCTION, CAUSING A LOSS OF STEERING, WHICH COULD CAUSE AN ACCIDENT.

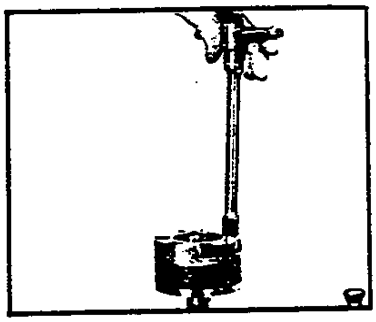


Figure 15

remove manifold

15. Hold the rotor set (12) and remove the manifold (16) from it. See FIGURE 16.

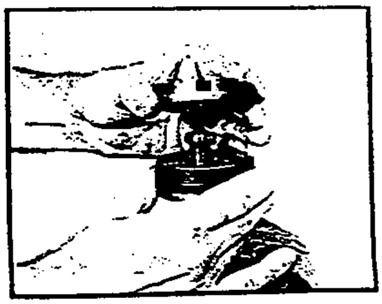


Figure 16

inspect manifold

16. Closely inspect the side and bore of the manifold (16) to detect wear marks. See FIGURE 17. Pencil point indicates inspection points. These surfaces have been ground and should be free of nicks, burrs, and scoring. Replace both the manifold and commutator (19) if wear in the manifold is visually obvious.

CAUTION

CAUTION: **The manifold and commutator are a matched set. You must replace both together if either is damaged or worn.**

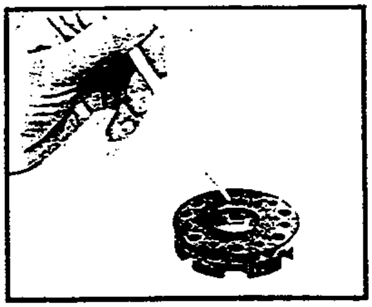


Figure 17

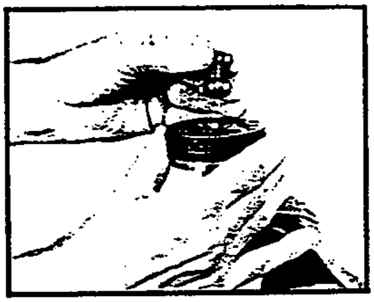


Figure 18

remove drive link

17. Remove the combined drive link and drive link pins assembly (14, 15). See FIGURE 18.

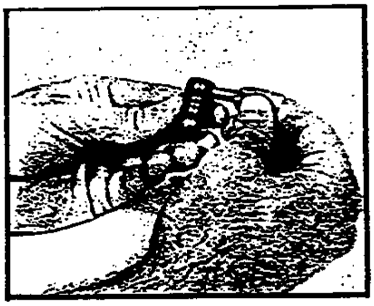


Figure 19

remove drive link pins

18. Remove the two drive link pins (15) from the drive link (14). See FIGURE 19.

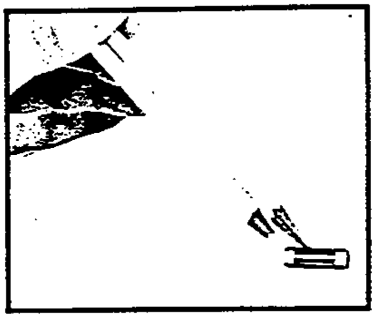


Figure 20

inspect pins

19. Visually inspect the drive link pins (15) to detect wea- on the ground diameter surface and side flats, as indicated by the pencils. See FIGURE 20. Replace one or both pins, as required.

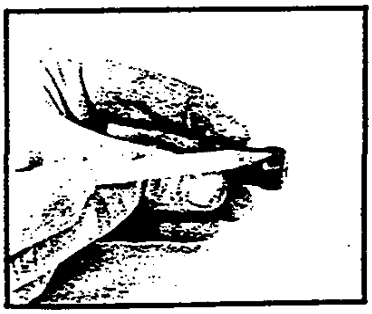


Figure 21

inspect drive link

20. Inspect the holes in the drive link (14) for wear marks and galling. See FIGURE 21. These holes should be smooth and round. If not, replace the drive link.

inspect rotor set

21. Inspect the rotor set (12) as it lies on the input shaft (11). See FIGURE 22. Rotor sets 1 inch thick or less consist of:
    - the stator (12A)
    - the rotor (12B)
    - six vane springs (12C)
    - six vanes (12D).

    Rotor sets thicker than one inch do not have vanes and springs. Handle the rotor set carefully to avoid nicks and scratches. Check the rotor for freedom to rotate and orbit within the stator. The vanes, if present, should move freely in their slots, without binding, due to the forces of the springs.

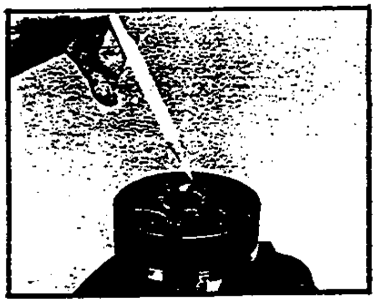


Figure 22

check clearance

22. Using a feeler gauge, check the rotor (12B) to stator (12A) clearance. The rotor should be centered at the pencil point. See FIGURE 23. If there is more than .007 inches of clearance, you must replace the whole rotor set.

NOTE

NOTE: This measurement applies to all rotor sets, with or without vanes and springs.

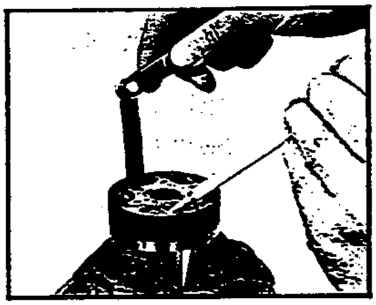


Figure 23

remove rotor set

23. Remove the rotor set (12) and, if one is present, the spacer (13) from the input shaft (11). If the set has vanes (12D), take care to prevent them, the vane springs (12C), and the rotor (12B) from falling out and becoming lost. When removing the rotor set, apply pressure to the rotor by gripping it between your fingers and easing it into contact with the stator. See FIGURE 24.

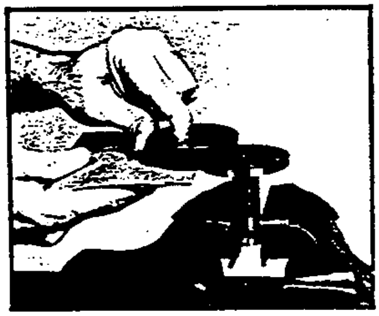


Figure 24

inspect spacer

24. Inspect the ground end of the spacer (13) for wear or grooves. See FIGURE 25. Replace the spacer if required.

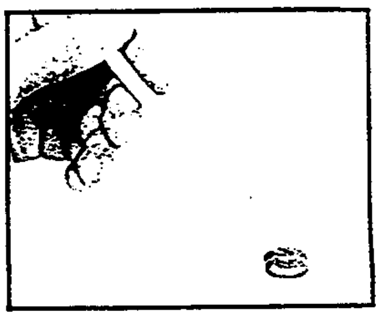


Figure 25

inspect input shaft

25. Inspect the input shaft (11) at the ground surfaces, as indicated by the pencil point. See FIGURE 26.

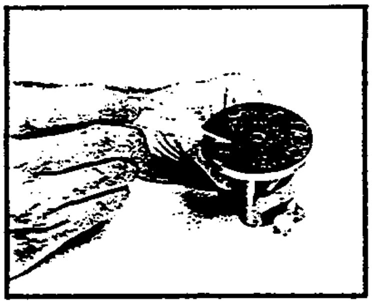


Figure 26

You should notice a polished pattern due to the rotor orbit motion. Inspect the shaft seal area and the bearing thrust area for excessive wear and pitting. See FIGURES 27 and 28. Replace the input shaft if necessary.

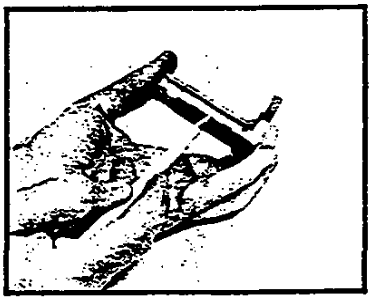


Figure 27

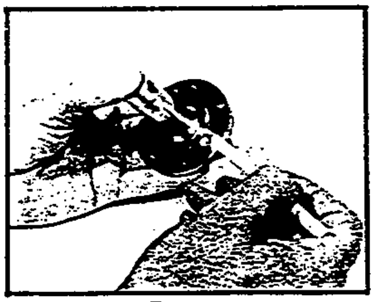


Figure 28

remove rotor

26. Remove the rotor (12B) from the stator (12A). See FIGURE 29.

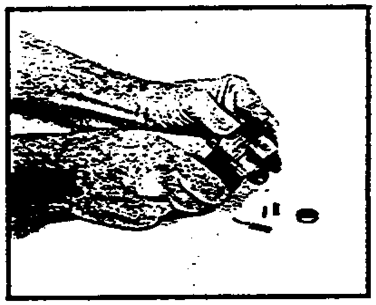


Figure 29

inspect vanes and springs

27. If your HGE unit has vanes (12D) and vane springs (12C), remove them from the rotor (12B). See FIGURE 30. Inspect for broken vanes or springs. If any are damaged or broken, you should replace all six of each, or all six of both.

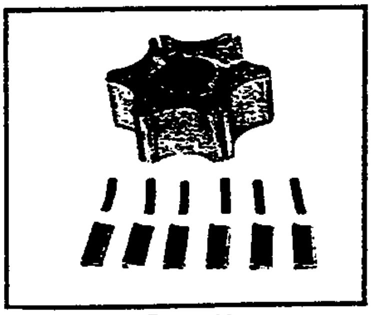


Figure 30

inspect rotor

28. Inspect the internal slots in the rotor (12B) for wear or galling. Also inspect the rotor vane slots for the same conditions. See FIGURE 31.

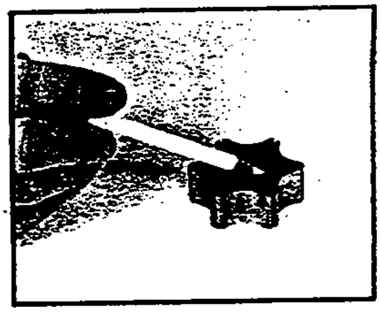


Figure 31

NOTE

NOTE: The rotor cannot be replaced separately. If required, you must replace the entire rotor set.

Figure 32

remove cap and jam nut

29. Position the housing (25) in a vise with soft jaws. Remove the cap (32), if it is present, and jam nut (31). See FIGURES 32 and 33. Remove and discard the seal (18) from the other end of the housing.

NOTE

NOTE: You may find a second part of the seal in the housing. If so, remove and discard the seal.

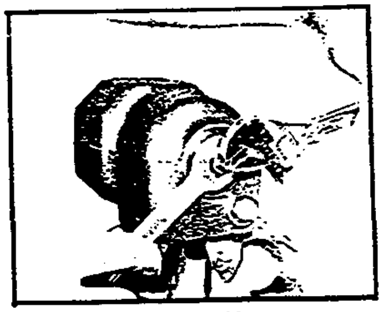


Figure 33

remove spool assembly

30. Push the end of the adjusting screw (23) in toward the housing until it's flush. This moves the spool (21) into position for you to take it from the opposite end of the housing. Carefully remove the spool assembly. See FIGURE 34.

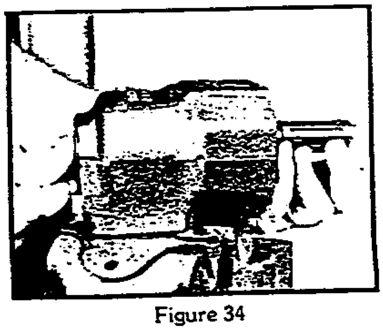


Figure 34

remove torsion blades

31. Remove the two torsion blades (22) and the adjusting screw (23) by pushing on the blades where they are exposed in the end of the spool (21).

remove hex plug

32. Reposition the housing (25) in a vise with soft jaws. Use very light clamp force. Remove the special hex plug (30), using a 3/8 inch allen wrench type socket. See FIGURE 35. Loosen but do not remove the plug and roll pin assembly (28).

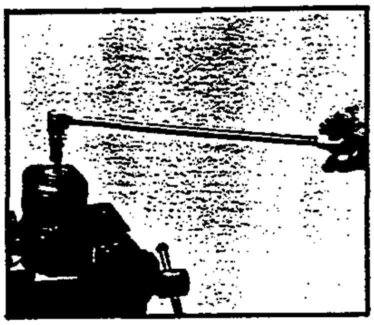


Figure 35

NOTE

NOTE: Avoid scratching or damaging the machined upper cover mounting surface.

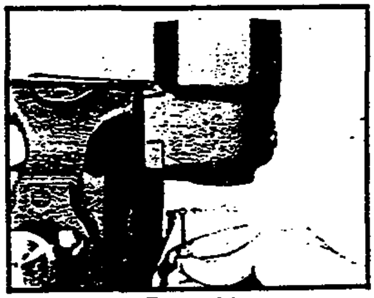


Figure 36

remove plug and roll pin

33. Turn the housing (25) to the vertical position. Remove the plug and roll pin assembly with your fingers, and be ready to catch the steel check ball (26) as it falls from its cavity. See FIGURE 36.

inspect parts

34. Remove the housing from the vise. Inspect the housing spool bore. The surfaces should be free of any scratches, and the corners of the oil passage slots should be free of nicks. See FIGURE 37. Inspect the spool (21), which should also be free of any surface scratches. All spool land edges should be sharp and square. You should notice four distinct ground modifications on the edges. Finally, inspect the torsion blades (22) for cracks.

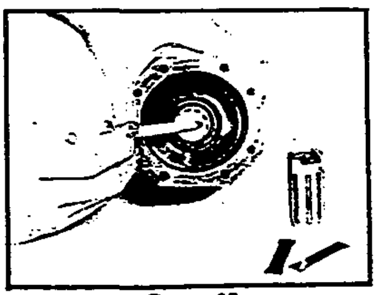


Figure 37

This completes the disassembly and inspection of the HGE.

HGE: Assembly

replace gaskets, seals, and rings

Replace all seals and rings with new ones each time you disassemble the HGE unit. See FIGURE 38.

clean and dry parts

Before you reassemble the HGE, wash all parts in clean petroleum based solvent. Blow them dry with compressed air.

WARNING

WARNING: SINCE THEY ARE FLAMMABLE, BE EXTREMELY CAREFUL WHEN USING ANY SOLVENT. EVEN A SMALL EXPLOSION OR FIRE COULD CAUSE INJURY OR DEATH.

Remove any paint chips from the upper cover mating surfaces of the housing, and from the port and sealing areas.

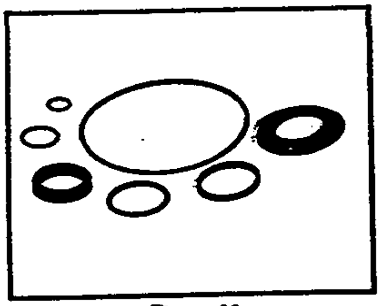


Figure 38

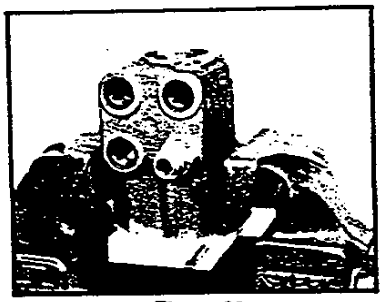


Figure 39

clamp housing in a vise

1. Clamp the housing (25) in a vise with soft jaws and on a clean piece of wood. See FIGURE 39.

NOTE

NOTE: Use very light clamp force to avoid damage to the housing.

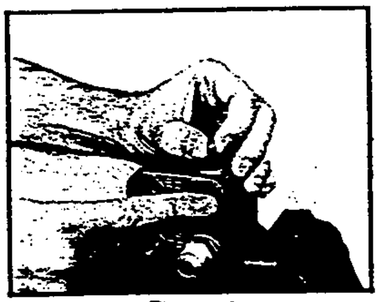


Figure 40

insert ball

2. Insert the steel check ball (26) into the cavity of the housing. See FIGURE 40.

CAUTION

CAUTION: Be sure that the ball drops into the drilled passage beyond the internal cores of the housing. If the ball is not in the drilled passage, power steering assist will not be available.

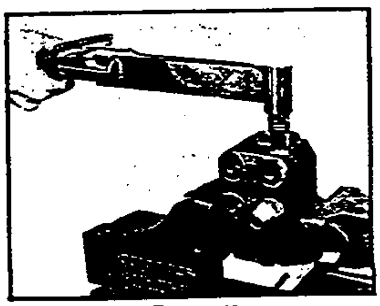


Figure 41

install new "O" ring

3. Install the new "O" ring (27) onto the plug and roll pin assembly (28). Install the plug and roll pin assembly into the housing and torque to 10-14 ft. lbs. See FIGURE 41.

install hex plug and "O" ring

4. Apply clean grease to the hex plug (30) and new "O" ring (29), and assemble the ring onto the plug. See FIGURE 42.

Figure 42

insert plug into housing

5. Assemble the hex plug (30) and new "O" ring (29) into the housing and torque to 55-60 ft. lbs. See FIGURE 43.

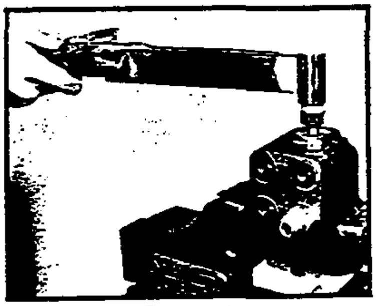


Figure 43

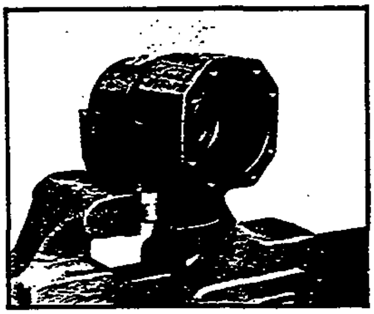


Figure 44

reclamp housing

6. Reclamp the housing in a vise using the "O" ring tube fitting. See FIGURE 44.

fit torsion blades together

7. Grasp the two torsion blades (22), one in each hand. See FIGURE 45. Rotate the blades to place the unstenciled sides next to each other. The stenciled "O's" should be on the outside and at opposite ends from each other. FIGURE 45 shows the blades being placed together properly.

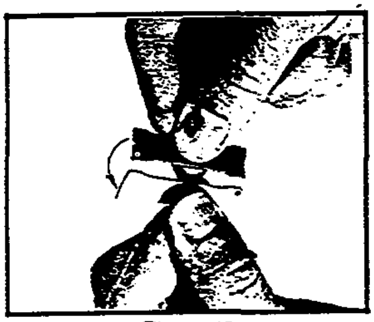


Figure 45

WARNING

WARNING: IMPROPER ASSEMBLY OF THE TORSION BLADES MAY PREVENT THE HGE FROM RECENTERING. THIS COULD OVERHEAT THE SYSTEM AND POSSIBLY RESULT IN A LOSS OF POWER STEERING ASSIST, WHICH COULD LEAD TO AN ACCIDENT.

assemble torsion blades

8. Install the two torsion blades (22) into the slot of the adjusting screw (23). The blades should fit snugly and be centered in the screw and flush at the bottom of the slot. Grease the new "O" ring (24) and install it onto the threaded side of the screw. See FIGURE 46.

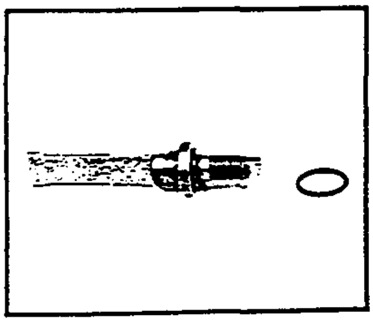


Figure 46

place assembly into spool

9. Install the combined adjusting screw and torsion blade assembly (23, 22) into the valve spool (21). These parts should fit snugly together. See FIGURES 47 and 48.

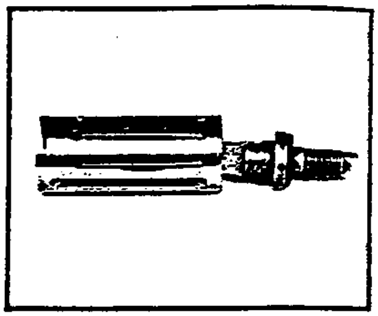


Figure 47

WARNING

WARNING: IMPROPER ASSEMBLY MAY PREVENT THE HGE FROM RECENTERING. THIS COULD OVERHEAT THE SYSTEM AND POSSIBLY RESULT IN A LOSS OF POWER STEERING ASSIST, WHICH COULD LEAD TO AN ACCIDENT.

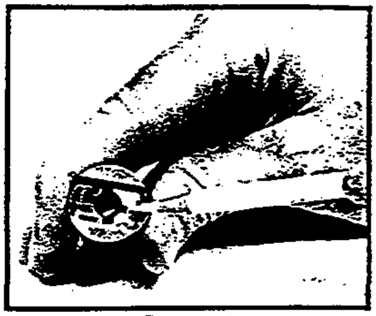


Figure 48

install spool

10. Oil the O.D. of the valve spool (21) and assemble it into the housing. See FIGURE 49. The adusting screw (23) should extend through the hex plug (30) at the rear of the housing.


Figure 49

install jam nut finger tight

11. Install the jam nut (31) finger tight onto the adjusting screw (23). See FIGURE 50.

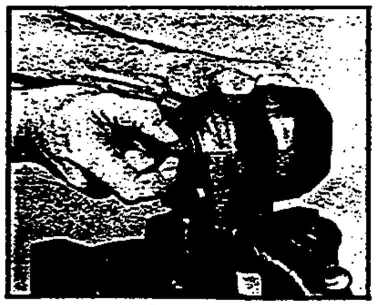


Figure 50

center commutator lugs

12. Position the valve spool (21) into the housing, using the drive coupling (20) and commutator (19) coupled to the spool as assembly guides. Center the commutator lugs in the milled slots of the housing. FIGURE 51 shows proper assembly, with the commutator lugs at 6 and 12 o'clock in the milled slots.

NOTE

NOTE: Doing this mechanically centers the spool. To center the spool hydraulically, you may have to balance the efforts for left and right turns after you assemble the HGE unit. This procedure is explained in assembly step 41.

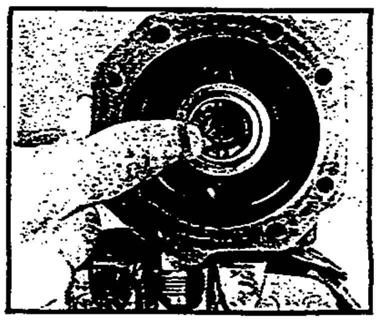


Figure 51

tighten jam nut

13. Being careful not to move the spool (21), remove the commutator (19) and drive coupling (20). Grasp the flats of the adjusting screw (23) and tighten the jam nut (31) to 10-15 ft. lbs. See FIGURE 52. Check the spool for proper position by repeating step 12, above. If the commutator is off center, correct it by rotating the adjusting screw a very slight amount. You do not need to loosen the jam nut. Remove the housing from the vise.

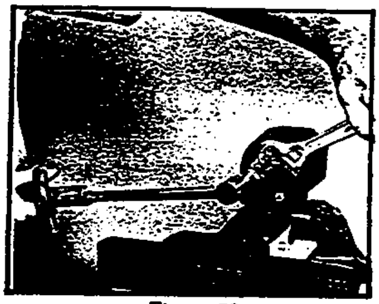


Figure 52

install commutator seal

14. Grease the new commutator seal (18) and place it into the groove of the commutator (19). The Teflon* portion (i.e., the harder side) of the seal should face out. See FIGURE 53.

NOTE

NOTE: This seal, which you may have removed in two pieces in disassembly step 7, has been replaced in the service kit by a one-piece seal.

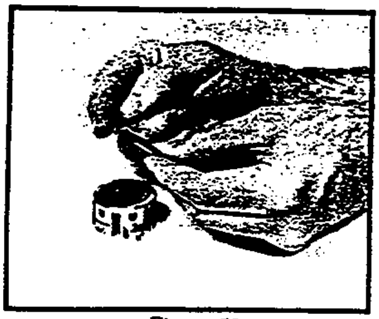


Figure 53

install commutator

15. Place the commutator (19) into the manifold (16) I.D. See FIGURE 54.

NOTE

NOTE: These are closely fitted, matched parts, and you must assemble them carefully. Do not use excessive force.

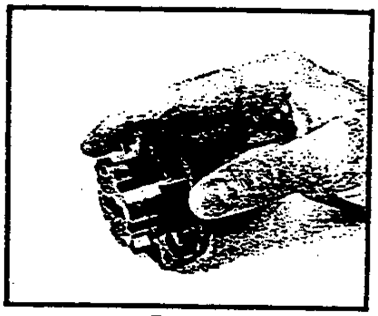


Figure 54

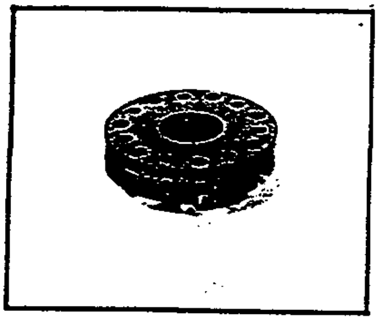


Figure 55

place assembly on bench

16. Place the combined commutator and manifold assembly (16, 19) on a clean surface with the commutator side down. See FIGURE 55.

insert drive link pins

17. Apply a light coat of grease to the drive link pins (15). Insert them into the holes of the drive link (14). See FIGURE 56.

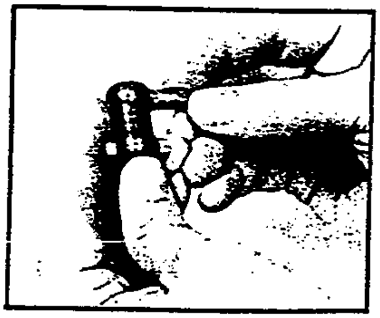


Figure 56

* Teflon is a registered trademark of DuPont, Inc.

place assembly into commutator

18. Place the combined drive link and pin assembly into the commutator (19). See FIGURE 57.

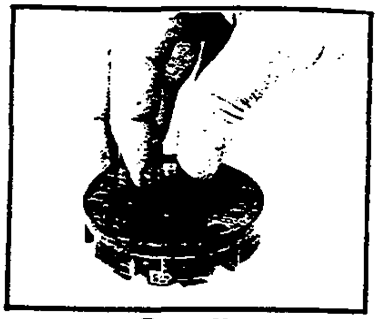


Figure 57

place rotor on manifold

19. Place the rotor (12B) over the drive link pin (15) and onto the manifold (16). See FIGURE 58.

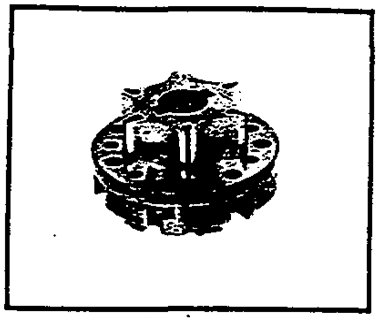


Figure 58

insert spacer

20. If your unit is equipped with one, insert the spacer (13) into the center of the rotor (12B). See FIGURE 59.

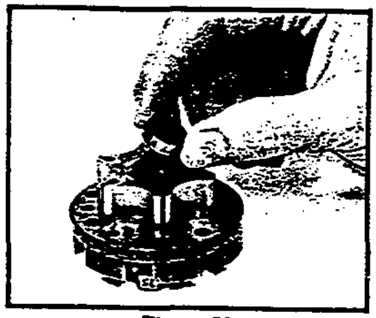


Figure 59

NOTE

NOTE: If the rotor set is either (a) 1¼ inch thick or (b) ½ inch thick or less, place the spacer into the recessed area of the input shaft. Use a small amount of grease to hold the spacer in place. See FIGURE 60.

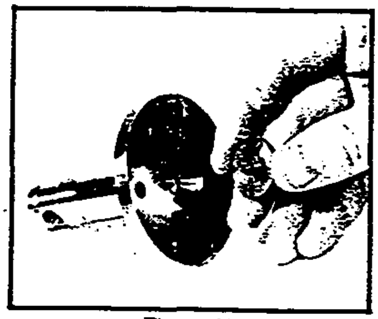


Figure 60

place stator over rotor

21. Place the stator (12A) over the rotor (12B) and onto the manifold (16). See FIGURE 61. Rotate the stator until the mounting bolt holes are aligned with the manifold.

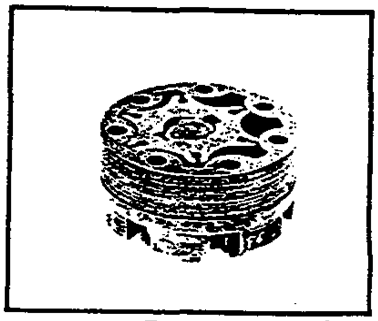


Figure 61

fit vanes into rotor slots

22. If your HGE is equipped with vanes (12D), slip them into the rotor slots. See FIGURE 62.

NOTE

NOTE: Rotor sets thicker than one inch do not have vanes or vane springs.

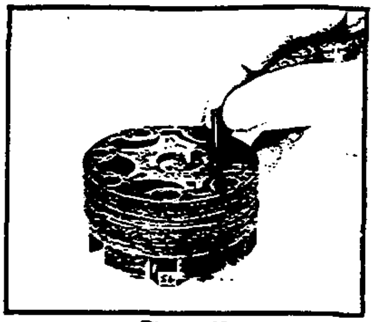


Figure 62

Figure 63

install vane springs

23. Push the vane springs (12C) under the vanes into the rotor slots, making sure the curved ends of the springs point toward the center. See FIGURE 63.

WARNING

WARNING: BE SURE THAT YOU INSTALL THE VANE SPRINGS FLUSH WITH OR SLIGHTLY BELOW THE ROTOR SURFACE. IF IMPROPERLY INSTALLED, THEY COULD LOCK THE HGE UP IN THE MANUAL STEERING MODE. IN THE POWER MODE, IMPROPERLY INSTALLED SPRINGS COULD BREAK, CONTAMINATING THE HGE AND POSSIBLY LOCKING IT UP. IN EITHER CASE, AN ACCIDENT COULD RESULT.

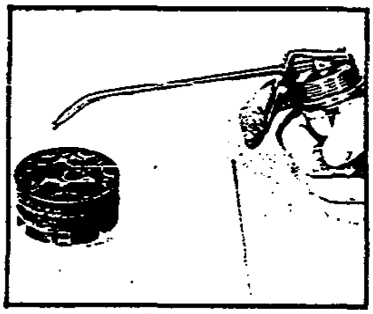


Figure 64

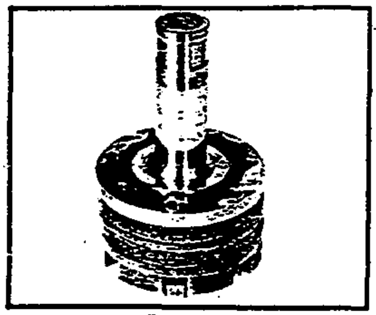


Figure 65

align input shaft

24. Place a few drops of oil in and on top of the rotor set (12). See FIGURE 64. Place the input shaft (11) onto the rotor set. See FIGURE 65. Align the mounting bolt holes.

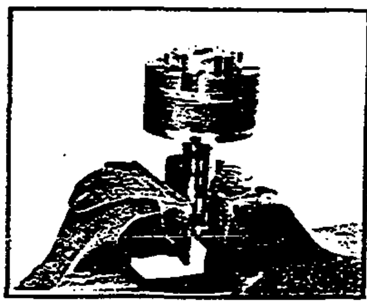


Figure 66

fasten input shaft in vise

25. While firmly holding the commutator (19) with your finger, grasp the complete stack of parts. Invert them and place the first one inch of the input shaft (11) into a vise with soft jaws. See FIGURE 66.

bolt manifold and stator to shaft

26. Insert the seven manifold bolts (17) through the manifold and stator assembly to the input shaft (11). Tighten the bolts finger tight. See FIGURE 67. Rotate the commutator (19) with your fingers to be sure that all parts are free.

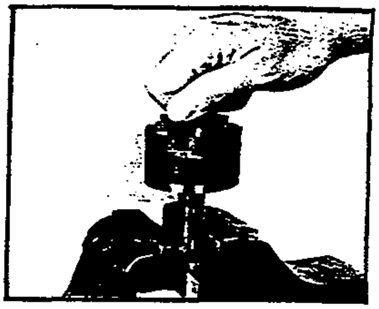


Figure 67

CAUTION

CAUTION: From now until you complete step 36, do not raise the commutator, or you will disengage the drive link pin or cause the commutator seal to fall out of place. If you should raise the commutator, you will have to restart assembly at step 14.

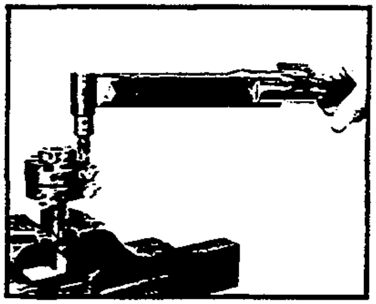


Figure 68

NOTE

NOTE: For the following procedure, use one of two methods to align the O.D.'s of the input shaft (11) and the manifold (16). If you have a dial indicator and "V" block, use the preferred method described in step 28. Otherwise, follow step 27. In either case, resume reassembly at step 29.

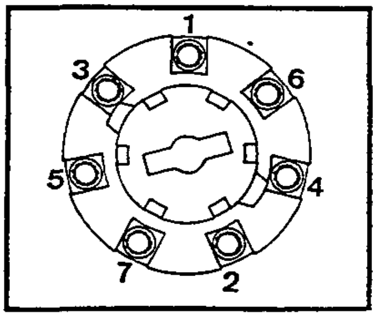


Figure 69

using ring compressors or hose clamps

27. Using a small piston ring compressor or two hose clamps, align the O.D.'s of the input shaft (11), rotor set (12), and manifold (16). See FIGURE 68. Tighten the bolts in the sequence shown in FIGURE 69 to 2-3 ft. lbs.

CAUTION

CAUTION: Only tighten the clamps enough for alignment. Too much force could distort the stator.

Next, rotate the commutator by hand to make sure that parts do not bind. See FIGURE 70. If they do bind, remove the manifold bolts and inspect the assembly to find and correct the cause of binding. Finish torquing the bolts to 10-14 ft. lbs. Make a final check for commutator rotation and remove the assembly from the vise. Again, hold the commutator to prevent disengagement of the drive link pin or contact with the commutator seal. Now, go to step 29.

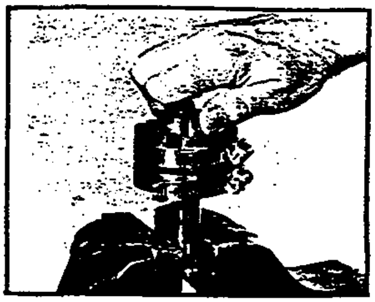


Figure 70

using dial indicator and "V" block

28. PREFERRED METHOD. Finger tighten the seven manifold bolts (17). Place the input shaft (11) in the "V" block and set the dial indicator probe on the O.D. of the manifold (16) and "tap in" to reduce runout to .005 T.I.R. See FIGURE 71. Tighten the bolts to 2-3 ft. lbs., in sequence (FIGURE 69). Rotate the commutator by hand to make sure that parts do not bind. Finish torquing the bolts to 10-14 ft. lbs. Make a final check for commutator rotation.

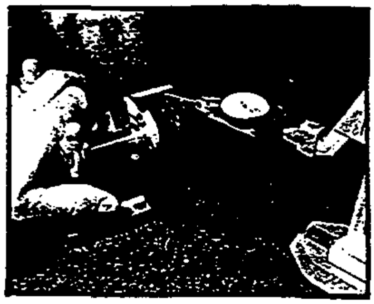


Figure 71

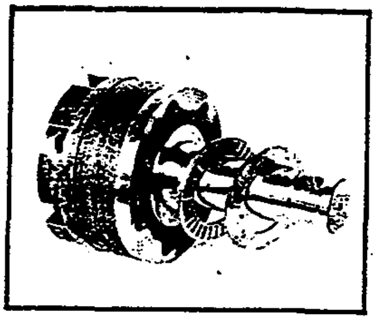


Figure 72

install thrust bearing and washer

29. Apply a light coat of grease to the thrust bearing (10) and place it in position on the input shaft (11), while holding the commutator (19) firmly in place on the manifold (16). See FIGURE 72.

NOTE

NOTE: To install a temporary thrust washer (9), refer to the date code on the HGE unit you are servicing. (See exploded view for location of date code.) For units built before date code 118-79, install "D" thrust washer. For units built after date code 117-79, install "G" thrust washer. Place the washer over the input shaft and onto the thrust bearing. See table on page 29 for thrust washer identification. Final installation of the proper thrust washer will be made in steps 35A and 35B.

Figure 73

install washer

30. Grease the new washer (16A) and center it on the manifold (16), over the bolt circle. See FIGURE 73.

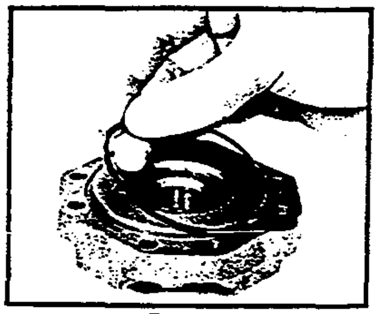


Figure 74

install upper cover seal

31. Grease the new upper cover Tetra seal (8) and install it into the upper cover (7) seal groove. See FIGURE 74.

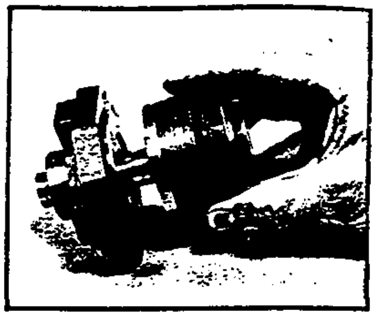


Figure 75

install upper cover

32. Slide the upper cover (7) over the input shaft (11), again being careful not to dislodge the commutator (19). See FIGURE 75.

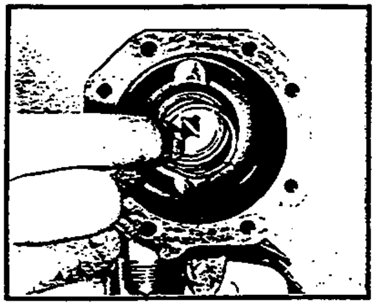


Figure 76

install seal and drive coupling

33. Place the housing assembly "O" ring tube fitting in a vise. Set two upper cover bolts (6) within arm's reach. Apply grease to the new seal (18) and place it in the housing seal groove with the Teflon portion (i.e., the harder side) facing out. See FIGURE 76. Check to see that the drive coupling (20) slides easily back and forth in both the spool slot and commutator slot. Then, grease and place the drive coupling into the center of the spool slot. See FIGURE 77.

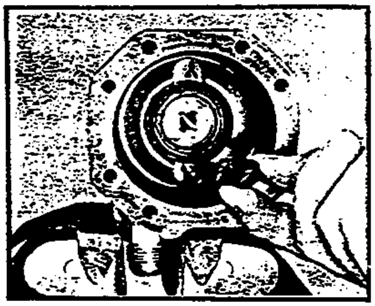


Figure 77

fit metering section/upper cover over housing

34. Align the commutator (19) lugs with the milled slots in the housing. Slip the metering section/upper cover into the housing. See FIGURE 78. Install the two nearby upper cover bolts (6) hand tight.

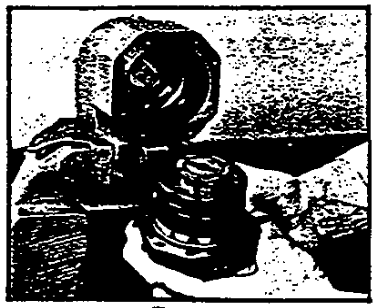


Figure 78

CAUTION

CAUTION: Do not force the components together. Withdraw and reinstall the drive coupling and the seal (18) if either is out of position, and repeat step 33.

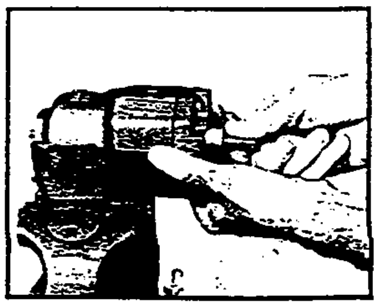


Figure 79

NOTE

NOTE: If you cannot get the upper cover (7) against the housing, slightly rotate the input shaft (11) back and forth to engage the drive coupling (20) in the commutator drive slot. See FIGURE 79.

install correct thrust washer

35. Tighten the two upper cover bolts (6) to 16-18 ft. lbs. In step 29, you installed a temporary thrust washer (9). To preload the commutator seal (18) with 40 lbs. force, you must now install a thrust washer of the correct thickness. Follow step 35A or 35B, depending on the date code of the HGE unit you are servicing. Refer to the Thrust Washer Thickness Table on this page.

units built before 118-79

35A. For units built before date code 118-79: Using an inch-pound torque wrench with dial reading, rotate the input shaft with ports open. If the torque required to rotate is greater than 15 in. lbs., remove the upper cover (7) and replace "D" washer with "C" washer. Reinstall the upper cover. This completes the preload. See FIGURE 80.

input torque 15 in. lbs. or less

However, if the torque required to rotate the input shaft is 15 in. lbs. or less, remove the upper cover and replace "D" washer with "E," then "F," and so on, until you reach a torque greater than 15 in. lbs. At that point, back down one washer thickness and replace the upper cover. This completes preload.

NOTE

NOTE: **If you install "I" washer and torque does not exceed 15 in. lbs., you will have completed preload.**

units built after 117-79

35B. For units built after date code 117-79: Using an inch-pound torque wrench with dial reading, rotate the input shaft with ports open. If the torque required to rotate is greater than 15 in. lbs., remove the upper cover and replace "G" washer with "F" washer. See FIGURE 80. Reinstall the upper cover. This completes preload.

input torque 15 in. lbs. or less

However, if the torque required to rotate is 15 in. lbs. or less, remove the upper cover and replace "G" washer with "H", then "I", and so on, until you reach a torque greater than 15 in. lbs. At that point, back down one washer thickness and replace the upper cover. This will complete preload.

NOTE

NOTE: **If you install "L" washer and torque does not exceed 15 in. lbs., you will have completed preload.**

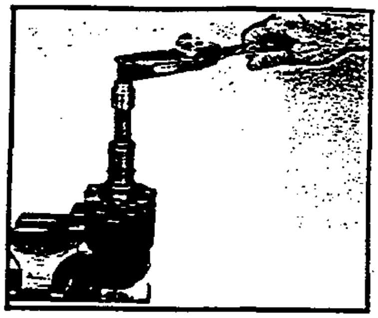


Figure 80

Thrust Washer Thickness Table

Identification	Thickness
Washer A	.034/.035 inches
B	.040/.041
C	.046/.047
D	.052/.053
E	.058/.059
F	.064/.065
G	.070/.071
H	.076/.077
I	.082/.083
J	.088/.089
K	.094/.095
L	.100/.101

install remaining bolts

36. Install the six remaining upper cover bolts (6) and torque all eight bolts to 16-18 ft. lbs. See FIGURE 81. Recheck the torque required to rotate the input shaft. It should read the same as in step 35A or 35B.

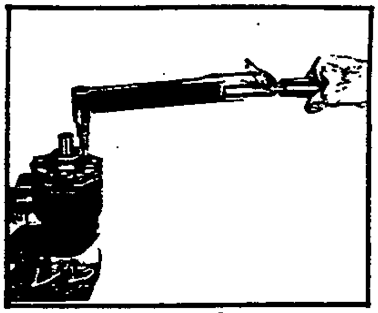


Figure 81

install shaft seal

37. Cover the end of the input shaft (11) with tape or a seal protector (J26910 Seal Kit). Lubricate and install the new shaft seal (5) over the input shaft and into the upper cover seal cavity. See FIGURE 82. Make sure the lip of the seal points toward the HGE unit. Remove the tape or seal protector.

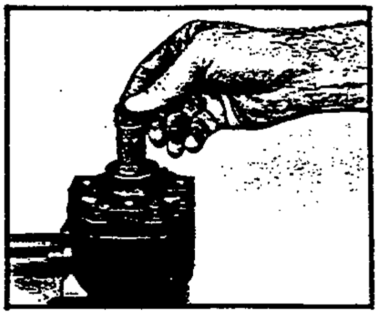


Figure 82

install backup ring

38. Install a new backup ring (4), with the small end first, over the input shaft (11). Push the backup ring and shaft seal (5) into the upper cover (7). To push these parts into place, use either a short piece of metal tubing, 15/16" minimum I.D. by 3/16" maximum wall thickness; or a 7/8" deep well socket. See FIGURE 83.

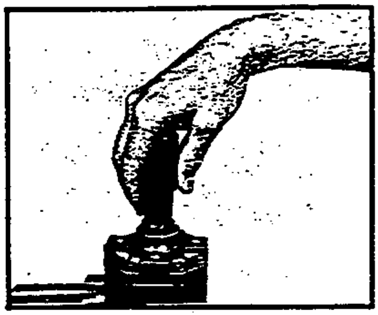


Figure 83

install retaining ring

39. Install the retaining ring (3) over the input shaft (11) and down into the upper cover (7) groove. See FIGURE 84. Make sure the rounded edge of the ring faces the HGE unit.

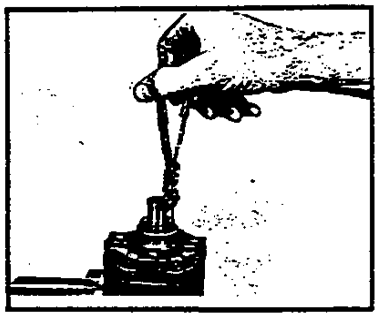


Figure 84

install dust seal

40. Pack the input shaft dust seal cavity with clean grease. Then, install the new dust seal (2) over the input shaft (11), and press the seal down into the upper cover (7) counterbore. See FIGURE 85.

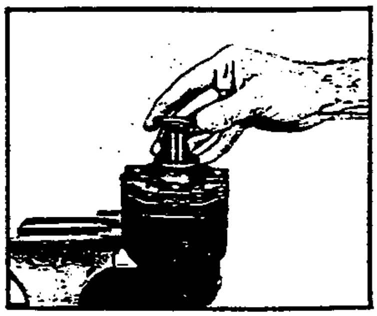


Figure 85

assembly complete; balance steering efforts, if required

This completes assembly of the HGE Hydra-guide unit. Only the adjustments necessary to balance steering efforts for right and left turns remain, and then only if you loosened the jam nut (31) during servicing.

WARNING

WARNING: THE UNIT IS ONLY MECHANICALLY CENTERED AT THIS POINT. WHEN YOU FIRST TURN ON THE POWER SUPPLY, STAY CLEAR OF THE STEERING WHEEL AND THE GROUND WHEELS. THE VEHICLE COULD SELF-STEER UNDER POWER, POSSIBLY STRIKING SOMEONE NEARBY.

adjust balance on vehicle

If you can reach the end of the adjusting screw (23) and jam nut (31), then adjust the steering efforts on-vehicle.

to balance steering effort

41. To balance the steering effort, right turn and left turn torsional force, proceed as follows:

Preliminary steps

A. Be sure that the hydraulic system is full of fluid and that all the air has been bled. See page 33. Make sure the steered wheels are straight ahead.

activate power

B. Activate the power supply and set the engine at half throttle to provide adequate flow through the HGE.

rotate input shaft

C. Using a dial-type, in.-lbs. torque wrench, rotate the input shaft no more than one turn each direction from center and at a constant speed. Note and record the torque readings in each direction.

adjust by turning adjusting screw

D. If torque reading is greater for a right hand turn, turn the adjusting screw (23) a slight amount to the left, as if you were unscrewing the screw. This adjustment is sensitive. Only a slight turn of the screw will be needed. See FIGURE 86. Do not loosen the jam nut (31).

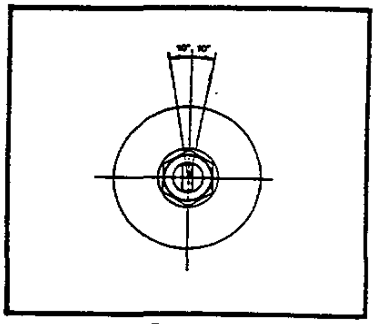


Figure 86

adjust opposite direction

E. If torque reading is greater for a left hand turn, turn the adjusting screw a slight amount to the right, as if you wer inserting the screw. Again, adjustment is sensitive. Do not loosen the jam nut.

steering at balance

F. At balance, steering efforts, as recorded by the torque wrench, should be within 2-3 in. lbs. left and right. When you bring the efforts to within 2-3 in. lbs., proceed to step G.

final adjustments

G. Tighten the jam nut (31) to 20 ft. lbs. and recheck steering effort balance. Torques for right and left turns should be within 2-3 in. lbs. Install the cap (32), if your unit is equipped with one.

Hydraulic Fluid

Keep the steering system filled with one of the following:

- Automatic Transmission Fluid Type "F"
- Automatic Transmission Fluid Dexron II
- Hydraulic fluid as recommended by the vehicle manufacturer

WARNING: DO NOT MIX OIL TYPES. ANY MIXTURE, OR AN UNAPPROVED OIL, COULD DETERIORATE THE SEALS. ENOUGH FLUID COULD THEN LEAK TO CREATE A LOSS OF POWER STEERING ASSIST. DO NOT ALLOW FLUID LEVEL TO GO BELOW FILL LINE ON DIPSTICK. BEFORE ADDING NEW FLUID, COMPLETELY DRAIN OLD OIL FROM THE SYSTEM. IT MAY BE NECESSARY ALSO THAT YOU FLUSH THE SYSTEM WITH CLEAN OIL.

Filling and Air Bleeding the System

NOTE: **For steps 1 and 2, do not turn the steering wheel.**

1. Fill the reservoir nearly full. Crank the engine for 10 seconds without, if possible, allowing the engine to start. If the engine does start, shut it off immediately. Do this procedure 3 times, each time checking and refilling the reservoir.

   CAUTION: **Do not allow fluid to drop significantly or to run out of the reservoir. This will induce air into the system.**

2. Start the engine and let it idle for 2 minutes. Shut the engine off and check the fluid level in the reservoir.

   NOTE: **For step 3, have someone turn the steering wheel while you check the reservoir.**

3. Start the engine. Steer the vehicle from full left to full right several times, all the while adding fluid. When you are finished, add fluid to the fill line on the dipstick.

Tips for Maintaining the Hydrostatic Steering System

—Top up fluid level in reservoir as necessary.

—Maintain correctly inflated tires.

—Always use a puller to remove the steering wheel. Do not use a hammer, torch, or crow bar.

—Investigate and correct immediately any play, rattle, shimmy, or other unusual occurrence in the steering system.

—Remove cause of steering column misalignment.

—Encourage all drivers or operators to report any malfunction or accident that may have damaged a steering system part.

—Do not attempt to weld any broken steering component. Replace the component with original equipment only.

—Do not cold straighten, hot straighten, or bend any steering part.

—Prevent dirt or other foreign matter from entering the hydraulic system. Clean off around filler caps before checking oil level.

—Investigate and correct any external leak in the steering system, no matter how minor the leak.

—Comply with manufacturer's specifications for cleaning or replacing the filter.

WARNINGS for Proper Steering System Operation

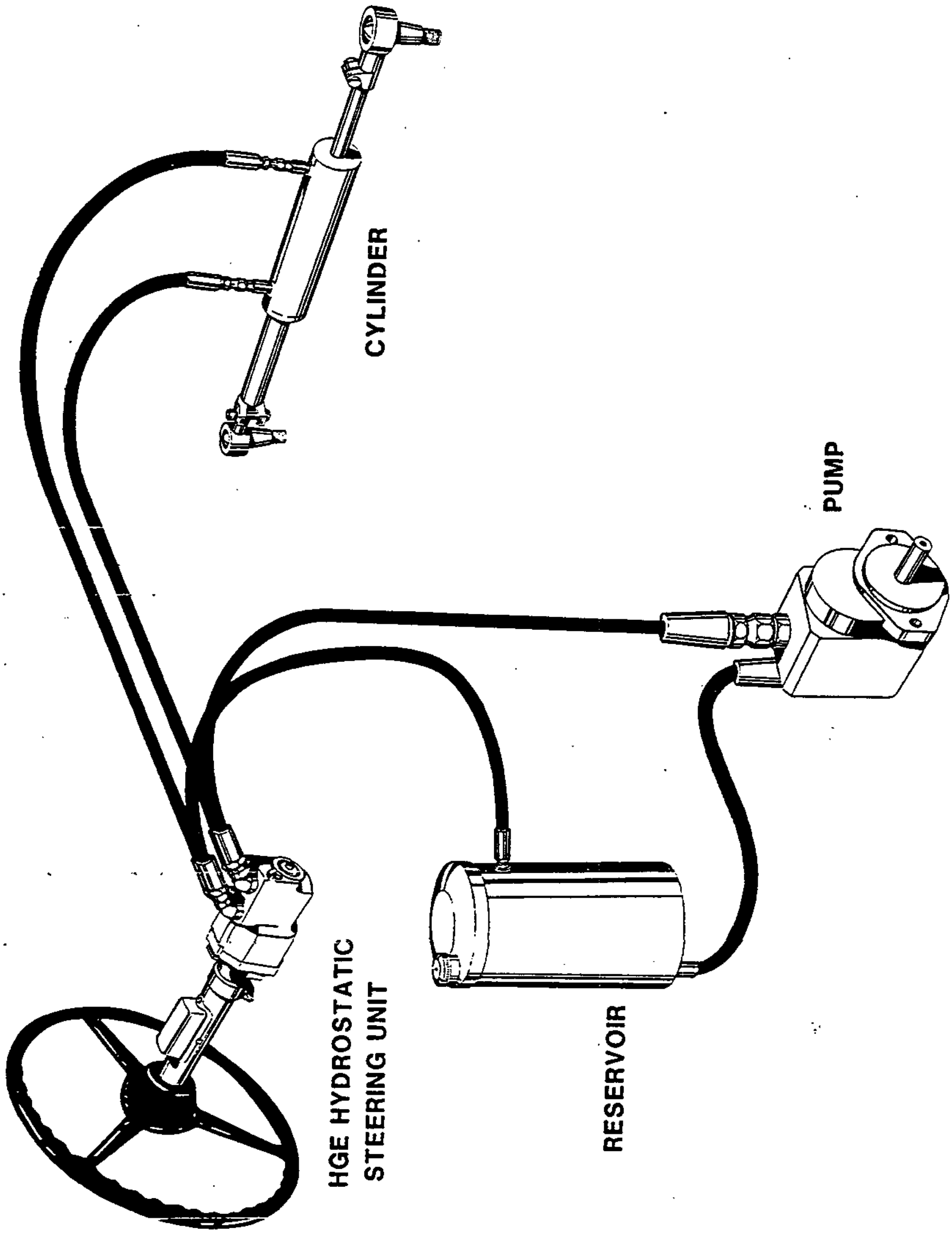
WARNING: Do not weld, braze, or solder any steering system component.

WARNING: Maximum operating pressure must not exceed vehicle manufacturer's recommended pump pressure capacity.

WARNING: Always carefully inspect any steering system component that may have been struck or damaged during operation or in an accident. Replace any component that is damaged or that is questionable.

Ross Gear extends close technical cooperation and assistance. If steering problems occur which you cannot solve, please contact our Ross Field Service Department. Our phone number and address are on the back cover of this manual.

Typical Installation Schematic



WRITE OR CALL FOR INFORMATION AND ADDED DETAILS
CONCERNING YOUR INSTALLATION AND APPLICATIONS.

PHONE: (317) 423-5377

TELEX: 279413

WRITE: TRW ROSS GEAR DIVISION
800 HEATH STREET
LAFAYETTE, INDIANA 47902

TRW

ROSS GEAR DIVISION

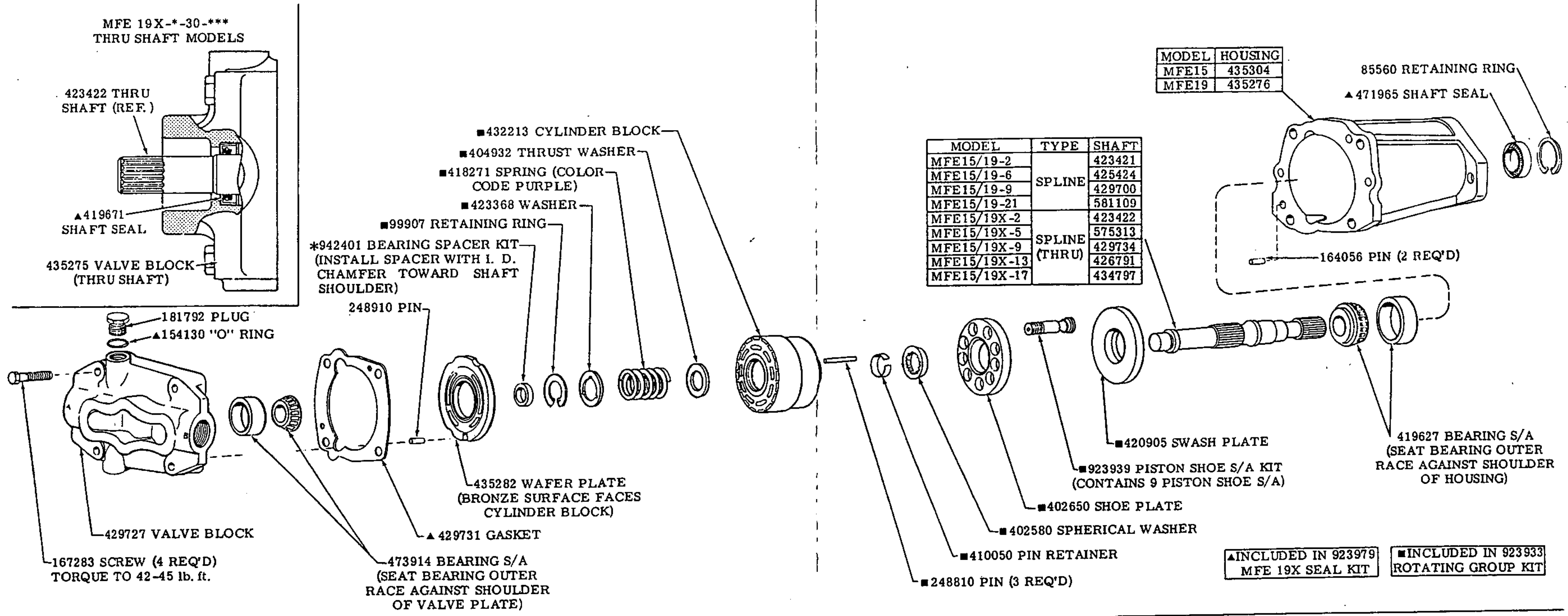
HGE-102
1.5M 3/81 CPC

V80980

Vickers Inc.

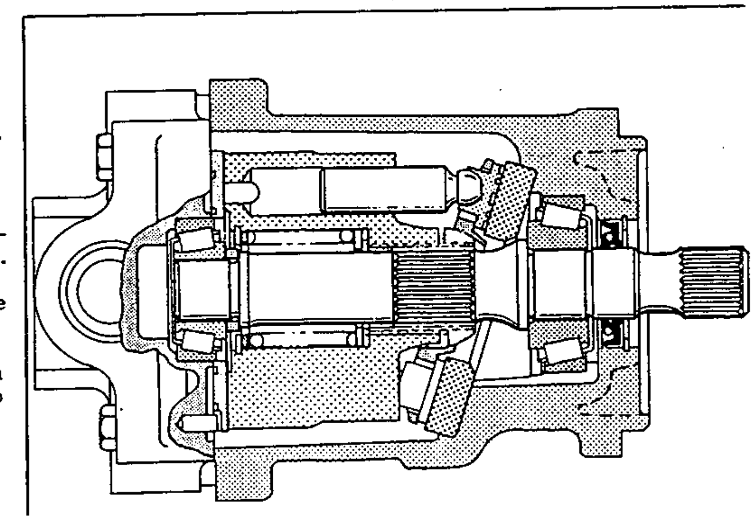
1401 Crooks Road

Troy, MI 48084-7106



MODEL	TYPE	SHAFT
MFE15/19-2	SPLINE	423421
MFE15/19-6		425424
MFE15/19-9		429700
MFE15/19-21		581109
MFE15/19X-2	SPLINE (THRU)	423422
MFE15/19X-5		575313
MFE15/19X-9		429734
MFE15/19X-13		426791
MFE15/19X-17		434797

MODEL	HOUSING
MFE15	435304
MFE19	435276



NOTE

If the shaft bearings, shaft, valve plate or housing were not replaced, use the bearing spacer removed during the disassembly procedure to preload the shaft. If preload is necessary, perform the following steps:

1. Install the thickest bearing spacer from the kit with chamfer facing toward shoulder of the shaft.

2. Slide tapered roller bearing over the shaft and up against the bearing spacer. The small diameter of the tapered roller bearing must face out of the housing.

* SHAFT BEARING PRELOAD ADJUSTMENT PROCEDURE

3. Install valve plate to housing without gasket and rotating group. Turn the shaft to seat bearings then torque the four valve plate attaching screw to two (2) lb. in. Check the opening between the valve plate and housing to be as even as possible after tightening.

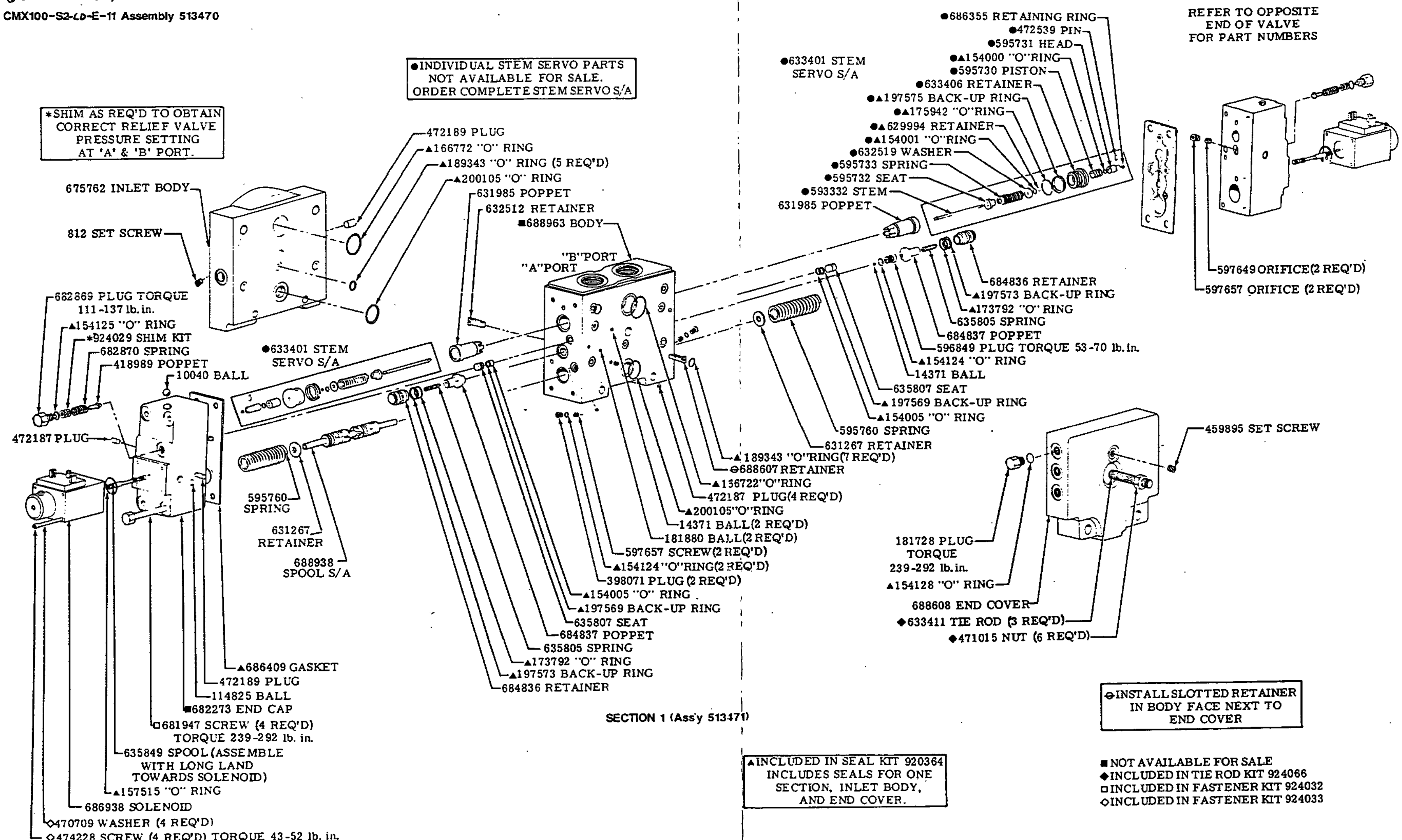
4. Use a feeler gage to measure the opening between valve plate and housing. Four (4) measurements should be obtained equidistant around the unit. A tapered feeler gage is especially useful for this purpose. Average the measurements by adding them together and dividing by four (4). Calculate thickness of the shaft bearing spacer as follows:

+0.150	Measured thickness of bearing spacer
-0.027	Average gap (assumed)
+0.003 ± 0.001	Preload setting
+0.020	Compressed thickness of gasket
0.146 ± 0.001	Required thickness of spacer to provide a 0.001 to 0.003 bearing preload.

5. Remove the large spacer and replace with one having the calculated dimensions.

6. Assemble the motor with rotating group and a new gasket. Cross torque the valve plate screws to 42-45 lb. ft.

620-0144
CMX100-S2-LD-E-11 Assembly 513470



SECTION 1 (Ass'y 513471)

VTECHO

Tech/Ops, Inc.

Sevcon Division

40 North Avenue

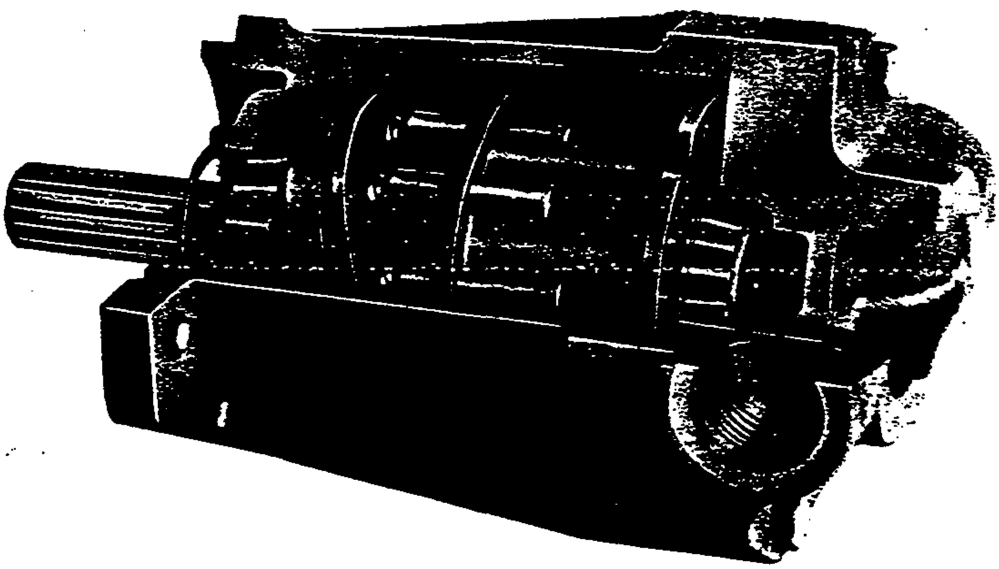
Burlington, MA 01803

VICKERS

Service Parts Information

Fixed Displacement Transmission Motors

MFE15(X)-*-30
MFE19(X)-*-30



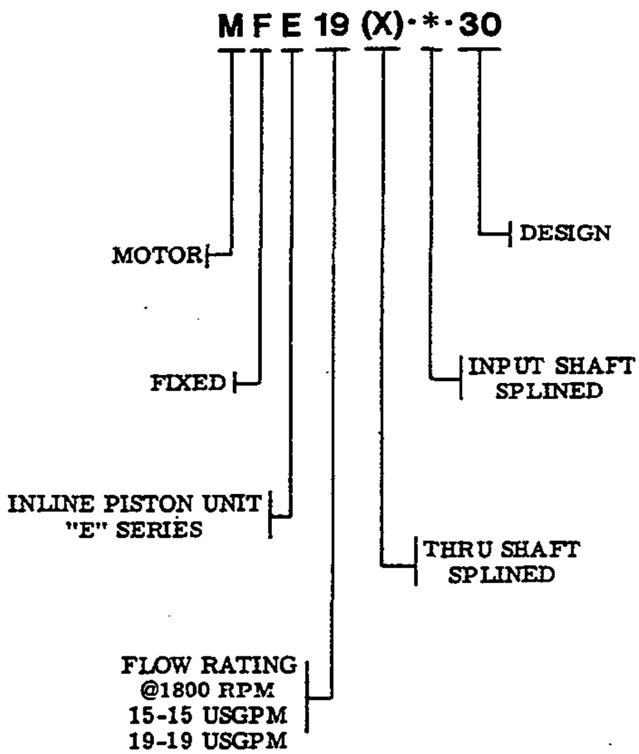
Vickers, Incorporated

1401 Crooks Road
Troy, Michigan 48084

Revised 11-1-85 **M-2837-S**

A Libbey-Owens-Ford Company

MODEL CODE BREAKDOWN



For satisfactory service life of these components, use full flow filtration to provide fluid which meets ISO cleanliness code 19/15 or cleaner. Selections from Vickers OFP, OFR, and OFRS series are recommended.

SPECIFICATION - P500

Dimensions:	182x150x154mm Height.
Supply Volts:	24v to 80v without adjustment.
Supply Tolerance:	60% to 115% of normal voltage.
Ambient Temperature Range:	-20°C to +40°C.
Storage Temperature Range:	-30°C to +50°C.
Duty Cycle:	300A for 1 min. 15% duty. 500A for 10 secs. 15% duty. 100A continuous at 25°C.

Reverse Battery Polarity Protection.

Logic Input Protection.

Arcless Contactor Switching.

SPECIFICATION - P1000

620-2106

Dimensions:	261x182x154mm Height.
Supply Volts:	24v to 80v without adjustment.
Supply Tolerance:	60% to 115% of normal voltage.
Ambient Temperature Range:	-20°C to +40°C.
Storage Temperature Range:	-30°C to +50°C.
Duty Cycle:	800A for 1 min. 15% duty. 1000A for 10 secs. 15% duty. 200A continuous at 25°C.

Reverse Battery Polarity Protection.

Logic Input Protection.

Arcless Contactor Switching.

DESCRIPTION

The P500 and P1000 Pump Controls are designed to control the speed of a D.C. motor used for hydraulic pump applications. They give an infinitely variable speed range for lift and programmable speeds for auxiliary functions such as tilt, side-shift and/or reach.

The advantages of using an SCR Pump Controller are:-

- More accurate control of lifting speed.
- Substantial increase in the lift of the pump contactor - it only acts as a line contactor and does not make or break high currents except under fault conditions.
- Increased shift time between charges due to lower demand on battery.
- Increased battery life due to a reduction in the number of high current peaks.
- Increased motor life as the motor no longer needs to run at full speed continuously.
- Increased time between oil changes as only the amount of oil required for a particular function is used at any one time.

INSTALLATION

Panel Mounting

The baseplate of the Controller is electrically isolated from the circuit. To achieve the specified rating it must be mounted in total surface contact with a continuous flat metal section of the vehicle frame or other heavy metal part. The surface onto which the control is to be mounted must be flat and have a good surface finish.

It should be perfectly clean and free of foundry scale, paint, weld splatter or other substances which might prevent the two surfaces coming together. (Maximum gap between panel and surface at any one point is 0.2mm)

Special care should be taken around mounting studs or bolt holes to ensure that a weld bead or raised tapping burr does not prevent the panel from lying flat against the surface.

Before fitting the panel, the mounting surface should be smeared with a thin layer of silicon grease or other thermally conductive compound to eliminate any air voids and improve thermal contact.

Sevcon can supply MS4 silicon grease.

Finally the controller should be fastened down using all mounting bolts, evenly tightened, taking care not to trap any loose wires or other foreign objects behind the panel. Recommended fixing is M8 or 5/16" bolt size.

Neglect of any of the above points could cause general or local overheating on the SCR control which would result in premature semiconductor failure after a period of operation.

The Controller, mounted in any position and in the prescribed manner, will operate without ventilation. Care should be taken to protect the panel from dirt and moisture. If necessary a cover may be fitted to prevent the entry of foreign objects.

WIRING

The control should be wired using 35mm^2 cable for the power connections with crimped cable lugs and 16/.02mm^2 cable for the light connections.

BAT+VE TO POWER FUSE (500 AMP) LIVE SIDE.

POWER FUSE (DEAD SIDE) TO LINE CONTACTOR.

LINE CONTACTOR TO ONE END OF MOTOR FIELD AND CATHODE OF PD1.

ONE END OF MOTOR ARMATURE TO HEATSINK CONNECTION ON PUMP CONTROL.

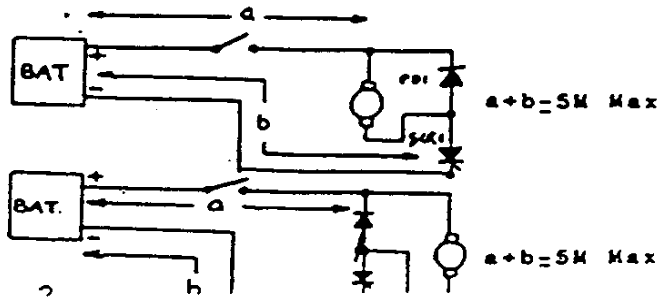
BAT-VE TO BAR CLAMP NEGATIVE CONNECTION

Light Wiring

Pump Logic Output Plug 'A'	Destination
Pin 1	- Neg. side of line Cont. Coil
Pin 2	- One side of SW3
Pin 3	- One side of SW2
Pin 4	- Pos. side of line Cont. Coil
Pin 5	- One side of SW1
Pin 6	- Common side SW1,2,3
Pin 7	- Wiper of VR4
Pin 8	- Bottom of VR4
Pin 9	- Omit
Pin 10	- Top of VR4
Pin 11	- Suppression Output

(Only used in conjunction with other Sevcon equipment)

NOTE: Motor Inductance
Min. 25mH - Max. 1mH
Power Cable length
5 Metres Battery Lead



PRELIMINARY CHECKS AND COMMISSIONING

Check:

All tools, nuts, washers, swarf and other debris has been cleared from the vicinity of all electrical parts. All electrical connections are tight and terminated correctly. VR1, VR2 and VR3 fully anti-clockwise.

Using a suitable ohmmeter ensure that there are no short circuits between battery positive and negative of the controller (battery disconnected).

Disconnect one of the motor leads on the controller and insulate the bare cable lug. Fit output Plug A to the controller.

Connect the battery and close the keyswitch.

With a suitable multimeter set on the appropriate voltage ranges, check the following Pin numbers of Plug A with respect to negative:-

Pin Number	Correct Voltage
A1	Battery Voltage
A2	Battery Voltage
A3	Battery Voltage
A4	Battery Voltage
A5	Battery Voltage
A6	0v
A7	4-8v
A8	4-8v
A9	-
A10	9-11v

Carry out the following checks:-

Close SW1
Line contactor pulls in
Open SW1
Line contactor drops out
Close SW2 (if fitted)
Line contactor pulls in
Open SW2
Line contactor drops out
Close SW3 (if fitted)
Line contactor pulls in
Open SW3
Line contactor drops out
Open keyswitch
Disconnect Battery
Reconnect Motor Lead
Connect Battery
Close Keyswitch
Close SW1
Check Unit Pulses
Operate VR4
Motor speed should increase as VR4 is adjusted

SETTING UP PROCEDURE

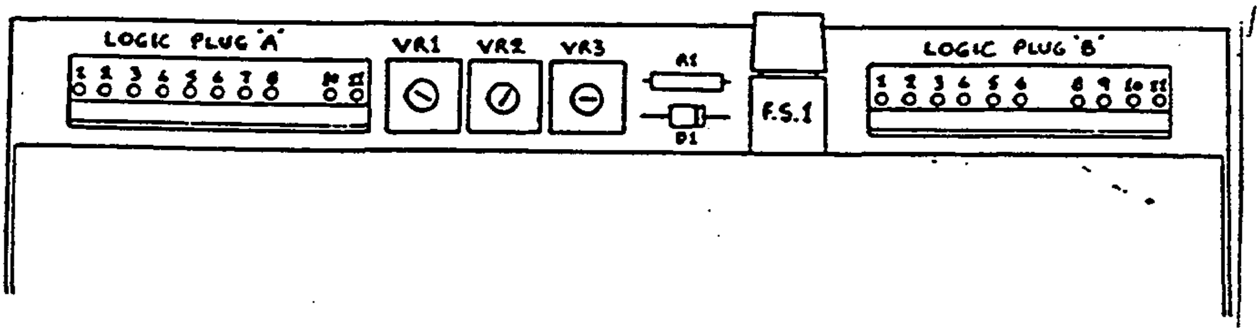
Set VR1, VR2 and VR3 anticlockwise (min. speed) and link A7 to A10 (wiper of VR4 to bottom of Potentiometer). CLose SW1 and adjust VR1 clockwise to give minimum motor speed required to maintain hydraulic flow. Open SW1, remove link from A7 to A10 and check operation of VR4 by closing SW1 and adjusting VR4. The motor speed should increase from the minimum previously set up to maximum. On units not using VR4 the motor should run up to maximum speed in a controlled fashion. SW1 is now set.

SW1 and SW3 open. Close SW2. Adjust VR2 until motor is operating at a speed sufficient to maintain a flow correct for the function selected. SW2 is now set.

SW1 and SW2 open. Close SW3. Adjust VR3 until motor is operating at a speed sufficient to maintain a flow correct for the function selected. SW3 is now set.

SYNCHRONISING FEEDS

It two or more Sevcontrollers are used from the same battery problems may arise due to 'OFF' and 'ON' pulses being fired simultaneously by different controllers thus removing energy from the commutation capacitor and causing a failure to commutate. The pump logics delays the firing of an 'ON' pulse for a few microseconds after an 'OFF' pulse is fired. The external connection to this circuit is simple buss pin (Pin 11 Plug A). This pin should be connected to similar pins on other units e.g., second pump control unit, MCF traction units etc. If no other controllers are fitted the pin is left unconnected. If controllers from other manufacturers are used with a SEVCONTROLLER refer to SEVCON for advice.



The Pump Control Logic allows for various combinations of setting and control. It can be used with or without an adjustable potentiometer (VR4) which allows the motor speed to be varied between the minimum motor speed (VR1) and maximum. VR2 and VR3 set the motor speed for various auxiliary functions. By removing certain components on the Logic various options of operation are obtainable.

Normal Operation

SW1: Used to operate the lift function in conjunction with the speed Pot. VR4 and speed setting Pot. VR1.

Closing SW1 operated the line contactor and allows the motor to run at the speed set by VR1. Adjusting VR4 takes the speed from that setting progressively to maximum speed.

SW2: Used in conjunction with VR2 and will give a medium to fast motor speed. Typical use is tilt function.

Closing SW2 operates the line contactor and allows the motor to run at the speed set by VR2.

SW3: Used in conjunction with VR3 and will give a slow to medium motor speed. Typical use is side shift or reach function.

Closing SW3 operates the line contactor and allows the motor to run at the speed set by VR3.

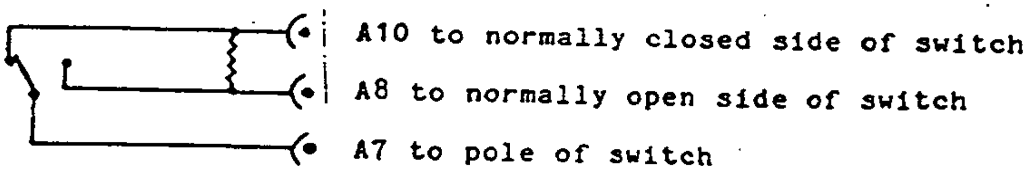
If SW3 is closed and the SW2 is operated the motor will run at the highest pre-set speed. If SW1 and VR4 are then brought into operation they will override SW2 and SW3 and the motor will run at the speed set by VR1 and VR4. In some cases this could mean a reduction in motor speed depending on the settings of the individual speed potentiometers.

Options

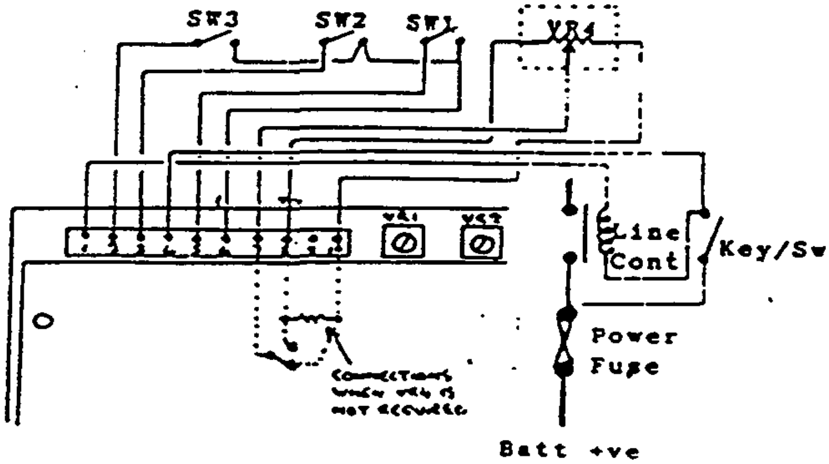
Cut D1 from logics. The motor speed set by VR2 and VR3 will be added together when using SW2 and SW3 simultaneously.

Cut R1 from logics. With SW1 closed and SW2 and/or SW3 operated the motor will run at the highest speed selected. SW1 and VR4 will not override SW2 and SW3.

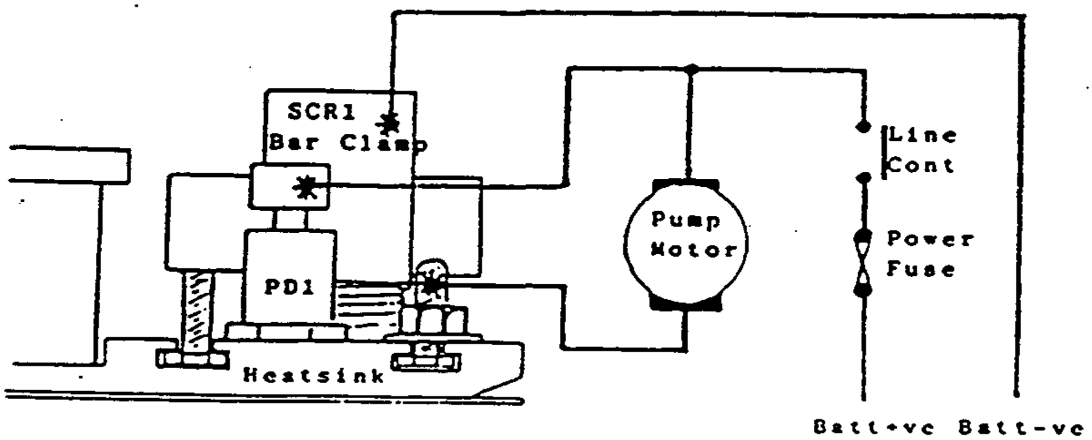
If a variable speed is not required (VR4), then a 5K Ohm resistor must be connected across logic Pins A10 and A8. A microswitch must be used to switch on logic output A7 between A10 and A8 as shown. This switch to operate with SW1 on the hoist lever.



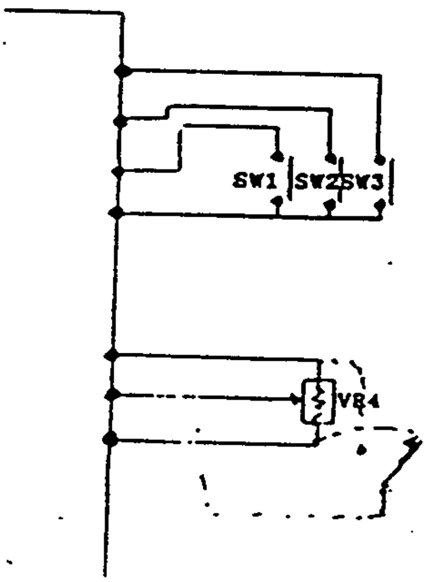
If the controller is required as a 'soft start' (no VR4) but it is not required to run at full speed then output Pin A7 and A10 must be connected together. Motor speed is then controlled by the setting on VR1.



CONTROL WIRING



POWER WIRING



SWITCH FUNCTIONS

SW1 - Use in conjunction with VR4 (Speed Pot). Typically hoist function.

SW2 - Fixed speed controlled by speed set on VR2. Typically medium to fast flow used on tilt function.

SW3 - Fixed speed controller by speed set on VR3. Typically slow flow used on side shift or slow tilt function.

SETTING OF SPEED POTENTIOMETERS

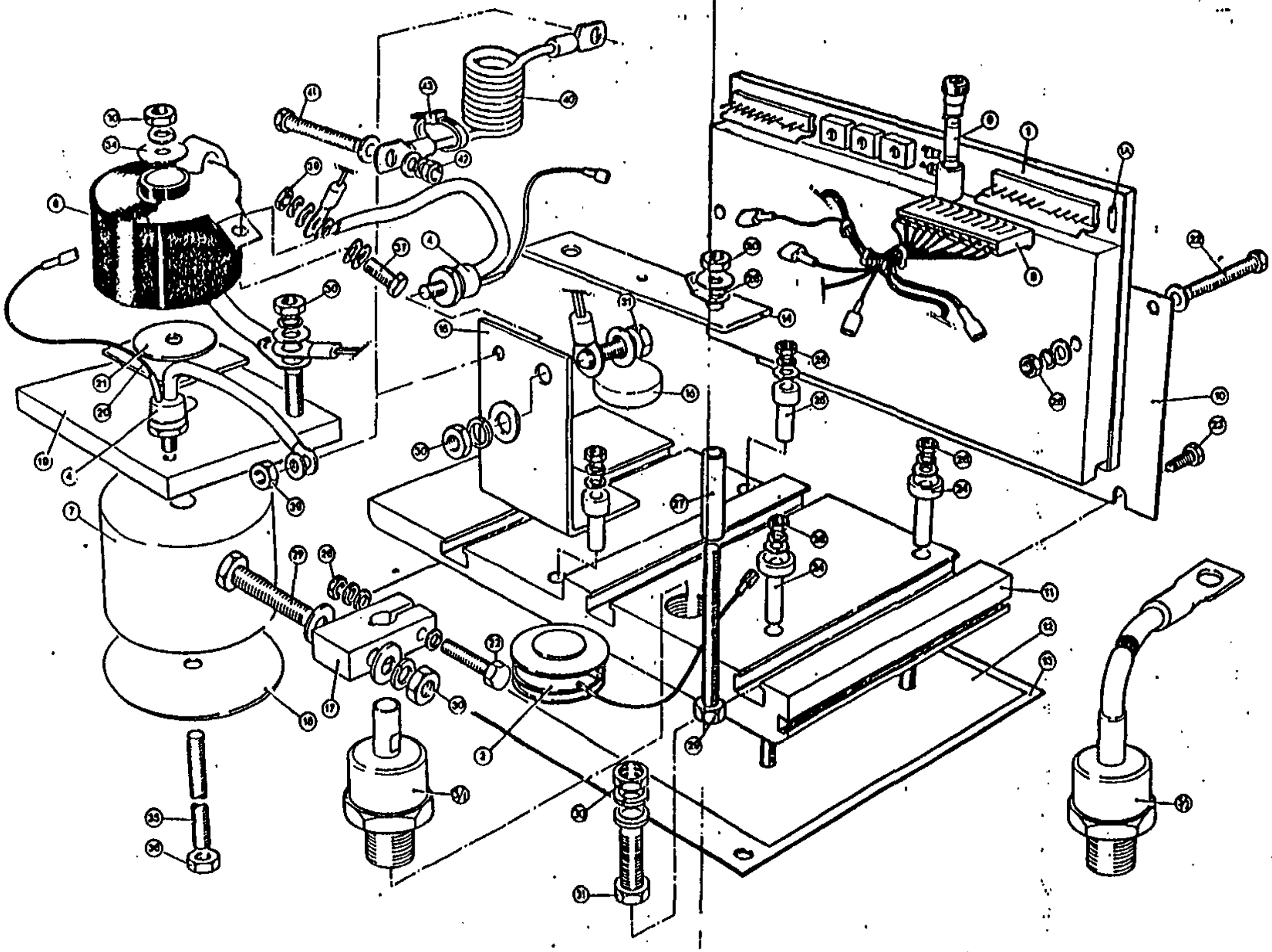
Set VR1, VR2 and VR3 anticlockwise (minimum speed) link A7 to A10 (wiper of VR4 to bottom of Potentiometer) close SW1 and adjust VR1 clockwise to give minimum speed required on motor to maintain hydraulic flow. Open SW1, remove link from A7 and A10 and check operation of VR4 by closing SW1 and operating VR4. Speed should increase from minimum previously set to maximum. SW1 operation is now set.

SW1 and SW3 open, close SW2. Adjust VR2 clockwise until motor is operating at a speed sufficient to maintain a flow correct for the function selected. SW2 operation is now set.

SW1 and SW2 open, close SW3. Adjust R3 clockwise until motor is operating at a speed sufficient to maintain a flow correct for the function selected. SW3 operation is now set.

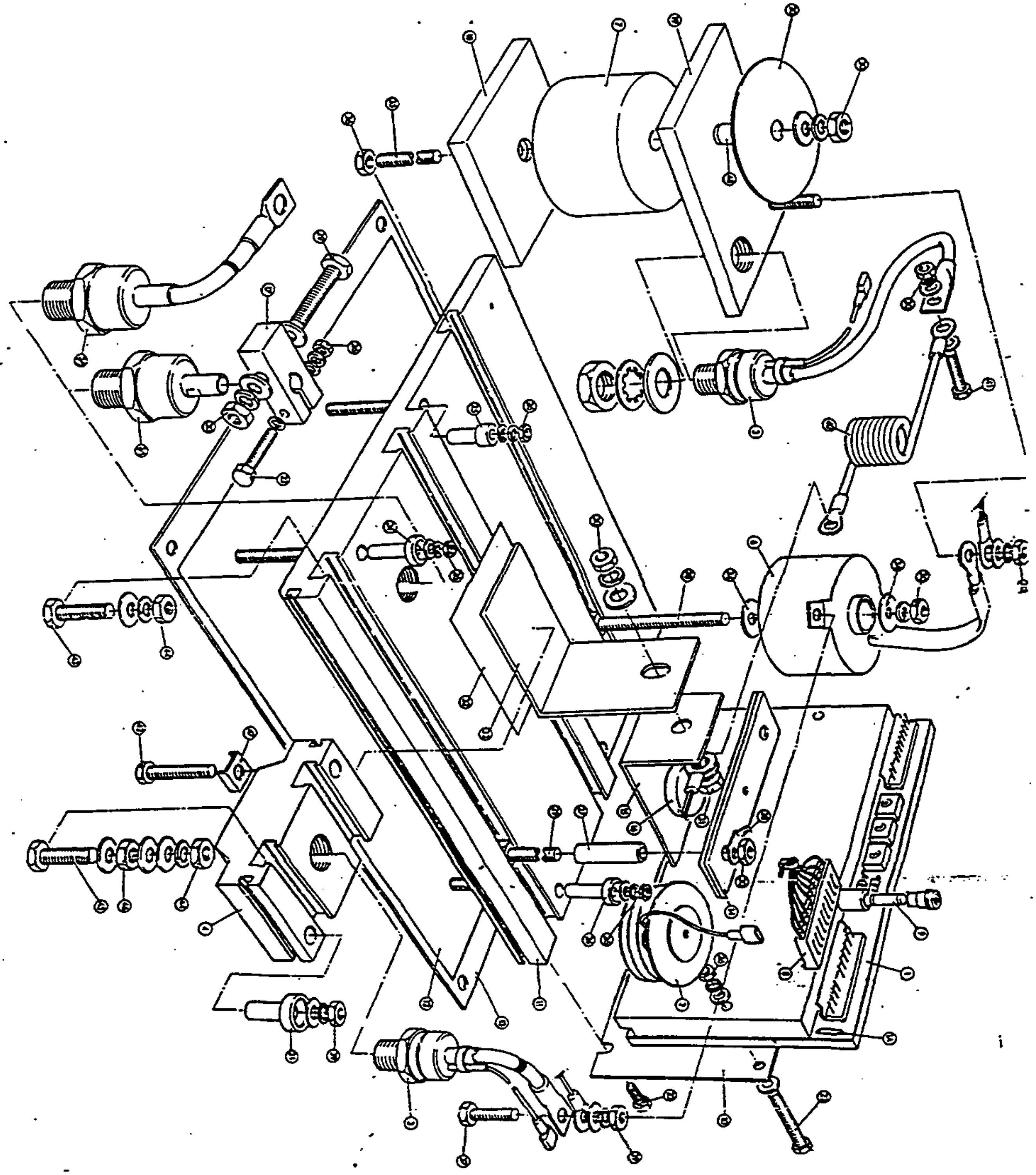
P500 PUMP CONTROL PARTS LIST 179/15015

ITEM	DESCRIPTION	PART NO.
1	Pump Logic Assembly	662/13064
1A	Pump Logic Assembly with Link	662/13066
2	Thyristor	965/53428
4	Thyristor	965/44225
5/1	Diode (Std. Pump Assembly)	840/64202
5/1	Diode (When L2 Option fitted)	840/64250
5/2	Diode (long Lead)	840/64201
6	Coil	122/23011
7	Capacitor	821/57046
8	Harness Assembly	184/21167
9	Fuse	858/20001
10	Mounting Plate	101/65056
11	Heatsink	133/17047
12	Insulating Sheet	151/46122
13	Baseplate Sub. Assembly	677/11038
14	Clamp	101/18042
15	Link	130/50922
16	Insulator	151/41043
17	Cable Clamp	825/12001
18	Capacitor Clamp Plate	130/18051
19	Capacitor Clamp Sub. Assembly	678/17032
20	Insulating Sheet	151/46077
21	Large Dia. Washer	470/70315
22	M5 x 30 Screw (St. Z.P.)	501/12512
23	M5 x 16 Taptite Screw	507/32534
24	Insulating Bush	151/16153
25	Insulating Bush	151/16151
26	M5 Full Nut (St. Z.P.)	550/10307
27	Insulating Spacer	151/72060
28	Male Lucar Connector	963/81357
29	M8 x 40 Screw (St. Z.P.)	501/12814
30	M8 Full Nut (St. Z.P.)	550/10309
31	M8 x 20 Screw (St. Z.P.)	501/12810
34	M8 21 x 18 Flatwasher	570/30308
35	M8 x 130 M8 Stud (Br. Z.P.)	592/20826
36	M8 Half Nut (St. Z.P.)	550/40309
37	M6 x 12 Screw (St. Z.P.)	501/12607
39	M6 Full Nut (St. Z.P.)	550/10308
40	Coil (L2 Option)	122/12001
41	M6 x 30 Screw (Br. Z.P.)	501/12662
42	M6 Full Nut (Br. Z.P.)	550/12308
43	Tyrap	826/82177

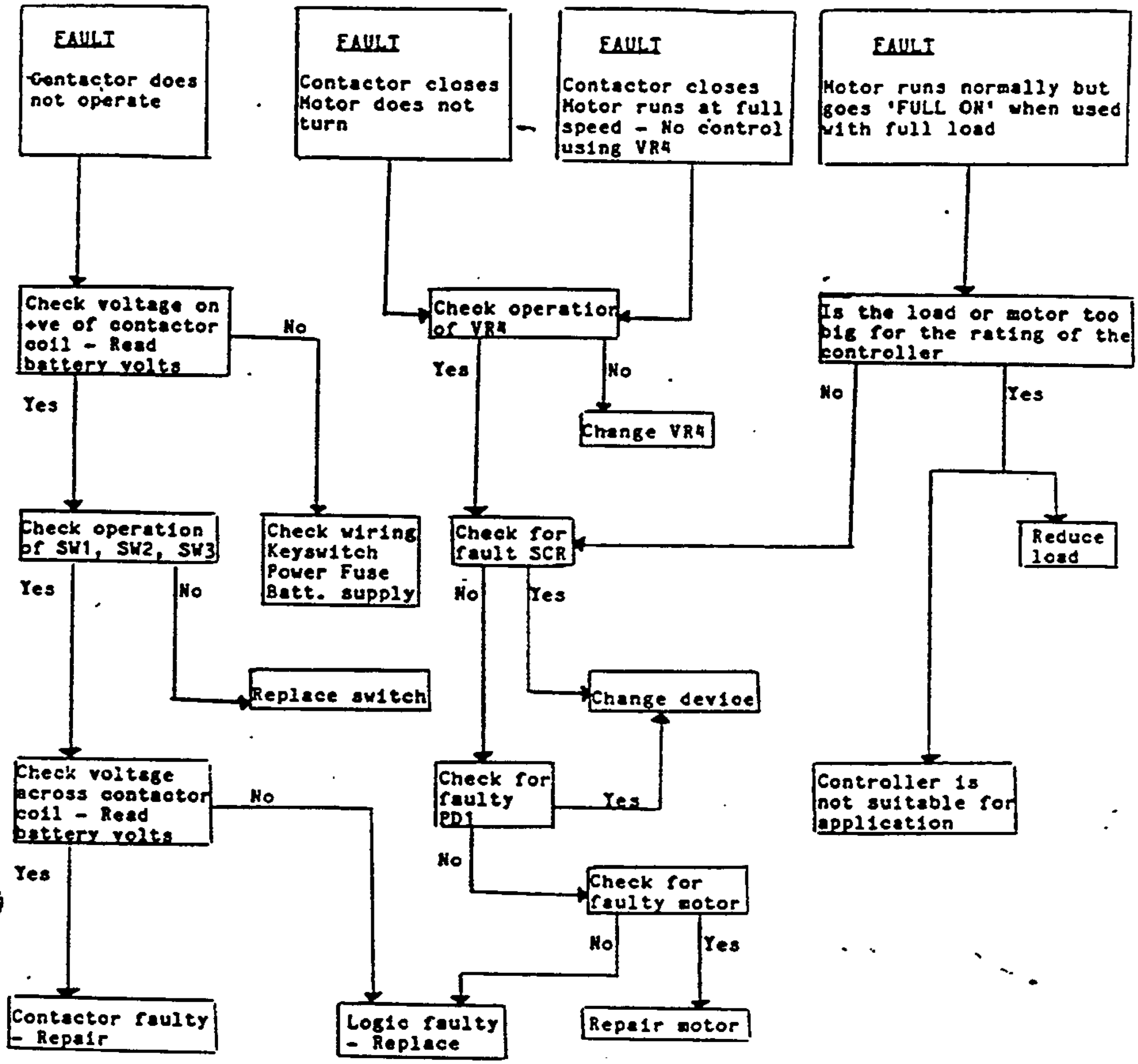


P1000 PUMP CONTROL PARTS LIST 179/15016

ITEM	DESCRIPTION	PART NO.
1	Pump Logic Assembly	662/13064
1A	Pump Logic Assembly with Link	662/13066
2	Thyristor SCR1	965/64448
3	Thyristor SCR2 & 3	965/55222
4	Heatsink	133/17059
5/1	Diode	840/64250
5/2	Diode (Long Lead)	840/64201
6	Coil	122/23011
7	Capacitor	821/57095
8	Harness Assembly	184/21167
9	Fuse	858/20001
10	Mounting Plate	101/65056
11	Heatsink	133/17058
12	Insulating Sheet	151/46167
13	Baseplate Assembly	677/11049
14	Clamp	101/18042
15	Link	121/59034
16	Insuator	151/41043
17	Cable Clamp	825/12001
18	Capacitor Bottom Plate	130/65029
19	Capacitor Plate Assembly	687/17042
20	Insulating Sheet	151/46109
21	Insulating Bush	151/16105
22	M5 x 30 Screw (St. Z.P.)	501/12512
23	M5 x 16 Taptite	507/32534
24	Insulating Bush	151/16153
25	Insulating Bush	151/16151
26	M5 Full Nut (St. Z.P.)	550/10307
27	Insulating Sleeve	151/72061
28	Male Lucar Connector	963/81357
29	M8 x 55 Screw (St. Z.P.)	501/12817
30	M8 Full Nut (St. Z.P.)	550/10309
31	M8 x 20 Screw (St. Z.P.)	501/12810
32	Insulating Sheet	151/46166
33	Link	121/50933
35	M8 x 95 Stud (St. Z.P.)	590/20819
36	M8 Half Nut (St. Z.P.)	550/40309
37	M6 x 16 Screw (St. Z.P.)	501/12609
38	M8 x 75 Screw (Br. Z.P.)	501/12871
39	M6 Full Nut (St. Z.P.)	550/10308
40	Coil	122/12002
41	M8 x 16 Screw (St. Z.P.)	501/12809
42	M6 x 50 Screw (St. Z.P.)	501/12616
43	M8 x 20 Screw (Br. Z.P.)	501/12860
44	M8 Full Nut (Br. Z.P.)	550/12309
45	M8 x 25 Screw (Br. Z.P.)	501/12861
46	M8 Half Nut (Br. Z.P.)	550/42309
47	Bracket	101/15078
48	Insulating Sleeve	151/71053



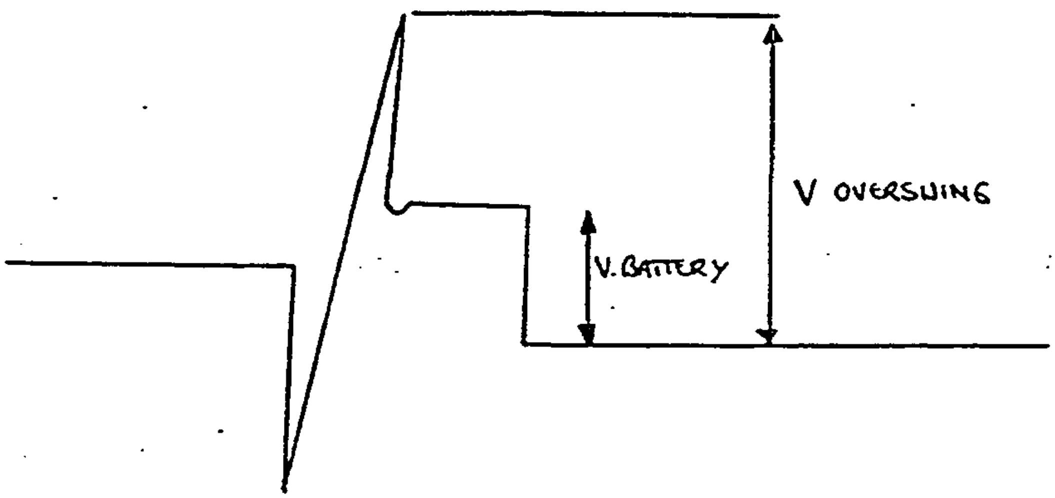
PUMP CONTROL FAULT FLOW CHART



OVERVOLTAGE CHECK ON CONTROLLER

Connect a suitable oscilloscope (see tools section) between B- and the anode of SCR1.

Set time/cm to 1ms/cm and 'Y' amp to 50V/cm (include probe attenuation if applicable). Switch on controller and run up to maximum working load. Note the height of the waveform and measure the overswing voltage as shown below. If the overswing voltage exceeds 180 to 190 volts this is probably due to long battery leads, which must be shortened or a frequent failure and ultimately failure of SCR1 will occur.



ILLEGAL OPERATIONS

1. The Pump Motor should not be shorted out.

2. Motor with inductance outside specification should not be driven - only drive a series motor.

3. Controller should not be run outside the specification.

4. Variations to circuit (other than those mentioned on previous pages) should not be made.

5. Do not flash test or megger controller or truck with controller connected. Use only a suitable multimeter.

VOBHC4

Mico West/SY-TEC

P. O. Box 9058

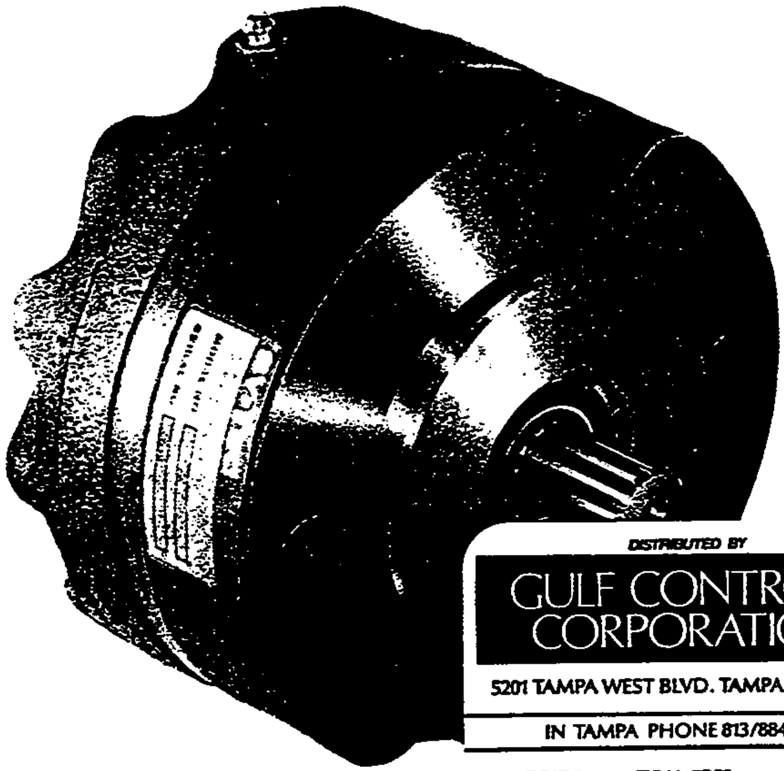
Ontario, CA 91762-9058

SY·TEC SERIES

MULTIPLE DISC BRAKE

(pressure override - SAE B size)

SERVICE MANUAL MICO



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FORM NO. 81-590-001 8/86

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TYPICAL BRAKE

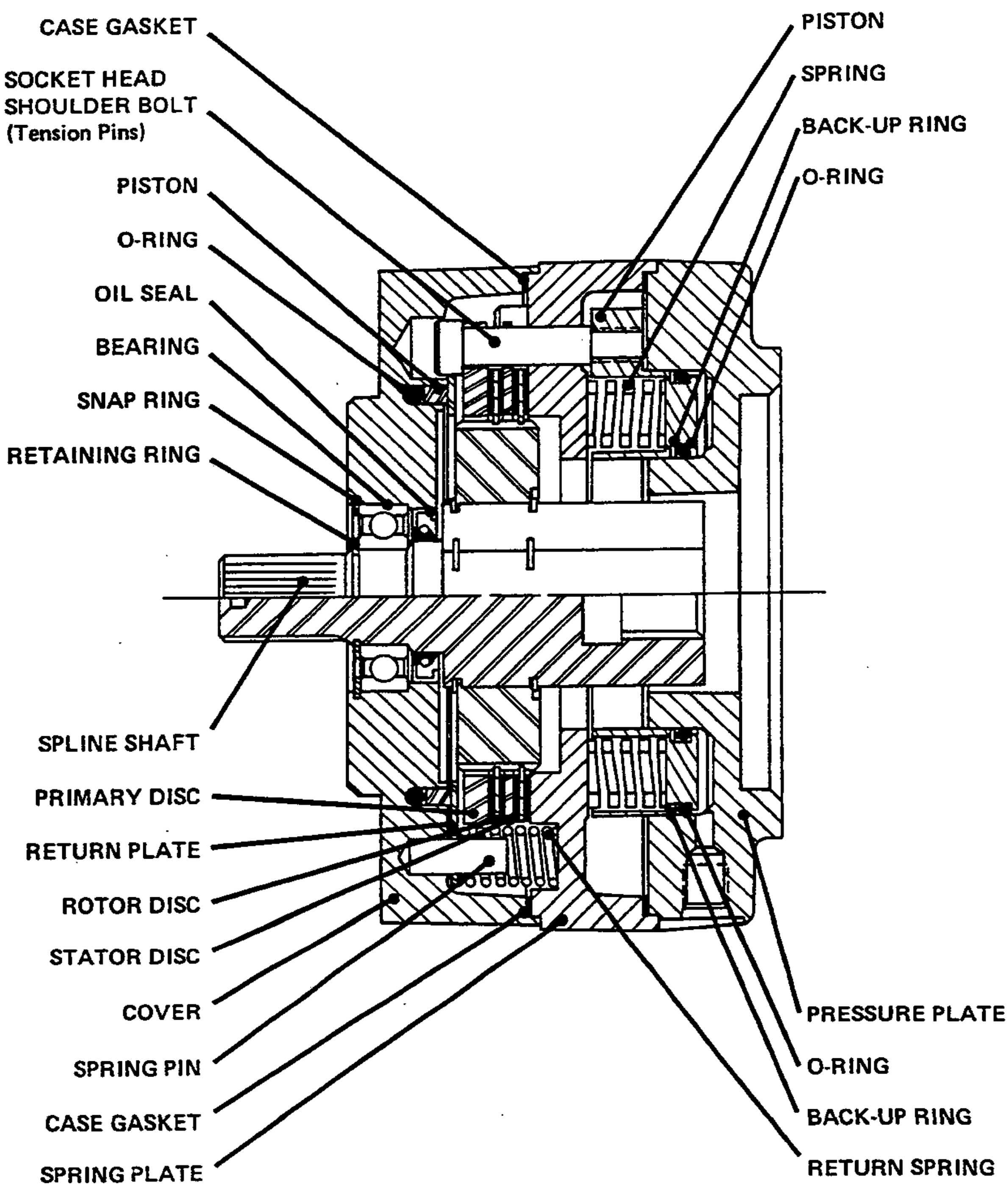

FIGURE 1

PRINCIPLES OF OPERATION

These brakes are spring set hydraulically released multiple disc brakes with a secondary pressure apply piston. The secondary piston allows modulation of the brake torque via any external pressure source. This type of brake is used primarily where positioning and limited dynamic braking is required. The parking or safety brake portion of a pressure override brake, although rated 3,000 psi, require only 100 psi to 220 psi to make them function normally. The exact pressure required for operation is dependent upon the number of springs used to generate the torque necessary to hold the designed load. Thus, a brake with a full compliment of springs, will generate the highest level of torque and require approximately 220 psi to fully release the brake and provide adequate running clearance for the individual discs. A brake with half of the full spring compliment will have half as much torque and will require only 100 psi to fully release the brake. Consult catalog to choose the torque which best suits your design parameters.

It is important to remember that any pressure on the brake's release piston will directly affect the level of torque.

Two application examples:

1. The brake has a release pressure of 200 psi. The actuation pressure is provided by a charge pump. During certain phases of the machine's operation, the charge pump pressure dips from 200 psi to 100 psi. At 200 psi the brake runs free (zero torque) but at 100 psi the brake will generate slightly less than half of its rated torque. The brake will drag - failure may occur. In this case, a brake should be selected which has a lower release pressure.
2. A brake has a release pressure of 200 psi. The system is set up to hold a load when a variable pump is shifted into neutral. Everything is running fine until the filter clogs, causing a build up of back-pressure in the return line to the tank. At a pressure of 60 psi, the brake will lose 25% of its holding torque, thus the load may slip. The situation can be corrected by replacing the filter or adding an extra margin of safety to your required brake torque in the initial design.

The service portion of a pressure override brake can be modulated by a master cylinder or hydraulic power brake valve. The modulation of the service portion in no way affects the release pressure of the safety brake portion. It is imperative that residual pressures in the modulating circuit do not exceed 8 psi and maximum operating pressures do not exceed 600 psi or damage may result. In all but a very few applications, flow thru oil cooling is required in this type of brake. It is very important that case pressures do not exceed 15 psi or leakage will occur. These brakes are designed to give thousands of trouble free hours of service when set up correctly in the hydraulic circuit.

DESCRIPTION OF MODEL NUMBERS

PB-1313 ** - * - *

PRESSURE OVERRIDE

GEAR BOX OUTPUT FACE
SAE2—Bolt B

INPUT SPLINE
13T 16/32

MOTOR INPUT FACE
C — C Mt.
M — Ross, White

TORQUE

Code	Torque	Rel. Press.
40	2800	190
35	2400	150
29	1900	135
25	1600	120
18	1200	100

OUTPUT SPLINE
13T 16/32

OPTIONS
Z — Wet Option

BLEEDING

1. Install brake in system and connect pressure lines.
2. Bleed pressure release section of brake by pressurizing side inlet port and allowing air to escape from top port. Pressure should not exceed 100 psi during bleeding.
3. Apply sufficient pressure to release brake and check for proper operation in system.

SERVICE DIAGNOSIS

PROBLEM	CAUSE	EXPLANATION	ACTION
Brake slips	A. Excessive pressure in hydraulic system	If there is back pressure in the brakes actuation line, the holding torque of the brakes is reduced.	Check filters, hose size, restrictions in other hydraulic components.
	B. Oil in brake if designed for dry use	Dry linings generate 66% more torque than linings saturated with oil. If the brake has oil in it, check the type of pil hydraulic or gearbox. 1. Gearbox oil 2. Hydraulic oil 3. Hydraulic oil	Replace oil seal in brake Check motor seal Check piston seals Note: Internal components will need to be inspected, cleaned and replaced as required.
	C. Disc plates worn	The thickness of the disc stack sets the torque level. A thin stack reduces torque.	Check disc thickness
	D. Springs broken or have taken a permanent set	Broken or set springs can cause reduced torque - a rare occurrence	Check release pressure (see spring replacement)
Brake drags or runs hot	A. Low actuation pressure	The brake should be pressurized to minimum of 20 psi over the specified release pressure under normal operating conditions. Lower pressures will cause the brake to drag thus generating heat.	Place pressure gauge in bleed port & check pressure with system on
	B. Bearing failure	If the bearing should fail, a large amount of drag can be generated	Replace bearing
	C. Oil in brake	Excess fill of oil in sump condition thru wet brakes can cause the unit to run hot. Also excessive rpm in sump condition.	Drain oil and refill as specified for brakes Switch to flow thru cooling.
Brake will not release	A. Stuck valve or clogged	Brakes are designed to come on when system pressure drops below stated release pressure. If pressure cannot get to brake, the brake will not release.	Place pressure gauge in bleed port - check for adequate pressure - Replace defective line or component
	B. Bad o-rings	If release piston will not hold pressure, brake will not release.	
	C. Discs frozen	Sy-Tec brakes are designed for only limited dynamic braking. A severe emergency stop or prolonged reduced release pressure operation may result in this type of damage.	Replace disc stack