



Service and Maintenance Manual

Model 60HT 60HTH

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ANSI

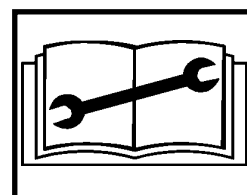


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INTRODUCTION — MAINTENANCE SAFETY PRECAUTIONS

A. GENERAL.

1. This section contains the general safety precautions which must be observed during maintenance of the aerial platform. It is of utmost importance that maintenance personnel pay strict attention to these warnings and precautions to avoid possible injury to themselves or others or damage to the equipment. A maintenance program must be established by a qualified person and must be followed to ensure that the machine is safe to operate.

WARNING

MODIFICATION OF THE MACHINE WITHOUT CERTIFICATION BY A RESPONSIBLE AUTHORITY THAT THE MACHINE IS AT LEAST AS SAFE AS ORIGINALLY MANUFACTURED IS A SAFETY VIOLATION.

2. The specific precautions to be observed during machine maintenance are inserted at the appropriate point in the manual. These precautions are, for the most part, those that apply when servicing hydraulic and larger machine component parts.
3. Your safety, and that of others, is the first consideration when engaging in the maintenance of equipment. Always be conscious of weight.

Never attempt to move heavy parts without the aid of a mechanical device. Do not allow heavy objects to rest in an unstable position. When raising a portion of the equipment, ensure that adequate support is provided.

WARNING

SINCE THE MACHINE MANUFACTURER HAS NO DIRECT CONTROL OVER THE FIELD INSPECTION AND MAINTENANCE, SAFETY IN THIS AREA IS THE RESPONSIBILITY OF THE OWNER/OPERATOR.

B. HYDRAULIC SYSTEM SAFETY.

1. It should be particularly noted that the machines hydraulic systems operate at extremely high and potentially dangerous pressures. Every effort should be made to relieve any system pressure prior to disconnecting or removing any portion of the system.

2. Relieve system pressure by cycling the applicable control several times with the engine stopped and ignition on, to direct any line pressure back into the return line to the reservoir. Pressure feed lines to system components can then be disconnected with minimal fluid loss.

C. MAINTENANCE.

WARNING

FAILURE TO COMPLY WITH SAFETY PRECAUTIONS LISTED IN THIS SECTION MAY RESULT IN MACHINE DAMAGE, PERSONNEL INJURY OR DEATH AND IS A SAFETY VIOLATION.

'NO SMOKING' IS MANDATORY. NEVER REFUEL DURING ELECTRICAL STORMS. ENSURE THAT FUEL CAP IS CLOSED AND SECURE AT ALL OTHER TIMES.

REMOVE ALL RINGS, WATCHES, AND JEWELRY WHEN PERFORMING ANY MAINTENANCE.

DO NOT WEAR LONG HAIR UNRESTRAINED, OR LOOSE-FITTING CLOTHING AND NECKTIES WHICH ARE APT TO BECOME CAUGHT ON OR ENTANGLED IN EQUIPMENT.

OBSERVE AND OBEY ALL WARNINGS AND CAUTIONS ON MACHINE AND IN SERVICE MANUAL.

KEEP OIL, GREASE, WATER, ETC. WIPED FROM STANDING SURFACES AND HAND HOLDS.

USE CAUTION WHEN CHECKING A HOT, PRESSURIZED COOLANT SYSTEM.

NEVER WORK UNDER AN ELEVATED BOOM UNTIL BOOM HAS BEEN SAFELY RESTRAINED FROM ANY MOVEMENT BY BLOCKING OR OVERHEAD SLING.

BEFORE MAKING ADJUSTMENTS, LUBRICATING OR PERFORMING ANY OTHER MAINTENANCE, SHUT OFF ALL POWER CONTROLS.

BATTERY SHOULD ALWAYS BE DISCONNECTED DURING REPLACEMENT OF ELECTRICAL COMPONENTS.

KEEP ALL SUPPORT EQUIPMENT AND ATTACHMENTS STOWED IN THEIR PROPER PLACE.

USE ONLY APPROVED, NONFLAMMABLE CLEANING SOLVENTS.

SECTION 1 — SPECIFICATIONS

1-1. CAPACITIES.

- a. Fuel Tank - 25 U.S. Gallons (94.60 L).
- b. Hydraulic Oil Tank - 50 U.S. Gallons (189.25 L).
- c. Hydraulic System (Including Tank) - 60 U.S. Gallons (227.10 L) approx.
- d. Torque Hub, Drive - 2.75 Pints (1.30 L).
- e. Torque Hub, Swing - 2.00 Pints (.95 L).

Note

Torque Hubs should be one-half full of lubricant.(EPGL 90)

- f. Engine Crankcase Ford w/Filter - 5 Quarts (4.73 L).
- g. Engine Crankcase Deutz w/Filter - 9.5 Quarts (8.99 L).
- h. Engine Crankcase Wisconsin w/Filter - 7 Quarts (6.62 L).

1-2. COMPONENT DATA.

a. Engine - Gas.

- (1). Manufacturer/Model - Ford LSG423.
- (2). Oil Capacity - 5 Quarts (4.73 L) w/Filter, 4 Quarts (3.79 L) w/o Filter.
- (3). Cooling System - 16 Quarts (15.14 L).
- (4). Idle RPM.
 - (a). Precision Governor - 1000 - no load.
 - (b). Adeco - 1000 - no load.
- (5). Low RPM
 - (a). Solenoid - 1625 - no load.
 - (b). Adeco - 1800 - no load.
 - (c). Precision - Governor - 1800 - no load.
- (6). High RPM - Gear Pump.
 - (a). Solenoid - 3000 - no load.
 - (b). Adeco - 3000, no load.
 - (c). Precision Governor - 3000 - no load.

(7). High RPM - Piston Pump.

- (a). Solenoid - 2500 - no load.
- (b). Adeco - 2500 - no load.
- (c). Precision Governor - 2500 - no load.

(8). Alternator - 40 Amps.

(9). Battery - 85 Amphour, 550 Cold Cranking Amps.

(10). Fuel Consumption - Low RPM 3.45 GPH (13.06 LPH).

(11). Fuel Consumption - High RPM

- (a). Gear Pump - 4.60 GPM (17.41 LPH).
- (b). Piston Pump - 4.23 GPH (16.01 LPH).

(12). Horsepower - 54 @ 2400 RPM, full load.

b. Engine - Diesel.

- (1). Manufacturer/Model - Deutz F3L912.
- (2). Oil Capacity - 9.5 Quarts (8.99 L) w/Filter, 8.5 Quarts (8.04 L) w/o Filter.
- (3). Low RPM.
 - (a). Solenoid - 1800 - no load
 - (b). Adeco - 1800, no load.
- (4). High RPM.
 - (a). Solenoid - 2450 - no load.
 - (b). Adeco - 2500 - no load.
- (5). Alternator - 33 Amps.
- (6). Battery - 235 Amphours, 475 Cold Cranking Amps.
- (7). Fuel Consumption - Low RPM.
 - (a). Solenoid - 2.03 GPH (7.68 LPH).
 - (b). Adeco - 2.03 GPH (7.68 LPH)
- (8). Fuel Consumption - High RPM.
 - (a). Solenoid - 2.73 GPH (2.76 LPH).
 - (b). Adeco - 2.73 GPH (2.76 LPH).
- (9). Horsepower - 47 @ 2300 RPM - full load.

SECTION 1 — SPECIFICATIONS

c. Engine - Gas.

- (1). Manufacturer/Model - Wisconsin V465D.
- (2). Oil Capacity - 7 quarts (6.62 L) w/filter.
- (3). Low RPM - 1600 - no load.
- (4). High RPM - 2400 - no load.
- (5). Alternator - 37 Amp.
- (6). Battery - 85 Amp hour, 550 Cold Cranking Amps.
- (7). Fuel Consumption - Low RPM - 2.46 GPH (9.31 LPH).
- (8). Fuel Consumption - High RPM - 3.59 GPH (13.59 LPH).
- (9). Horsepower - 60 @ 2400 RPM, full load.

d. Drive System.

- (1). Tires - 14 x 17.5, 10 ply rating, power implement, foam filled 2WD, pneumatic 4WD.
- (2). Drive Motor Displacement.
 - (a). Standard - 5.04 in³/rev.
 - (b). Oscillating Axle - .98 - 2.50 in³/rev.
 - (c). 4WD Rear - 1.22 - 2.50 in³/rev.
 - (d). 4WD Front - 2.50 in³/rev.
- (3). Drive Hub Ratio.
 - (a). Vickers Fixed and 60HTH Fixed and oscillating - 3.6:1.
 - (b). Standard - 35:1.
 - (c). Cast and Steel Spindle, 60 HTH Fixed and oscillating, Vickers - 18:1.
 - (d). 4WD - 53.58:1.
- (4). Drive Brake - Automatic spring applied, hydraulically released disc brakes (4WD same).
- (5). Tire Pressure - 95 PSI (4WD).

e. Steer System.

- (1). Tires - 14 x 17.5, 10 ply, rib implement, foam filled (4WD, power implement, pneumatic).
- (2). Toe-in, adjust for 1/4" (6.35 mm) overall.
- (3). Tire Pressure - 95 PSI (4WD).

f. Swing System.

- (1). Swing Motor Displacement - 4.5 in³/Rev.
- (2). Swing Hub Ratio - 69:1.
- (3). Swing Brake - Automatic spring applied hydraulically released disc brakes.

g. Hydraulic Pump (Gear, 4 Bolt Mount) - Wisconsin, Deutz.

- (1). First Section to High Drive - 24 GPM (90.84 LPM).
- (2). Second Section to Racine Proportional Valve - 24 GPM (90.84 LPM).
- (3). Third Section to Bang-Bang Valve - 9.5 GPM (35.96 LPM).
- (4). Clockwise Rotation.

g. Hydraulic Pump (Gear, 4 Bolt Mount) - Deutz, Ford.

- (1). First Section to High Drive Valve - 19 GPM (71.92 LPM).
- (2). Second Section to Racine Proportional Valve - 19 GPM (71.92 LPM).
- (3). Third Section to Bang-Bang Valve - 9.5 GPM (35.96 LPM).
- (4). Clockwise Rotation.

i. Hydraulic Pump (Gear, 2 Bolt Mount) - Wisconsin, Deutz, Ford.

- (1). First Section to Vickers Proportional Valve - 15 GPM (56.78 LPM).
- (2). Second Section to High Drive Valve - 9 GPM (34.07 LPM).
- (3). Third Section to Racine Bang-Bang Valve - 9 GPM (34.07 LPM).
- (4). Clockwise Rotation.

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j. Hydraulic Pump. (Piston w/Piggy-Back Gear Pump) - Ford.

- (1). Piston Pump to HPI Proportional Valve and High Drive Valve - 41 GPM (155.18 LPM).
- (2). Gear Pump to Bang-Bang Valve - 10 GPM (37.85 LPM).
- (3). Clockwise Rotation.

k. Auxiliary Power Pump.

- (1). 3.75 GPM (14.19 LPM).
- (2). 12 VDC Motor.
- (3). Clockwise Rotation.

l. Hydraulic Filter - Tank.

- (1). Return - Bypass Type.
- (2). 10 Microns Nominal.

m. Hydraulic Filter - Inline.

- (1). High Pressure - Non-Bypass Type.
- (2). 10 Microns Nominal.

1-3. PERFORMANCE DATA.

- a. Travel Speed - 3.5 MPH (5.63 KMH).
- b. Gradeability - 20% Hard Surface.
- c. Turning Radius (Outside).
 - (1). 60HT - 15 Feet 0 Inches (4.57 m).
 - (2). 60HTH - 18 Feet 3 3/4 Inches (5.58 m).
- d. Boom Speed - Extend 35-55 Seconds, Retract 35-55 Seconds.
- e. Boom Speed - Lift Up 32-48 Seconds, Lift Down 32-48 Seconds.
- f. Swing Speed 360° - 60-90 Seconds.
- g. Boom Elevation - -18° to +75°.
- h. Machine Weight (Standard).
 - (1). 60HT - 33,570 Lbs. (15,241.00 KG).
 - (2). 60HTH - 28,130 Lbs. (12,759.77 KG).

i. Machine Height.

- (1). 60HT - 7 Ft. 11 In. (241.30 CM).
- (2). 60HTH - 8 Ft. 2 3/4 In. (250.83 CM) 2WD. 8 Ft. 6 3/4 In. (260.99 CM) 4 WD.

j. Machine Length.

- (1). 60HT - 27 Ft. 8 In. (8.43.28 CM).
- (2). 60HTH - 29 Ft. 1 1/2 In. (887.73 CM).

k. Machine Width.

- (1). 60HT - 6 Ft. 7 In. (200.66 CM).
- (2). 60HTH - 7 Ft. 10 3/16 In. (239.24 CM).

l. Wheel Base.

- (1). 60HT - 84 In. (213.36 CM).
- (2). 60HTH - 102 In. (259.08 CM).

1-4. TORQUE REQUIREMENTS.

Description	Torque Value (Dry)	Interval Hours
A. Bearing To Chassis	110 FT LBS (15.21 KGM)	Initially 200 Then 500
B. Bearing To Turntable	220 FT LBS (30.42 KGM)	Initially 200 Then 500
C. Wheel Lugs	300 FT LBS (41.48 KGM)	50
D. Boom Chains	40 FT LBS (5.53 KGM)	200

Note

See Procedure Section for tightening sequence of turntable and chassis bearing bolts.

Note

When maintenance becomes necessary or a fastener has loosened, refer to the Torque Chart to determine proper torque value.

SECTION 1 — SPECIFICATIONS

1-5. LUBRICATION.

a. Ford LSG 423 Engine.

- (1). Single Viscosity Oils (SF, SF-SE, SF-CC, SF-CD).

When Outside Temp is Consistently	Use SAE Viscosity Number
-10° F. to +60° F.	*10W
+10° F. to +90° F.	20W-20
Above +32° F.	30
Above +50° F.	40

- (2). Multi-Viscosity Oils (SF, SF-SE, SF-CC, SF-CD).

When Outside Temp is Consistently	Use SAE Viscosity Number
Below +10° F.	*5W-20
Below +60° F.	5W-30
-10° F. to +90° F.	10W-30
Above -10° F.	10W-40 or 10W-50
Above +20° F.	20W-40 or 20W-50

*Not recommended for severe service including high RPM operation.

b. Deutz F3L912 Engine.

- (1). Single Viscosity Oils (CD-SE, CD-SF).

When Outside Temp is Consistently	Use SAE Viscosity Number
-20° F. to +25° F.	*10W
+15° F. to +50° F.	20W-20
+40° F. to +85° F.	30
Above 75° F.	40

- (2). Multi-Viscosity Oils (CD-SE, CD-SF).

When Outside Temp is Consistently	Use SAE Viscosity Number
-40° F. to +75° F.	*5W-30 (Synthetic)
-5° F. to +70° F.	10W-30
-5° F. to +85° F.	10W-40
+15° F. to +75° F.	15W-40
Above +15° F.	15W-40

*This viscosity can be used at colder temperatures with engine oil preheating.

c. Wisconsin V465D Engine.

- (1). Single Viscosity Oil (MS, SD, SE).

When Outside Temp. is Consistently	Use SAE Viscosity Number
+120° F. to +40° F.	30
+15° F. to 0° F.	10W

- (2). Multi-Viscosity Oil (MS, SD, SE)

When Outside Temp is Consistently	Use SAE Viscosity Number
+40° F. to +15° F.	20-20W
Below zero	5W-20

***Note**

Do not use any oil heavier than SAE 30 in the Wisconsin Engine.

d. Table 1-1. Hydraulic Oil.

Hydraulic System Operating Temperature Range	SAE Viscosity Grade
0° F. - 180° F. (-18° C. - 83° C.)	Low
0° F. - 210° F. (-18° C. - 99° C.)	10W-20, 10W-30
50° F. - 210° F. (10° C. - 99° C.)	20W-20

SECTION 1 — SPECIFICATIONS

e. Lubricant Key.

Table 1-2. Lubrication Specifications.

KEY	SPECIFICATIONS
MPG	Multipurpose Grease having a minimum dripping point of 350 degrees F. Excellent water resistance and adhesive qualities, and being of extreme pressure type (Timken OK 40 pounds minimum).
EPGL	Extreme pressure gear lube (oil) meeting API service classification GL-5 or Mil-Spec MIL-L-2105.
HO	Hydraulic oil. API Service Classification GL-3, SAE 10W-20, Viscosity Index 152, e.g. Kendall Hyken 052.
EO	Engine (crankcase) oil. Mil-Spec MIL-L-2104.

Note

Refer to Lubrication Chart, Figure 1-1 for specific lubrication procedures.

NOTES:

1. Crankcase oils must meet API Service Classification:

- a. Gas - SF, SF-SE, SF-CC, SF-CD, MS, SD
- b. Diesel - CD-SE, CD-SF

2. Hydraulic oils must have anti-wear qualities at least to API Service Classification GL-3, and sufficient chemical stability for mobile hydraulic system service, (e.g. Kendall Hyken 052).

3. Temperatures listed in above hydraulic oil chart are system cold start to maximum operating temperature.

4. For machines equipped with a steering wheel, hydraulic oil must be diluted with diesel fuel by 20% when ambient temperature is below 20° F (-7° C.). System capacity is approximately 60 U.S. gallons (227.10 L). Add 12 U.S. gallons (45.42 L) diesel fuel after draining an equivalent amount of hydraulic fluid. Diesel fuel will dissipate gradually over time so that this would need to be done each winter as necessary.

1-6. PRESSURE SETTINGS.

a. Proportional Valve, Racine w/Gear Pump

- (1). Main Relief - 2900 PSI.
- (2). Drive - 2900 PSI.
- (3). Lift Up - 2900 PSI.
Lift Down - 1100 PSI.
- (4). Swing - 1200 PSI.

b. Proportional Valve, HPI w/Piston Pump

- (1). Main Relief - 3000 PSI.
- (2). Drive - 3000 PSI.
- (3). Lift Up - 3000 PSI.
Lift Down - 1100 PSI.
- (4). Swing - 1200 PSI.

Note

Allowable variance for above pressures - plus or minus 5%.

Note

The pilot pressure is factory set and normally should not require adjusting. Adjust only if you notice poor or sluggish response to proportional functions or loss of auxiliary power.

c. Proportional Valve, Vickers.

- (1). Main Relief - 3400 PSI.
- (2). Drive - 3200 PSI.
- (3). Lift Up - 2500 PSI (Plus 150 PSI, Minus 0)
Lift Down - 1200 PSI.
- (4). Swing - 1100 PSI.

Note

Allowable variance for above Vickers pressures, plus or minus 150 PSI, except lift up.

- (5). Sequence Valve - 400 PSI.
- (6). Pilot Pressure - 600 PSI.

d. Solenoid Valve

- (1). Main Relief - 2500 PSI.
- (2). Telescope
 - (a). In - 2500 PSI.
 - (b). Out - 1500 PSI.

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- (3). Rotate - 2500 PSI.
- (4). Level.
 - (a). Barrel end - 2500 PSI.
 - (b). Rod end - 1500 PSI.
- (5). Steer.
 - (a). Without Wheel - 1500 PSI.
 - (b). With Wheel - 2500 PSI.

Note

Refer to Section 2 for pressure setting procedures.

Note

Allowable variance for all above Solenoid Valve pressures, plus or minus 5%.

e. High Drive Valve - 2500 PSI.

Note

Refer to Section 2 for pressure setting procedures.

1-7. CYLINDER SPECIFICATIONS.

DESCRIPTION	BORE	STROKE	ROD DIA.
Lift	7.00	36.69	3.00
Master	2.50	15.25	1.25
Slave (Early)	2.50	15.21	1.25
Slave (Late)	15.22	2.50	1.25
Steer (Fixed)	3.00	8.62	1.25
Steer (Oscillate)	3.00	8.06	1.25
Steer (4WD)	3.00	9.81	1.50
Telescope	3.00	185.63	2.00
Lockout (2WD)	4.00	4.87	1.25
Lockout (4WD)	4.00	4.25	1.25

WARNING

WHEN REBUILDING THE MASTER, SLAVE AND LOCKOUT CYLINDERS, APPLY LOCTITE #242 TO PISTON NUT THREADS AND TIGHTEN SECURELY.

WARNING

WHEN REBUILDING THE TELESCOPE, STEER AND LIFT CYLINDERS, APPLY LOCTITE #242 TO PISTON NUT AND SETSCREWS, THEN TIGHTEN SECURELY.

Note

These cylinders use nylon point setscrews which should be discarded and replaced whenever they are removed.

1-8. BOOM TAPE.

a. 1.5:1 Stability.

(1). With Radius Limit System.

- (a). Blue 95.00 In. (241.3 cm).
- (b). Yellow 29.50 In. (74.93 cm).
- (c). Red 65.625 In. (166.69 cm).

(2). Without Radius Limit System

- (a). Blue 95.00 In. (241.3 cm).
- (b). Yellow 29.50 In. (74.93 cm).
- (c). Red 41.625 In. (105.73 cm).
- (d). Orange 24.00 In. (60.96 cm).

(3). 7' Wide Frame.

- (a). Blue 115.875 In. (294.32 cm).
- (b). Yellow 31.75 In. (80.64 cm).
- (c). Red 42.00 In. (106.68 cm).

b. 2:1 Stability

(1). With Radius Limit System.

- (a). Blue 79.375 In. (201.61 cm).
- (b). Yellow 33.75 In. (85.72 cm).
- (c). Red 76.50 In. (194.31 cm).

(2). 7' Wide Frame.

- (a). Blue 98.375 (249.87 cm).
- (b). Yellow 36.25 (92.07 cm).
- (c). Red 55.00 (139.70 cm).

SECTION 1 — SPECIFICATIONS

1-9. MAJOR COMPONENTS WEIGHTS.

Standard machine with Ford engine, basket rotator and three section boom.

Platform (std 3 x 5) less control box = 140 lbs. (63.50 kg)

Boom Complete (incl. a-frame support and rotator) = 3,165 lbs. (1435.64 kg)

Turntable Complete (incl. engine) = 17,825 lbs. (8085.42 kg)

Frame Complete (incl. tires, wheels) = 12,440 lbs. (5642.78 kg)

Frame Complete 60HTH (incl. tires, wheels) = 7,290 lbs. (3306.74 kg)

SECTION 1 — SPECIFICATIONS

SIZE	BOLT DIAMETER D (IN.)	TENSILE STRESS AREA (SQ. IN.)	SAE GRADE 5 BOLTS			SAE GRADE 8 BOLTS			RECOMMENDED TORQUE WRENCH SIZE (PRODUCTION)		
			CLAMP LOAD P (LB.)	TIGHTENING DRY K = 0.20 LB. IN.	TORQUE LUB. K = 0.15 LB. IN.	CLAMP LOAD P (LB.)	TIGHTENING DRY K = 0.20 LB. IN.	TORQUE LUB. K = 0.15 LB. IN.	IN-OZS.	IN-LBS.	FT-LBS.
4	0.1120	0.00604	380	8	6	540	12	9	160	10	
	0.1120	0.00661	420	9	7	600	13	10	160	10	
6	0.1380	0.00909	580	16	12	820	23	17		25	
	0.1380	0.01015	610	18	13	920	25	19		25	
8	0.1640	0.01400	900	30	22	1260	41	31		25	
	0.1640	0.01474	940	31	23	1320	43	32		25	
10	0.1900	0.01750	1120	43	32	1580	60	45		50	
	0.1900	0.02000	1285	49	36	1800	68	51		50	
1/4	0.2500	0.0318	2020	96	75	2860	144	108		100	
	0.2500	0.0364	2320	120	86	3280	168	120		200	
				LB. FT.	LB. FT.		LB. FT.	LB. FT.			
5/16	0.3125	0.0524	3340	17	13	4720	25	18		200	25
	0.3125	0.0580	3700	19	14	5220	25	20		200	
3/8	0.3750	0.0775	4940	30	23	7000	45	35		300	
	0.3750	0.0878	5600	35	25	7900	50	35		300	50
7/16	0.4375	0.1063	6800	50	35	9550	70	55		600	50
	0.4375	0.1187	7550	55	40	10700	80	60		600	50
1/2	0.5000	0.1413	9050	75	55	12750	110	80		1200	100
	0.5000	0.1599	10700	90	65	14400	120	90		1200	100
9/16	0.5625	0.1820	11600	110	80	16400	150	110		1200	100
	0.5625	0.2030	12950	120	90	18250	170	130		1200	100
5/8	0.6250	0.2260	14400	150	110	20350	220	170		1800	150
	0.6250	0.2550	16300	170	130	23000	240	180		1800	150
3/4	0.7500	0.3340	21300	260	200	30100	380	280		2400	200
	0.7500	0.3730	23800	300	220	33600	420	320		2400	200
7/8	0.8750	0.4620	29400	430	320	41600	600	460		3600	300
	0.8750	0.5090	32400	470	350	45800	660	500		3600	300
1	1.0000	0.6060	38600	640	480	51500	900	680		7200	600
	1.0000	0.6630	42200	700	530	59700	1000	740		7200	600
1 1/8	1.1250	0.7630	42300	800	600	68700	1280	960		7200	600
	1.1250	0.8560	47500	880	660	77000	1440	1080		7200	600
1 1/4	1.2500	0.9690	53800	1120	840	87200	1820	1360			
	1.2500	1.0730	59600	1240	920	96600	2000	1500			
1 3/8	1.3750	1.1550	64100	1460	1100	104000	2380	1780			
	1.3750	1.3150	73000	1680	1260	118100	2720	2040			
1 1/2	1.5000	1.4050	78000	1940	1460	126500	3160	2360			
	1.5000	1.5800	87700	2200	1640	142200	3560	2660			

NOTE: Tensile strength for bolt size 4 to 1 - 120,000 (min. psi), size 1 1/8 to 1 1/2 - 105,000 (min. psi).
 *Torque multiplier. Torque specifications are usually given in foot-pounds - - - - lower ranges in inch-pounds or inch-ounces.



Grade 8



Grade 5

Figure 1-1. Torque Chart.

SECTION 1 — SPECIFICATIONS

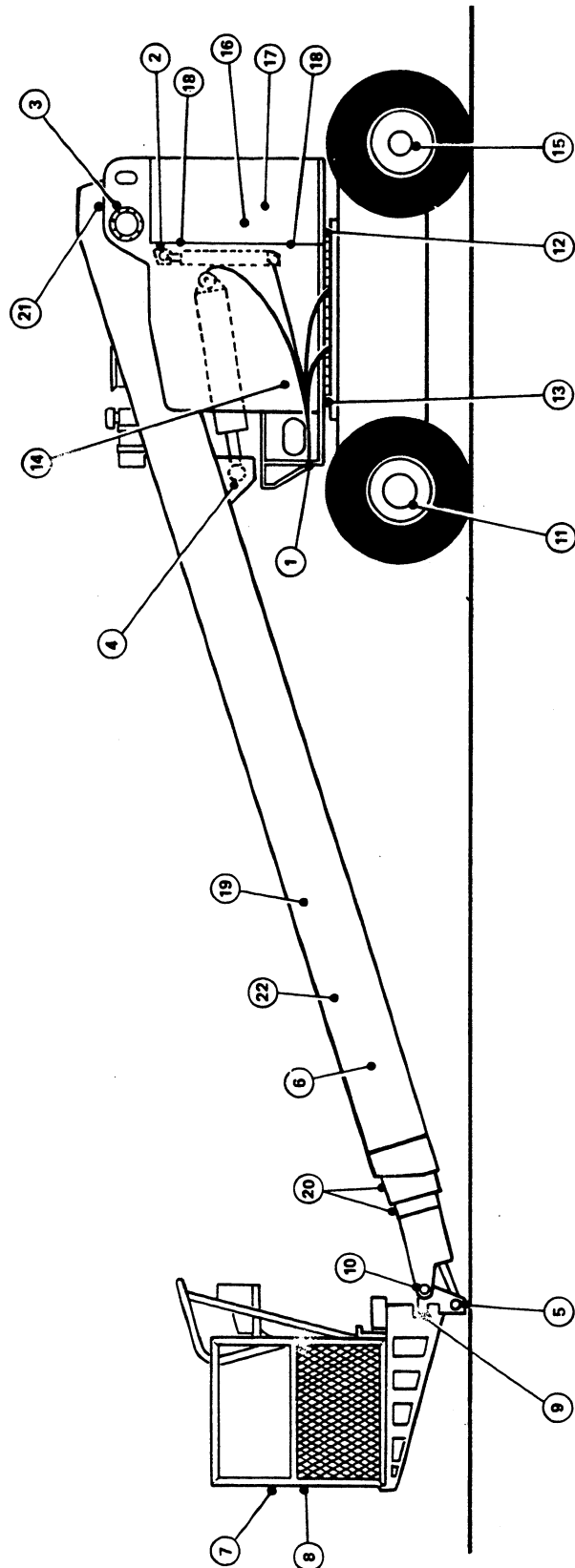


Figure 1-2. Lube Chart (Sheet 1 of 2).

SECTION 1 — SPECIFICATIONS

INDEX NO.	COMPONENT	NUMBER/TYPE LUBE POINTS	LUBE & METHOD	INTERVAL (HOURS)
1	Master Leveling Cylinder (Base Shaft) - Remote Access	1 Grease Fitting	MPG - Pressure Gun	50
2	Swing Bearing - Remote Access	2 Grease Fittings	MPG - Pressure Gun	100
3	Lift Cylinder (Base Shaft) - Remote Access	1 Grease Fitting	MPG - Pressure Gun	50
4	Master Leveling Cylinder (Rod-End Bushing)	1 Grease Fitting	MPG - Pressure Gun	50
5	Boom Pivot Bearings	2 Grease Fittings	MoS ₂ - Pressure Gun	10
6	Lift Cylinder (Rod-End Shaft) - Elevate Boom	2 Grease Fittings	MPG - Pressure Gun	10
7	Slave Leveling Cylinder (Rod-End Shaft)	1 Grease Fitting	MPG - Pressure Gun	50
8	Slave Leveling Cylinder (Base Shaft)	1 Grease Fitting	MPG - Pressure Gun	50
9	Platform Door Hinges	2 Grease Fittings	MPG - Pressure Gun	100
10	Platform Door Latch	N/A	SAE - 10 - Oil Can	100
11	Rotary Platform Control Stand (If Applicable)	2 Grease Fittings	MPG - Pressure Gun	100
12	Platform Attach Pin	1 Grease Fitting	MPG - Pressure Gun	10
13	Wheel Drive Hubs	Fill Plug	EPGL (SAE - 90)	500
14	Swing Bearing Gear	N/A	MPG - Brush	100
15	Speed Reducer Pinion	N/A	MPG - Brush	100
16	Speed Reducer (Turntable)	Fill Plug	EPGL (SAE - 90)	500
17	Steer Spindle	2 Grease Fittings	MPG - Pressure Gun	50
18	Steer Cylinder (Barrel End)	1 Grease Fitting	MPG - Pressure Gun	50
19	Steer Cylinder (Rod End)	1 Grease Fitting	MPG - Pressure Gun	50
20	Wheel Bearings	N/A	MPG - (Repack)	500
21	Engine Crankcase	Fill Cap	EO (SAE - 30)	50
22	Engine Oil Filter	N/A	Replaceable Cartridge	50
23	Door and Access Panel Hinges	N/A	SAE - 10 - Oil Can	200
24	Boom Chains	N/A	SAE - 10 - Oil Bath	500
25	Wear Pad Travel Area	N/A	MPG - Brush	500
26	Boom Chain Retract Sheaves (Align with access hole in base boom.)	2 Grease Fittings	MPG - Pressure Gun	50
27	Boom Chain Extend Sheave (Align with access holes in fly and mid boom.)	1 Grease Fitting	MPG - Pressure Gun	50

Key to Lubricants:

- EPGL — Extreme Pressure Gear Lubricant
- EO — Engine Oil
- MoS₂ — Molybdenum Disulphide Dry Film Lubricant
- MPG — Multi-Purpose Grease

Figure 1-2. Lube Chart (Sheet 2 of 2).

SECTION 2 — PROCEDURES

2-1. GENERAL.

- a. This section provides information necessary to perform maintenance on the aerial platform. Descriptions, techniques and specific procedures are designed to provide the safest and most efficient maintenance for use by personnel responsible for ensuring the correct installation and operation of machine components and systems.

CAUTION

WHEN AN ABNORMAL CONDITION IS NOTED AND PROCEDURES CONTAINED HEREIN DO NOT SPECIFICALLY RELATE TO THE NOTED IRREGULARITY, WORK SHOULD BE STOPPED AND TECHNICALLY QUALIFIED GUIDANCE OBTAINED BEFORE WORK IS RESUMED.

- b. The maintenance procedures included consist of servicing and component removal and installation, disassembly and assembly, inspection, lubrication and cleaning. Information on any special tools or test equipment is also provided where applicable.

2-2. SERVICING AND MAINTENANCE GUIDELINES.

a. General.

The following information is provided to assist you in the use and application of servicing and maintenance procedures contained in this chapter.

b. Safety and Workmanship.

Your safety, and that of others, is the first consideration when engaging in the maintenance of equipment. Always be conscious of weight. Never attempt to move heavy parts without the aid of a mechanical device. Do not allow heavy objects to rest in an unstable position. When raising a portion of the equipment, ensure that adequate support is provided.

c. Cleanliness.

- (1). The most important single item in preserving the long service life of a machine is to keep dirt and foreign materials out of the vital components. Precautions have been taken to safeguard against this. Shields, covers, seals, and filters are provided to keep air, fuel, and oil supplies clean; however, these items must be maintained on a scheduled basis in order to function properly.

- (2). At any time when air, fuel, or oil lines are disconnected, clear adjacent areas as well as the openings and fittings themselves. As soon as a line or component is disconnected, cap or cover all openings to prevent entry of foreign matter.

- (3). Clean and inspect all parts during servicing or maintenance, and assure that all passages and openings are unobstructed. Cover all parts to keep them clean. Be sure all parts are clean before they are installed. New parts should remain in their containers until they are ready to be used.

d. Components Removal and Installation.

- (1). Use adjustable lifting devices, whenever possible, if mechanical assistance is required. All slings (chains, cables, etc.) should be parallel to each other and as near perpendicular as possible to top of part being lifted.
- (2). Should it be necessary to remove a component on an angle, keep in mind that the capacity of an eyebolt or similar bracket lessens, as the angle between the supporting structure and the component becomes less than 90 degrees.
- (3). If a part resists removal, check to see whether all nuts, bolts, cables, brackets, wiring, etc., have been removed and that no adjacent parts are interfering.

e. Component Disassembly and Reassembly.

When disassembling or reassembling a component, complete the procedural steps in sequence. Do not partially disassemble or assemble one part, then start on another. Always recheck your work to assure that nothing has been overlooked. Do not make any adjustments, other than those recommended, without obtaining proper approval.

f. Pressure-Fit Parts.

When assembling pressure-fit parts, use an "anti-seize" or molybdenum disulfide base compound to lubricate the mating surface.

g. Bearings.

- (1). When a bearing is removed, cover it to keep out dirt and abrasives. Clean bearings in nonflammable cleaning solvent and allow to drip dry. Compressed air can be used but do not spin the bearing.

SECTION 2 — PROCEDURES

- (2). Discard bearings if the races and balls (or rollers) are pitted, scored, or burned.
- (3). If bearing is found to be serviceable, apply a light coat of oil and wrap it in clean (waxed) paper. Do not unwrap reusable or new bearings until they are ready to install.
- (4). Lubricate new or used serviceable bearings before installation. When pressing a bearing into a retainer or bore, apply pressure to the outer race. If the bearing is to be installed on a shaft, apply pressure to the inner race.

h. Gaskets.

Check that holes in gaskets align with openings in the mating parts. If it becomes necessary to hand-fabricate a gasket, use gasket material or stock of equivalent material and thickness. Be sure to cut holes in the right location, as blank gaskets can cause serious system damage.

i. Bolt Usage and Torque Application.

- (1). Use bolts of proper length. A bolt which is too long will bottom before the head is tight against its related part. If a bolt is too short, there will not be enough thread area to engage and hold the part properly. When replacing bolts, use only those having the same specifications of the original, or one which is equivalent.
- (2). Unless specific torque requirements are given within the text, standard torque values should be used on heat-treated bolts, studs, and steel nuts, in accordance with recommended shop practices. (See Figure 1-2)

j. Hydraulic Lines and Electrical Wiring.

Clearly mark or tag hydraulic lines and electrical wiring, as well as their receptacles, when disconnecting or removing them from the unit. This will assure that they are correctly reinstalled.

k. Hydraulic System.

- (1). Keep the system clean. If evidence of metal or rubber particles are found in the hydraulic system, drain and flush the entire system.

- (2). Disassemble and reassemble parts on clean work surface. Clean all metal parts with nonflammable cleaning solvent. Lubricate components, as required, to aid assembly.

l. Lubrication.

Service applicable components with the amount, type, and grade of lubricant recommended in this manual, at the specified intervals. When recommended lubricants are not available, consult your local supplier for an equivalent that meets or exceeds the specifications listed.

m. Battery.

Clean battery, using a non-metallic brush and a solution of baking soda and water. Rinse with clean water. After cleaning, thoroughly dry battery and coat terminals with an anticorrosion compound.

n. Lubrication and Servicing.

Components and assemblies requiring lubrication and servicing are shown in Figure 1-2.

2-3. LUBRICATION INFORMATION.

a. Hydraulic System.

- (1). The primary enemy of a hydraulic system is contamination. Contaminants enter the system by various means, e.g., using inadequate hydraulic oil, allowing moisture, grease, filings, sealing components, sand, etc., to enter when performing maintenance, or by permitting the pump to cavitate due to insufficient system warm-up or leaks in the pump supply (suction) lines.
- (2). The design and manufacturing tolerances of the component working parts are very close, therefore, even the smallest amount of dirt or foreign matter entering a system can cause wear or damage to the components and generally results in faulty operation. Every precaution must be taken to keep hydraulic oil clean, including reserve oil in storage. Hydraulic system filters should be checked, cleaned, and/or replaced as necessary, at the specified intervals required in Figure 1-2. Always examine filters for evidence of metal particles.

SECTION 2 — PROCEDURES

- (3). Cloudy oils indicate a high moisture content which permits organic growth, resulting in oxidation or corrosion. If this condition occurs, the system must be drained, flushed, and refilled with clean oil.
- (4). Aside from JLG recommendations, it is not advisable to mix oils of different brands or types, as they may not contain the same required additives or be of comparable viscosities. Good grade mineral oils, with viscosities suited to the ambient temperatures in which the machine is operating, are recommended for use.

Note

Metal particles may appear in the oil or filters of new machines due to the wear-in of meshing components.

b. Hydraulic Oil.

- (1). Refer to Table 1-1 for recommendations for viscosity ranges for gear pumps and gerotor motors.
- (2). SAE 10W-20 is the best all round recommendation and JLG Industries recommends Kendall Hyken 052 hydraulic oil, which has an SAE viscosity of 10W-20 and a viscosity index of 152.

Note

Start-up of hydraulic system with oil temperatures below -15° F. is not recommended. If it is necessary to start the system in a sub-zero environment, it will be necessary to heat the oil with a low density, 100V ac heater to a minimum temperature of -15° F.

- (3). The only exception to the above is to drain and fill the system with Mobil DTE 11 oil or its equivalent. This will allow start-up at temperatures down to -20° F. However, use of this oil will give poor performance at temperatures above 120° F. Systems using DTE 11 oil should not be operated at temperatures above 200° F. under any condition.

c. Changing Hydraulic Oil.

- (1). Use of any of the recommended crankcase or hydraulic oils eliminates the need for changing the oil on a regular basis. However, filter elements must be changed after the first 40 hours of operation and every 250 hours thereafter. If it is necessary to change the oil, use only those oils meeting or exceeding the specifications appearing in this manual. If unable to obtain the same type of oil supplied with the machine, consult local

suppliers for assistance in selecting the proper equivalent. Avoid mixing petroleum and synthetic base oils. JLG Industries recommends changing the hydraulic oil annually.

- (2). Use every precaution to keep the hydraulic oil clean. If the oil must be poured from the original container into another, be sure to clean all possible contaminants from the service container. Always clean the mesh element of the filter and replace the cartridge any time the system oil is changed.
- (3). While the unit is shut down, a good preventive maintenance measure is to make a thorough inspection of all hydraulic components, lines, fitting, etc., as well as a functional check of each system, before placing the machine back in service.

d. Lubrication Specifications.

Specified lubricants, as recommended by the component manufacturers, are always the best choice, however, multi-purpose greases usually have the qualities which meet a variety of single purpose grease requirements. Should any question arise, regarding the use of greases in maintenance stock, consult your local supplier for evaluation. Refer to Table 1-2 for an explanation of the lubricant key designations appearing in the Lubrication Chart.

2-4. CYLINDERS - THEORY OF OPERATION.

- a. Cylinders are of the double-acting type. Systems incorporating double-acting cylinders are as follows: Lift, Telescope, Platform Leveling and Steer. A double-acting cylinder is one that requires oil flow to operate the cylinder rod in both directions. Directing oil (by actuating the corresponding control valve to the piston side of the cylinder) forces the piston to travel toward the rod end of the barrel, extending the cylinder rod (piston attached to rod). When the oil flow is stopped, movement of the rod will stop. By directing oil to the rod side of the cylinder, the piston will be forced in the opposite direction and the cylinder rod will retract.
- b. Holding valves are used in the Lift, Telescope and Slave Level circuits to prevent retraction of the cylinder rod, should a hydraulic line rupture or a leak develop between the cylinder and its related control valve.

SECTION 2 — PROCEDURES

2-5. VALVES - THEORY OF OPERATION.

a. Proportional Control Valve - Vickers.

CMX Series valves provide a power output matching that required by the load. A small line connected to a load sensing port feeds load pressure back to the pump. The pump senses the difference between the load and pump outlet pressures, and varies the pump displacement to keep the difference constant. This differential pressure is applied across the valves meter-in spool, with the effect that pump flow is determined by the degree of spool opening, independent of load pressure. Return lines are connected together simplifying routing of return flow and to help reduce cavitation. Load sensing lines connect through shuttle valves to feed the highest load signal back to the pump. Integral actuator port relief valves, anti-cavitation check valves, and load check valves are standard. The load drop check prevents any drop of a suspended load before upward movement.

b. Solenoid Control Valves. (Bang-Bang)

Control valves used are four-way three position solenoid valves of the sliding spool design. When a circuit is activated and the control valve solenoid energizes, the spool is shifted and the corresponding work port opens to permit oil flow to the component in the selected circuit with the opposite work port opening to reservoir. Once the circuit is deactivated (control returned to neutral) the valve spool returns to neutral (center), and oil flow is then directed through the valve body and returns to reservoir. A typical control valve consists of the valve body, sliding spool, and two solenoid assemblies. The spool is machine fitted in the bore of the valve body. Lands on the spool divide the bore into various chambers, which, when the spool is shifted, align with corresponding ports in the valve body open to common flow. At the same time other ports would be blocked to flow. The spool is spring-loaded to center position, therefore when the control is released, the spool automatically returns to neutral, prohibiting any flow through the circuit.

c. Relief Valves.

Main relief valves are installed at various points with the hydraulic system to protect associated systems and components against excessive pressure. Excessive pressure can be developed when a cylinder reaches its limit of travel and the flow of pressurized fluid continues from the system control. The relief

valve provides an alternate path for the continuing flow from the pump, thus preventing rupture of the cylinder, hydraulic line or fitting. Complete failure of the system pump is also avoided by relieving circuit pressure. The relief valve is installed in the circuit between the pump outlet (pressure line) and the cylinder of the circuit, generally as an integral part of the system valve bank. Relief pressures are set slightly higher than the load requirement, with the valve diverting excess pump delivery back to the reservoir when operating pressure of the component is reached.

d. Crossover Relief Valves.

Crossover relief valves are used in circuits where the actuator requires an operating pressure lower than that supplied to the system. When the circuit is activated and the required pressure at the actuator is developed, the crossover relief diverts excess pump flow to the reservoir. Individual, integral reliefs are provided for each side of the circuit.

2-6. BOOM CHAINS. (See Figure 2-1.)

a. Adjusting Procedures.

WARNING

ENSURE MACHINE IS ON A FIRM AND LEVEL SURFACE.

- (1). Fully retract boom in the horizontal position.
- (2). Torque fly boom retract chain, adjust to 40 ft. lbs. (5.53 Kgm).
- (3). Torque fly boom extend chain, adjust to 40 ft. lbs. (5.53 Kgm).
- (4). Cycle boom (extend at least three feet and return to the fully retracted position).
- (5). Recheck fly boom retract chain (40 ft. lbs. (5.53 Kgm) required).
- (6). Recheck fly boom extend chain (40 ft. lbs. (5.53 Kgm) required).
- (7). Repeat steps #2, #3 and #4 if necessary.
- (8). Check for proper operation of boom.

SECTION 2 — PROCEDURES

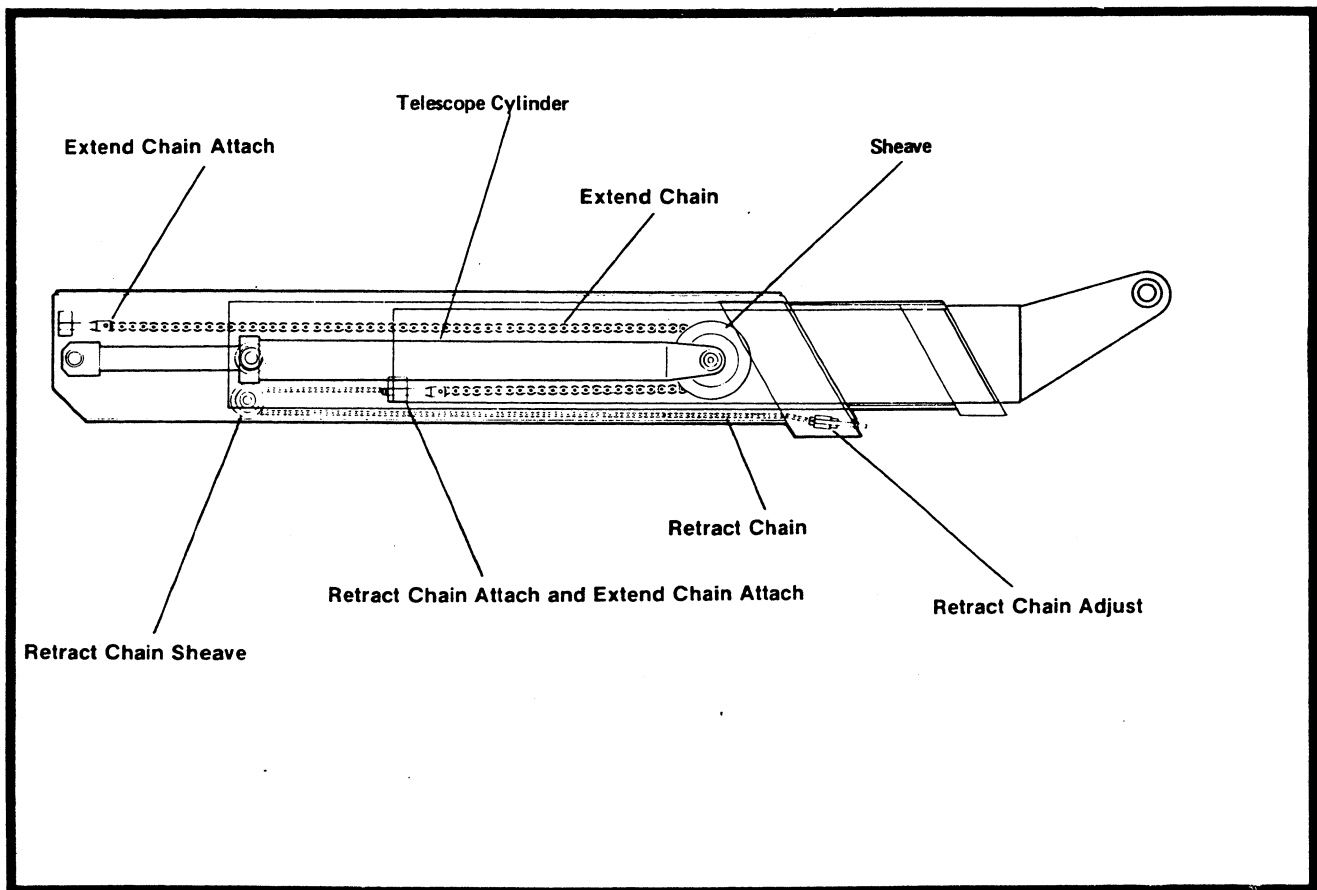


Figure 2-1. Typical Boom Assembly.

b. Inspection Procedures.

WARNING

BOOM CHAINS TO BE INSPECTED AT TIME OF NEXT BOOM OVERHAUL AND WHEN DEEMED NECESSARY BY MACHINE OWNER, BUT NOT TO EXCEED 500 HOURS OF MACHINE OPERATION.

- (1). Inspect boom chains for the following conditions:

- (a). **Wear:** Always inspect that segment of chain that operates over a sheave. As the chain flexes over the extend/retract sheaves, joints and plate edges very gradually wear. Chain "stretch" can be measured using a manufacturers wear scale or steel tape. When chains have elongated 3% they must be removed and replaced. The correct length of any twenty-four pitches of a new chain measures 15.00 inches. If the length of any twenty-four consecutive pitches stretches beyond a length of 15.45 inches, the chain(s) should be replaced immediately. Peening and wear of

chain plate edges are caused by sliding over a chain worn contact face of a sheave, or unusually heavy loads. All of the above require replacement of the chain and correction of the cause. Chain side wear, noticeable when pin heads and outside plates show a definite wear pattern, is caused by misalignment of the sheave/chain anchors and must be corrected promptly. Do not repair chains: if a section of chain is damaged, replace the entire chain set.

- (b). **Rust and corrosion:** Rust and corrosion will cause a major reduction in the load-carrying capacity of the chain, because these are primary reasons for side plate cracking. The initial lubrication at the factory is applied in a hot dip tank to assure full penetration into the joint. Do not steam clean or degrease chains. At time of chain installation, factory lube must be supplemented by a maintenance program to provide a film of oil on the chains at all times.

SECTION 2 — PROCEDURES

If chains are corroded, they must be inspected, especially the outside plates, for cracks in-line with the pins. If cracks are found, replace the chain; if no cracks are discovered, lubricate the chains by dipping in heated oil, and reinstall on the machine. Keep chains lubricated.

Note

Hot Oil Bath for Chains:

50° and Up
30° to 50°
0° to 30°

SAE 40
SAE 30
SAE 20

(c). **Fatigue cracks:** Fatigue is a phenomenon that affects most metals, and is the most common cause of chain plate failures. Fatigue cracks are found thru the link holes, perpendicular (90 degrees) from the pin in-line position. Inspect chains carefully after long time use and heavy loading for this type crack. If any cracks are discovered, replace all chains, as seemingly sound plates are on the verge of cracking. Fatigue and ultimate strength failures on JLG Lifts/Cranes are incurred as a result of severe abuse as design specs are well within the rated lifting capacity of these chains.

(d). **Tight joints:** All joints in the chain should flex freely. On roller chain, tight joints are usually caused by rust/corrosion, or the inside plates "walking" off the bushing. Limber up rusty/corroded chains (after inspecting carefully) with a heavy application of oil (preferably a hot oil dip). Tap inside "walking" plates inward: if "walking" persists change the chain. This type problem is accelerated by poor lubrication maintenance practice, and most tight joint chains have been operated with little or no lubrication. Tight joints on leaf chain are generally caused by:

1. Bent pins or plates.
2. Rusty joints.
3. Peened plate edges.

Oil rusty chains, and replace chains with bent or peened chain components. Keep chains lubricated.

(e). **Protruding or turned pins:** Chains operating with inadequate lube generate tremendous friction between the pin and plates (pin and bushing on roller chain). In extreme cases, this frictional torque can actually turn the pins in the outside press-fit plates. If this happens the pins will slowly work out of the plates. Inspect for turned pins, which can be easily spotted as the "V" flats on the pin heads are no longer in line. Replace all chains showing evidence of turned or protruding pins. Keep chains lubricated.

(f). **Chain anchors and sheaves:** An inspection of the chain must include a close examination of chain anchors and sheaves. Check chain anchors for wear breakage, and misalignment. Anchors with worn or broken fingers should be replaced, they should also be adjusted to eliminate twisting the chain for an even load distribution.

Sheaves should be inspected for worn flanges, which would indicate misalignment, and wear on the outside diameter of the sheave. A worn sheave can mean several problems as follows:

1. Chains too tight.
2. Sheave bearings/pin bad.
3. Bent/misaligned chains.

2-7. WEAR PADS.

- a. Shim up wear pads to within 1/16" (1.59 mm) tolerance between wear pad and adjacent surface.
- b. Replace wear pads when worn within 1/8" (3.18 mm) of insert.

SECTION 2 — PROCEDURES

2-8. DRIFT TEST.

a. Telescope Cylinder.

Note

Switches referenced in this procedure are located on the Ground Control Panel.

- (1). Activate hydraulic system and position boom in stowed position; adhere to all safety precautions.

WARNING

DO NOT EXCEED MANUFACTURER'S RATED PLATFORM CAPACITY. (REFER TO PLACARD ADJACENT TO PLATFORM.)

- (2). Place capacity load on platform; secure load.

WARNING

BEFORE RAISING AND EXTENDING BOOM, ENSURE THAT AREAS ABOVE AND BELOW BOOM AND PLATFORM AND AHEAD OF PLATFORM ARE CLEAR OF ALL OBSTRUCTIONS AND PERSONNEL.

- (3). Position LIFT control switch to UP and hold until boom reaches horizontal.
- (4). Position TELESCOPE control switch to OUT and hold until boom extends approximately four (4) feet; measure from end of base section to end of mid section.
- (5). Position LIFT control to UP and hold until boom reaches maximum elevation (70 degrees).
- (6). Shut down hydraulic system by positioning IGNITION switch to OFF. After engine stops, return switch to ON position.
- (7). Position TELESCOPE control switch to OUT; if boom starts to retract, counterbalance valve is defective and requires replacement.
- (8). If boom does not retract, complete steps (9) through (12).

CAUTION

HYDRAULIC LINES AND PORTS SHOULD BE CAPPED IMMEDIATELY AFTER DISCONNECTING LINES TO AVOID THE ENTRY OF CONTAMINANTS INTO THE SYSTEM.

- (9). Tag and carefully disconnect the hydraulic lines to telescope cylinder. Do not remove manual descent line. Use a suitable container to retain any residual hydraulic fluid. Immediately cap lines and ports.

- (10). Leave boom elevated in test position for approximately one hour.

WARNING

BEFORE LOWERING BOOM, ENSURE THAT AREAS BELOW BOOM AND PLATFORM ARE CLEAR OF ALL PERSONNEL AND OBSTRUCTION.

- (11). Position LIFT control switch on DOWN and hold until boom reaches horizontal; check boom length against original measurement. If boom has retracted more than one inch and oil is leaking around rod-end of telescope cylinder (check with light and inspection mirror), seals are defective and require replacement, or cylinder rod is scored and cylinder requires overhaul or replacement. If boom has retracted and oil is leaking from counterbalance valve, the valve is either improperly adjusted, or defective and requires replacement.
- (12). Connect hydraulic lines to telescope cylinder.

b. Lift Cylinder.

Note

Switches referenced in this procedure are located on Ground Control Panel.

- (1). Activate hydraulic system and position boom in stowed position; adhere to all safety precautions.

Note

Tape measure or cord should be at least seven (7) feet long for use in this test.

- (2). Attach tape measure or cord to bottom of platform.

WARNING

DO NOT EXCEED MANUFACTURER'S RATED PLATFORM CAPACITY. (REFER TO PLACARD ON BOOM, ADJACENT TO PLATFORM.)

- (3). Position capacity load on platform; secure load.

SECTION 2 — PROCEDURES

WARNING

BEFORE RAISING BOOM, ENSURE THAT AREAS ABOVE AND BELOW BOOM AND PLATFORM ARE CLEAR OF ALL OBSTRUCTIONS AND PERSONNEL.

- (4). Place LIFT control switch to UP and hold until platform is approximately six (6) feet above ground level.
- (5). Shut down hydraulic system by positioning IGNITION switch to OFF. After engine stops return switch to ON position. DO NOT START ENGINE.
- (6). Position LIFT control switch to UP; if boom starts to lower counterbalance valve is defective and requires replacement.
- (7). If boom does not lower, complete steps (8) through (10).
- (8). Leave boom elevated in test position for approximately one (1) hour.
- (9). With tape measure or cord used for reference, check to see whether boom has lowered (crept) more than six (6) inches.
- (10). If boom has lowered and oil is leaking around rod-end cap of cylinder, seals in cylinder are defective and require replacement. If boom has lowered and oil is leaking from the counterbalance valve, the valve is either improperly adjusted or defective and requires replacement.

CAUTION

ENSURE THAT HYDRAULIC LINES ARE CONNECTED AS MARKED PRIOR TO BEING DISCONNECTED.

- (11). Connect hydraulic lines to lift cylinder.

2-9. CYLINDER REPAIR.

Note

The following are general procedures that apply to all of the cylinders on this machine. Procedures that apply to a specific cylinder will be so noted.

a. Disassembly.

IMPORTANT

DISASSEMBLY OF THE CYLINDER SHOULD BE PERFORMED ON A CLEAN WORK SURFACE IN A DIRT FREE WORK AREA.

- (1). Connect a suitable auxiliary hydraulic power source to the cylinder port block fitting.
- (2). Operate the hydraulic power source and extend the cylinder. Shut down and disconnect the power source. Adequately support the cylinder rod, if applicable.
- (3). If so equipped, remove the cartridge-type holding valve and fittings from the cylinder port block. Discard o-rings.
- (4). Place the cylinder barrel or cylinder barrel trunnion (telescope cylinder) into a suitable holding fixture.
- (5). Using a suitable spanner wrench loosen the cylinder head retainer, if applicable, and/or cylinder head gland, and remove from cylinder barrel.
- (6). Attach a suitable pulling device to the cylinder rod port block end or cylinder rod end, as applicable.

IMPORTANT

EXTREME CARE SHOULD BE TAKEN WHEN REMOVING THE CYLINDER ROD, HEAD, AND PISTON. AVOID PULLING THE ROD OFF-CENTER, WHICH COULD CAUSE DAMAGE TO THE PISTON AND CYLINDER BARREL SURFACES.

- (7). With the barrel or barrel trunnion clamped securely, apply pressure to the rod pulling device and carefully withdraw the complete rod assembly from the cylinder barrel.
- (8). Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to the piston as possible.
- (9). Remove the setscrew(s), if applicable, and nut which attach the piston to the rod, and remove the piston. Discard setscrews.
- (10). Remove the piston rings.
- (11). Remove and discard the piston o-rings, seal rings, and back-up rings.
- (12). Remove the setscrew, if applicable, piston spacer, and wear ring, if applicable, from the rod.
- (13). Remove the rod from the holding fixture and remove the cylinder head gland, retainer, if applicable, and rod support, if applicable. Discard the o-rings, back-up rings, rod seals, and wiper seals.

b. Cleaning and Inspection.

- (1). Clean all parts thoroughly in an approved cleaning solvent.

SECTION 2 — PROCEDURES

- (2). Inspect the cylinder rod for scoring, tapering, ovality, or other damage. If necessary, dress rod with Scotch Brite or equivalent. Replace rod if necessary.
- (3). Inspect threaded portion of rod for excessive damage. Dress threads as necessary.
- (4). Inspect inner surface of cylinder barrel tube for scoring or other damage. Check inside diameter for tapering or ovality. Replace if necessary.
- (5). Inspect threaded portion of barrel for damage. Dress threads as necessary.
- (6). Inspect piston surface for damage and scoring and for distortion. Dress piston surface or replace piston as necessary.
- (7). Inspect seal and o-ring grooves in piston for burrs and sharp edges. Dress applicable surfaces as necessary.
- (8). Inspect cylinder head inside diameter for scoring or other damage and for ovality and tapering. Replace as necessary.
- (9). Inspect seal and o-ring grooves in head for burrs and sharp edges. Dress applicable surfaces as necessary.
- (10). If applicable, inspect cylinder head retainer or end cap for surface or thread damage. Repair or replace as necessary.
- (11). Inspect cylinder head outside diameter for scoring or other damage and ovality and tapering. Replace as necessary.
- (12). If applicable, inspect thread ring for scoring or other damage. Dress threads or applicable surfaces as necessary.
- (13). If applicable, inspect seal grooves in thread ring for burrs and sharp edges. Dress applicable surfaces as necessary.
- (14). If applicable, inspect rod and barrel bushings for signs of correct lubrication and excessive wear. Replace as necessary.
- (15). Inspect travel limiting collar or spacer for burrs and sharp edges. If necessary, dress inside diameter surface with Scotch Brite or equivalent.
- (16). Inspect port block fittings and holding valve. Replace as necessary.
- (17). If applicable, inspect the oil ports in both the cylinder rod and piston spacer for blockage or the presence of dirt or other foreign material. Repair as necessary.

- (18). If applicable, inspect piston rings for cracks or other damage. Replace as necessary.

Note

Steps (19) through (22) apply to the telescope cylinder only.

- (19). Inspect chain sheave bushings for scoring, tapering, ovality, and for excessive wear and evidence of correct lubrication. Replace bushings as necessary.
- (20). Inspect sheave chain groove for damage. Replace bushings as necessary.
- (21). Inspect sheave attach pin for scoring or other damage and for evidence of correct lubrication. Dress pin surface with Scotch Brite or equivalent or replace pin as necessary.
- (22). Inspect sheave pin lubrication drilling and fitting for blockage or the presence of dirt or other foreign material. Repair as necessary.

c. Assembly.

Note

Prior to cylinder assembly, ensure that the proper cylinder seal kit is used. See your JLG Parts Manual.

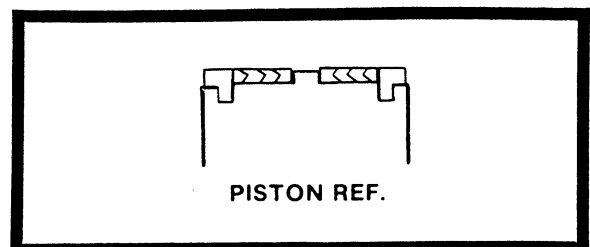
Note

Apply a light film of hydraulic oil to all components prior to assembly.

IMPORTANT

WHEN INSTALLING NEW PISTON SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. REFER TO ILLUSTRATION BELOW FOR CORRECT SEAL ORIENTATION. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

- (1). Place a new wiper seal and rod seal into the applicable cylinder head gland grooves.



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- (2). Carefully install the head gland on the rod, ensuring that the wiper and rod seals are not damaged or dislodged. Push the head along the rod to the rod end or rod support assembly, as applicable.
- (3). Carefully slide the piston spacer on the rod. If applicable, align the oil holes in the rod and the spacer. Secure the spacer, if applicable.
- (4). If applicable, correctly place a new o-ring and back-up rings in the inner piston diameter groove.
- (5). Carefully place the piston on the cylinder rod, ensuring that the o-ring and back-up rings are not damaged or dislodged.
- (6). Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to the piston as possible.

WARNING

WHEN REBUILDING THE TELESCOPE MASTER AND SLAVE LEVEL OR TELESCOPE CYLINDERS, APPLY LOCTITE #242 TO PISTON NUT THREADS AND TIGHTEN SECURELY.

- (7). Push the piston onto the rod until it abuts the spacer end and install the attaching nut.

WARNING

WHEN REBUILDING THE LOCKOUT, LIFT AND STEER CYLINDERS, APPLY LOCTITE #242 TO PISTON NUT AND SETSCREWS, THEN TIGHTEN BOTH SECURELY.

- (8). If applicable, install the setscrew(s) which secure the piston attaching nut to the diameter groove.
- (9). Remove the cylinder rod from the holding fixture.
- (10). Place new o-rings and seals in the applicable outside diameter grooves of both the piston and the cylinder head.
- (11). Position the cylinder barrel in a suitable holding fixture.

IMPORTANT

EXTREME CARE SHOULD BE TAKEN WHEN INSTALLING THE CYLINDER ROD, HEAD, AND PISTON. AVOID PULLING THE ROD OFF-CENTER, WHICH COULD CAUSE DAMAGE TO THE PISTON AND CYLINDER BARREL SURFACES.

- (12). With barrel clamped securely, and while adequately supporting the rod, insert the piston end into the barrel cylinder. Ensure that the piston loading o-ring and seal ring are not damaged or dislodged.
- (13). Continue pushing the rod into the barrel until the cylinder head gland can be inserted into the barrel cylinder or, if applicable, until the cylinder head threads engage the threads of the barrel.
- (14). If applicable, secure the cylinder head gland using a suitable spanner type wrench in the holes provided.
- (15). If applicable, secure the cylinder head retainer using a suitable spanner type wrench in the holes provided.
- (16). Install the cartridge-type holding valve and fittings in the rod port block using new o-rings as applicable.

2-10. TELESCOPE CYLINDER REMOVAL AND INSTALLATION.

a. Removal.

- (1). Be sure boom is fully retracted and in horizontal position.
- (2). Shut down engine.
- (3). Remove boom end-cover.

CAUTION

HYDRAULIC LINES AND PORTS SHOULD BE CAPPED IMMEDIATELY AFTER DISCONNECTING LINES TO AVOID THE ENTRY OF CONTAMINANTS INTO THE SYSTEM.

- (4). Tag and disconnect hydraulic lines to telescope cylinder. Use suitable containers to retain any residual hydraulic fluid. Immediately cap lines and ports.
- (5). Remove the two retaining rings that retain the telescope cylinder pin to the base boom.
- (6). Using a suitable brass drift, carefully drive the telescope cylinder pin from base boom.
- (7). Remove the telescope cylinder trunnion pin covers from each side of the boom.
- (8). Remove the hardware securing the trunnion pins from each side of the boom.
- (9). Using a suitable slide hammer, remove the trunnion pins attaching the telescope cylinder to the mid boom.

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- (10). Attach a suitable sling to the telescope cylinder. Support with an overhead crane or other suitable device.
- (11). Remove the two (2) extension chain adjusting nuts from the eyebolt through the chain adjust assembly.
- (12). Remove the four (4) bolts and lockwashers attaching the chain attach block to the base boom section and remove block.
- (13). Attach a suitable lifting device to the extension chain adjusting eyebolt above cylinder rod.

Note

The extension chain will come out of the boom twice as far as the telescope cylinder.

- (14). Using both lifting devices, carefully pull the cylinder from the boom assembly.
- (15). As the cylinder is removed from the boom, lay the extension chain on top of the base boom.
- (16). Using another lifting device, support the sheave wheel end of the cylinder and remove the cylinder from the boom assembly.
- (17). Carefully lift the cylinder clear of the boom assembly and lower to the ground or suitably supported work area.

b. Installation.

- (1). Using suitable lifting equipment, carefully lower the cylinder to the boom assembly.
- (2). Using another lifting device, support the sheave wheel, or rod end, of the cylinder and install the cylinder into the boom assembly.
- (3). Slide the cylinder into the boom, sliding the extension chain in place as the cylinder is moving in.
- (4). Attach a suitable lifting device to the extension chain adjusting eyebolt.
- (5). Install chain adjust block with four (4) lockwashers and bolts to base boom section.
- (6). Install the two (2) extension chain adjusting nuts that attach the eyebolt to the chain adjust block.
- (7). Remove the lifting devices from the telescope cylinder.

- (8). Using a suitable brass drift install the trunnion pins attaching the telescope cylinder to the mid boom section.
- (9). Install the hardware securing the trunnion pins to each side of the boom. Note that loctite 242 is required on the capscrew threads.
- (10). Install trunnion pin covers on each boom side.
- (11). Carefully install the telescope cylinder rod attach pin into the base boom.
- (12). Install the retaining rings that retain the telescope cylinder pin to the base boom.
- (13). Remove applicable hydraulic line and port caps and correctly connect the hydraulic lines to the telescope cylinder. Ensure all hoses are correctly routed.
- (14). Install boom end cover.
- (15). Activate hydraulic system.
- (16). Using all applicable safety precautions, operate the boom functions. Check for correct operation and hydraulic leaks. Secure as necessary.
- (17). Cycle (extend/retract) boom several times, then torque boom chains to 40 ft. lbs. (5.53 Kgm). See Section 2- for correct torquing procedure.
- (18). Check fluid level of hydraulic tank and adjust as necessary.

2-11. TILT ALARM SWITCH LEVELING.

CAUTION

PERFORM TILT ALARM SWITCH LEVELING PROCEDURE A MINIMUM OF EVERY SIX MONTHS TO ENSURE PROPER OPERATION AND ADJUSTMENT OF SWITCH.

- a. Park the machine on a flat, level surface. Ensure machine is level and tires are filled to rated pressure if pneumatic.

Note

Ensure switch mounting bracket is level and securely attached.

- b. Level the base of the indicator by tightening the three flange nuts through approximately one half of its spring travel. **DO NOT ADJUST THE "X" NUT DURING THE REMAINDER OF THE PROCEDURE.**

SECTION 2 — PROCEDURES

- c. With the electrical connections complete, slowly tighten one of the "Y" nuts until the circuit is closed and the light on the Platform Control Console illuminates.
 - d. Slowly back off the nut, counting the number of turns, until the circuit is again closed and the light again illuminates.
 - e. Divide the number of turns determined in step d in half. Tighten the nut this many turns. The line determined by this nut and the "X" nut is now parallel to the ground.
 - f. Repeat steps c through e for the remaining "Y" nut. The switch is now level.
 - g. Individually push down on one corner at a time; there should be enough travel to cause the switch to trip. If the switch does not trip in all three tests, the flange nuts have been tightened too far. Loosen the "X" nut and repeat steps c through g.
- c. Using the punched mark as a center, drill a .312 inch diameter hole .75 inches deep.
 - d. Tap the hole .38-16 N.C. x .56 DP. Remove burrs.
 - e. Install a new socket setscrew into the newly drilled holes.

Note

The procedure listed above may also be observed when replacing the bushing; choose a point which diametrically opposes the original pin end bore, punch center point, drill and tap to the above specifications.

Note

No more than two holes should be drilled in either the pin or bushing; always replace pin or bushing if a new bore becomes necessary.

2-12. SLAVE CYLINDER PIN. (See Figure 2-2.)

- a. Insert a cross pin; if necessary, tap pin until pin end is flush with bushing edge.
- b. Choose a point diametrically opposing the original bore and located on the inner edge of bushing/outer edge of pin. Mark the point with a punch.

2-13. TELESCOPE CYLINDER ECCENTRIC BUSHING.

- a. When replacing eccentric bushings, drill 5/16" diameter x 3/4" deep, tap 3/8-16 NC x 9/16" deep for new set screws (pin to bushing and bushing to boom) either above or below original holes. Allow enough room between holes for strength while staying on the thick side of the bushing. (See Figure 2-3.)

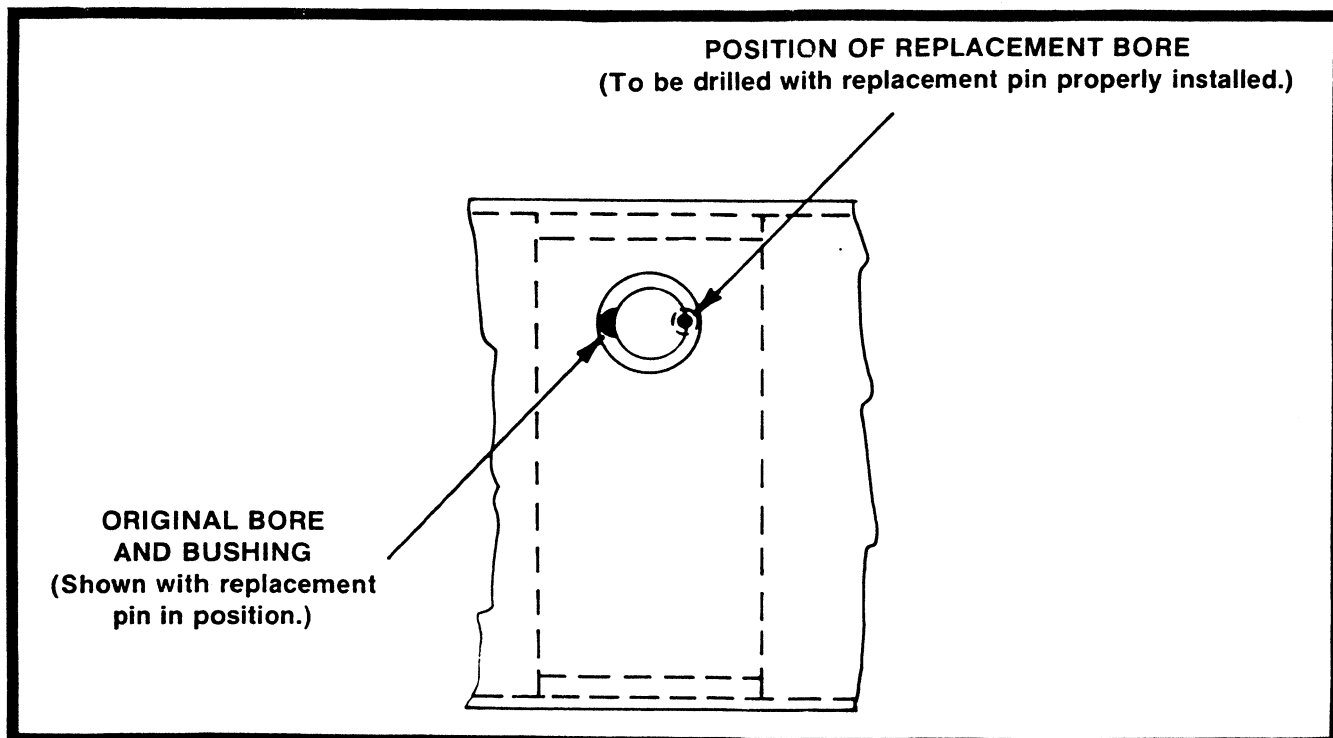


Figure 2-2. Slave Cylinder Pin.

SECTION 2 — PROCEDURES

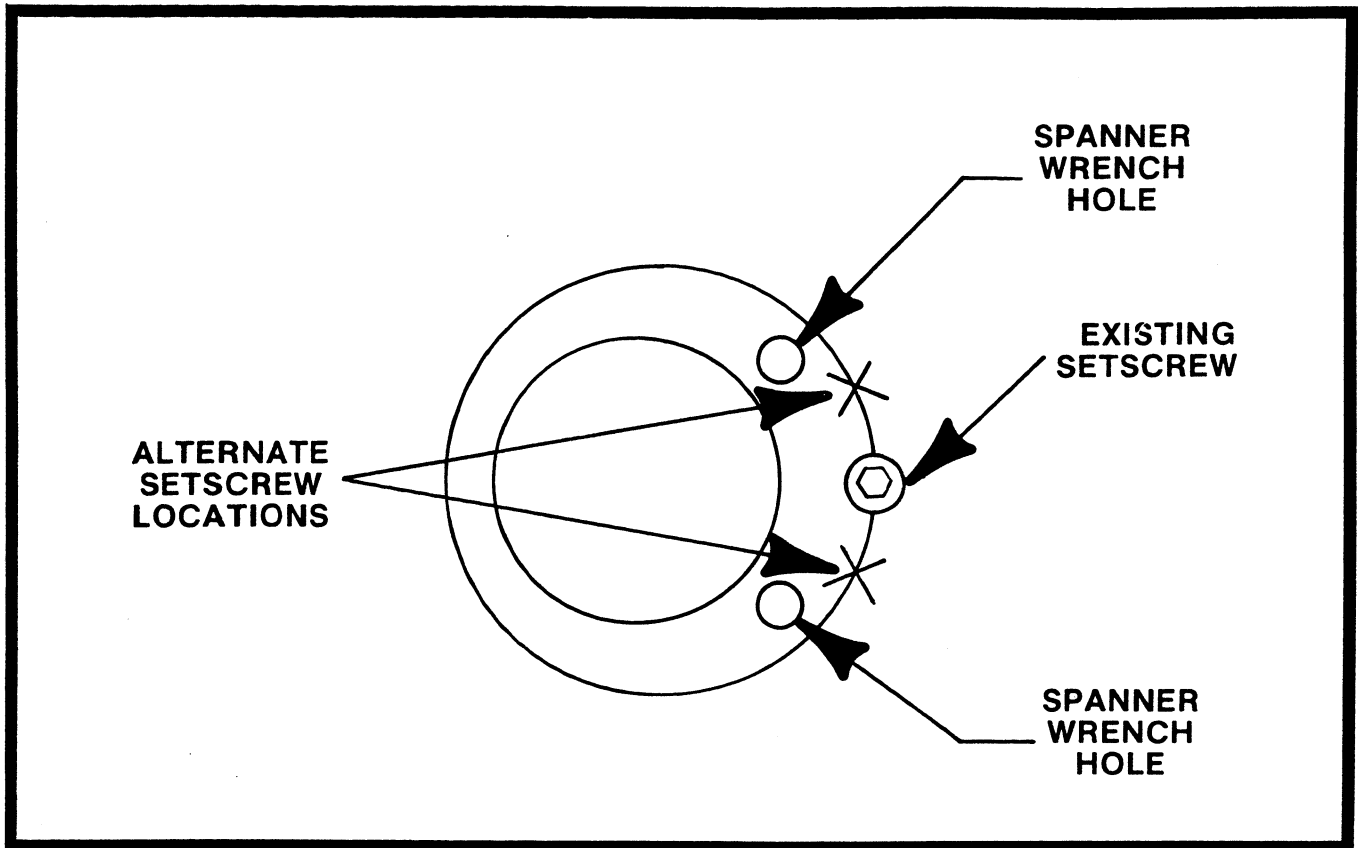
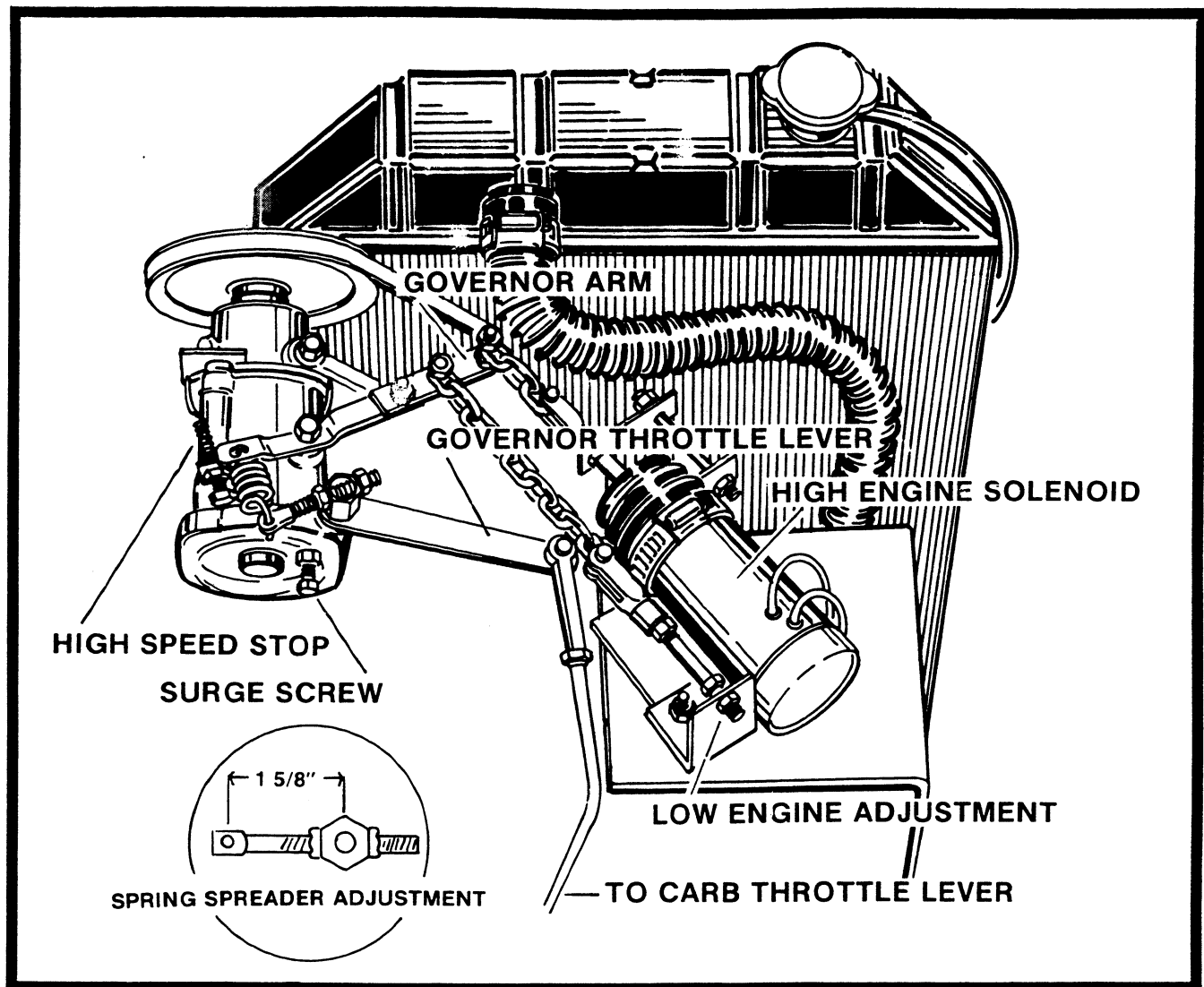


Figure 2-3. Telescope Cylinder Eccentric Bushing.

SECTION 2 — PROCEDURES

Figure 2-4. Governor Adjustment, Solenoid, LSG423.



2-14. GOVERNOR CHECKS AND ADJUSTMENTS, SOLENOID, LSG-423.

a. Checks. (Refer to Figure 2-4.)

- (1). Check governor drive belt for tension. A belt in operation for 10 minutes or more should be set at 100 ft. lbs. (13.82 Kgm).
- (2). Check to be sure high engine solenoid and governor arm are in alignment.
- (3). Check that high speed stop is never in contact with governor.
- (4). Manually move the governor throttle lever to maximum high speed position. Carburetor throttle lever should have 1/32" travel remaining to throttle stop.

b. Adjustments. (Refer to Figure 2-4.)

- (1). Start engine. Energize high engine solenoid and adjust RPM to 2975 at the solenoid clevis. Then adjust the surge screw to raise RPM to 3000.
- (2). If the engine hunts or surges in the maximum speed no-load condition, slowly turn the surge screw clockwise into the governor until the no-load speed increases by 25 RPM. Lock the surge screw in this position and re-adjust engine speed at the solenoid clevis to 3000 RPM.

CAUTION

DO NOT TURN SURGE SCREW IN ANY FURTHER OR REGULATION OF GOVERNOR WILL BE AFFECTED.

- (3). Select low engine and using the low engine adjustment set RPM to 1625.

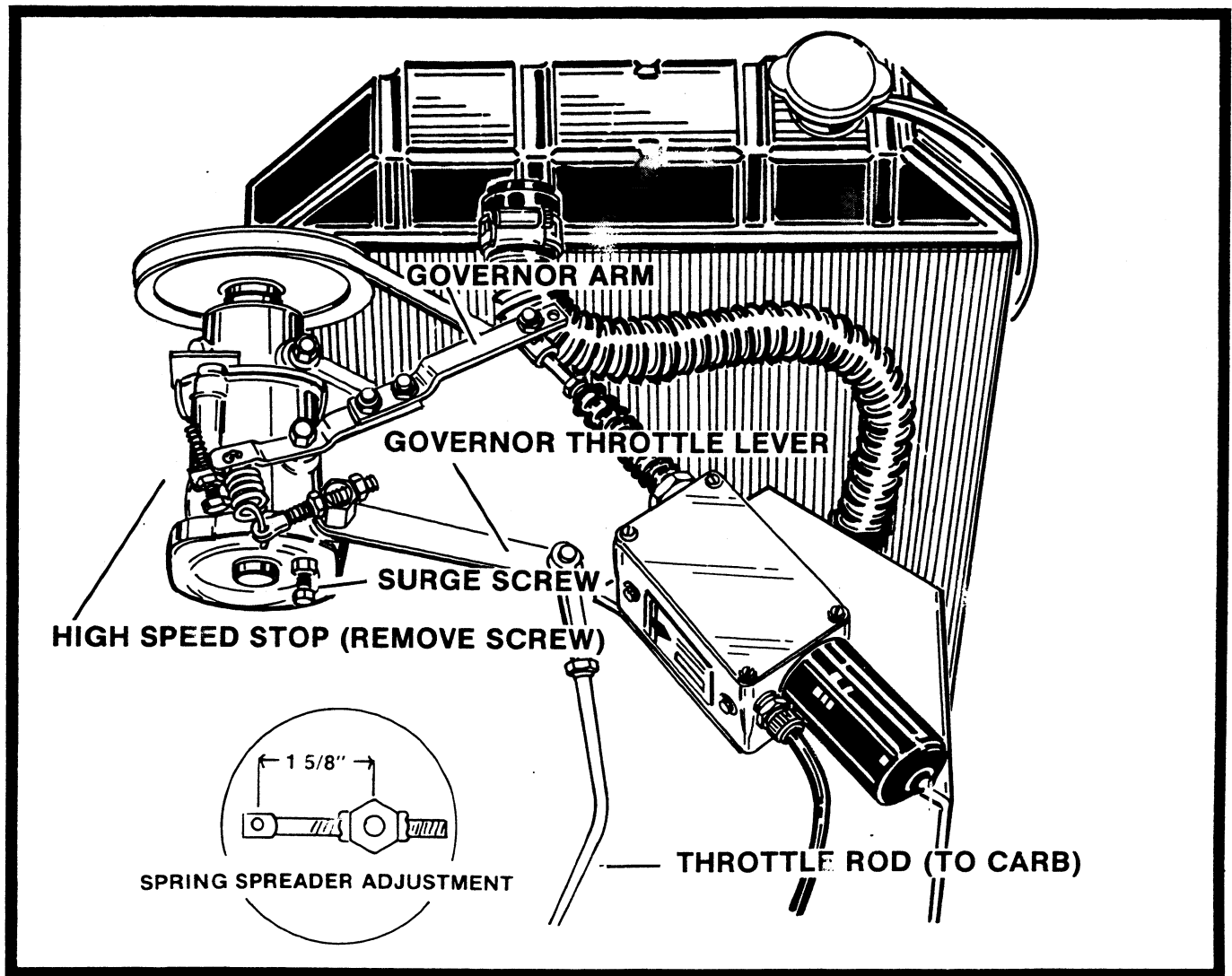


Figure 2-5. Governor Adjustment, Adeco, LSG423.

2-15. GOVERNOR CHECKS AND ADECO ADJUSTMENTS, LSG423.

a. Checks. (Refer to Figure 2-5)

- (1). Check governor drive belt tension. A belt in operation for 10 minutes or more should be set at 100 ft. lbs. (13.82 Kgm).
- (2). Check length of spring spreader adjustment from centerline of eye to centerline of eye. Dimension should be 1 5/8 inch.
- (3). Manually move the governor throttle lever to maximum high speed position. (The Adeco actuator must be disconnected to accomplish this.) The carburetor throttle lever should have 1/32 to 1/16 inch travel remaining to stop. The governor high speed stop screw was removed at the factory.

Note

All governor adjustments must be made with Adeco throttle actuator disconnected.

(b). Adjustments. (Refer to Figure 2-5 and 2-6)

- (1). With the throttle rod and Adeco actuator disconnected from governor, advance governor arm to high speed position. This should advance governor throttle lever to maximum wide open position. Verify wide open position of lever by checking governor spring for tension. Reconnect throttle rod.
- (2). From ground control, start engine. Allow engine to come up to normal operating temperature. Advance governor arm to wide open position. Set high engine speed at 3000 RPM Gear Pump or 2500 RPM Piston Pump by making adjustments at throttle rod. Return engine speed to low.

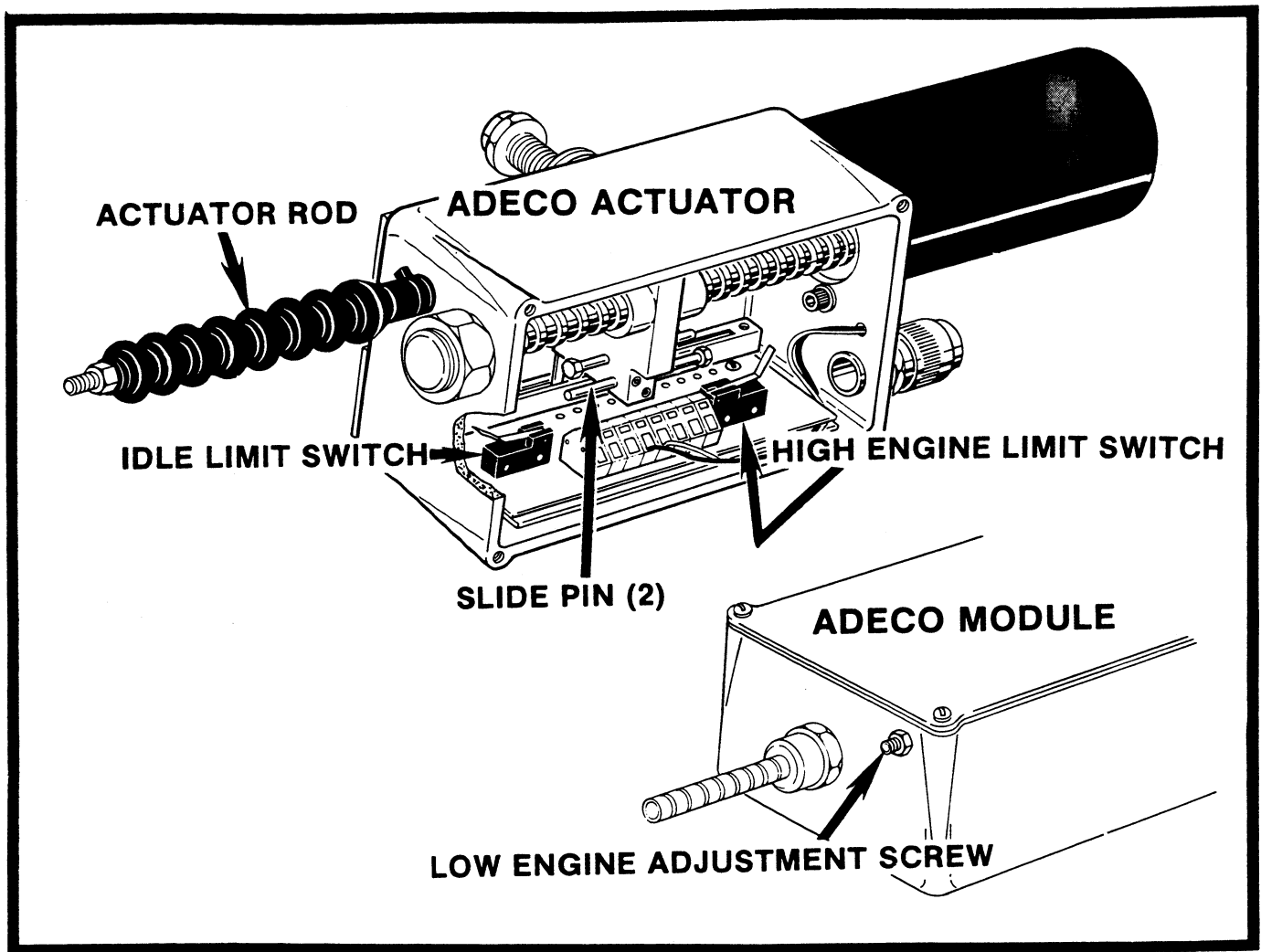


Figure 2-6. Adeco Adjustment, LSG423.

- (3). If the engine hunts or surges in the maximum speed no load condition, decrease engine speed until surging stops. Increase speed slowly to 2925 RPM Gear Pump or 2425 RPM Piston Pump. Slowly turn governor surge screw clockwise until no load engine speed increases to 2400 RPM. Lock surge screw in position. Shut off engine.

Note

Do not turn surge screw in any further than necessary or governor performance will be affected.

- (4). From basket (for idle) start engine and allow engine to come up to operating temperature. Set idle speed at 1000 RPM using idle adjustment screw on carburetor. Shut off engine.
- (5). Remove cover on Adeco actuator. With no function activated, actuator should be fully extended. Hold governor arm in idle position. Adjust slide pin to contact idle limit switch at output rod end of actuator. Adjust actuator rod until you can hook up to governor arm.

- (6). With the aid of an assistant, start engine from basket and allow to come up to operating temperature. Disconnect proportional dump valve wire. Activate footswitch. Turn high engine switch on. Hold drive controller in full drive position. Adjust slide pin to contact high engine limit switch at 3000 RPM Gear Pump or 2500 RPM Piston Pump. Shut off all switches and controllers. Reconnect proportional dump valve wire.

- (7). With the aid of an assistant, start engine from basket and allow to come up to operating temperature. Disconnect bang-bang dump valve wire. Activate footswitch. Operate a bang-bang function switch to increase RPM to low engine. Using a small screwdriver set low engine at 1800 RPM at the Adeco electronic module.

Note

Early machines are at idle until a function is activated. Later machines are at idle only at platform without footswitch activated. Therefore when setting low engine speed on later machines it will not be necessary to disconnect bang-bang dump valve wire or operate a bang-bang function. Just activate footswitch to get low engine.

SECTION 2 — PROCEDURES

2-16. THROTTLE CHECKS AND PRECISION GOVERNOR ADJUSTMENTS, LSG-423. (Refer to Figure 2-7)

a. Checks.

- (1). Check that anti-dieseling solenoid is operating. If solenoid is operating, an audible click at the carburetor should be heard when ignition is switched on.
- (2). Check throttle linkage for smooth operation by rotating throttle lever by hand to full throttle position then slowly back to idle position feeling closely for sticking or binding. To accomplish this the throttle rod must first be disconnected.

b. Choke Adjustments.

Note

Automatic choke and vacuum pulloff adjustment procedure to be made only on a cold engine.

- (1). Make sure choke body and mounting bracket are positioned so that choke rod moves freely with no binding anywhere through its stroke.
- (2). The choke spring should hold the choke plate firmly closed but require only slight finger pressure to open at 70° F. (21.28° C.).
- (3). Retract pulloff shaft until it bottoms (as if under engine vacuum). Bend pulloff rod until a 3/8" (9.53 mm) rod just fits between choke plate and carburetor body.
- (4). The above procedure outlines the correct choke system adjustment for most conditions. Some environments such as high altitude, very warm or very cold temperatures may require that the choke cover be set richer or leaner, or the amount of pulloff may need to be varied somewhat.

c. Carburetor and Governor Adjustments.

- (1). With the aid of an assistant, start the engine at platform console and allow it to come up to operating temperature with air cleaner installed. Adjust carburetor idle screw until engine idles at 1000 RPM. Shut down engine.

Note

Steps (2), (3) and (4) are preliminary settings.

- (2). With engine shut down, open ground control box. Turn 'low (mid) engine' adjusting screw CCW to the stop. Do not turn past stop, this breaks pot disabling the governor.

- (3). On controller (in ground control box) turn 'high engine' (P1) adjusting screw 25-30 turns CCW, then 10 turns CW.
- (4). On controller (in ground control box) turn 'gain' (P2) adjusting screw CCW to the stop, then CW until screw slot is vertical (approximately 1/4 turn).
- (5). On controller (in ground control box) turn 'droop' (P3) adjusting screw CCW to the stop, then CW until screw slot is vertical (approximately 1/4 turn). No further adjustment should be necessary to 'droop' (P3).
- (6). With the aid of an assistant at platform console start the engine and allow to come up to operating temperature. Then have assistant depress footswitch and place engine speed switch to HIGH ENGINE.
- (7). If engine surging occurs at this point, turn 'gain' (P2) adjusting screw CCW until surging ceases. Turn 'high engine' (P1) adjusting screw until engine runs at 2400 RPM. Turning the screw CW increases RPM. Turning the screw CCW decreases RPM.
- (8). While your assistant continues to depress the footswitch, have him place engine speed switch to LOW ENGINE. Turn 'low (mid) engine' adjusting screw until engine runs at 1800 RPM. Turning the screw CW increases RPM. Turning the screw CCW decreases RPM. Shut down engine.

Note

If engine surges under no load and you cannot get enough response from adjusting 'gain' (P2), try adjusting surge screw on actuator. Loosen surge screw locknut. Disconnect throttle linkage. Turn surge screw CW until linkage arm moves. Manually stroke the linkage fully and allow to return slowly until it stops. Try to move linkage towards return position. If linkage moves, turn surge screw CCW 1/2 turn. Again stroke linkage and allow to return slowly until it stops. Try to move linkage towards return position. If linkage moves, turn surge screw CCW 1/2 turn. Again stroke linkage and allow to return slowly until it stops. Try to move linkage towards return position. If linkage moves, turn surge screw CCW 1/2 turn. Repeat this procedure until linkage does not move after stroking. This will set buffer spring tension properly. Reconnect throttle linkage.

- (9). With engine speed switch set to LOW ENGINE, when footswitch is depressed, engine should immediately respond, if response time lags, turn 'gain' (P2) adjusting screw CW to improve response time. Turn adjusting screw in small increments only until response time is correct. Turning adjusting screw too far CW can cause surging. (See 7 above)

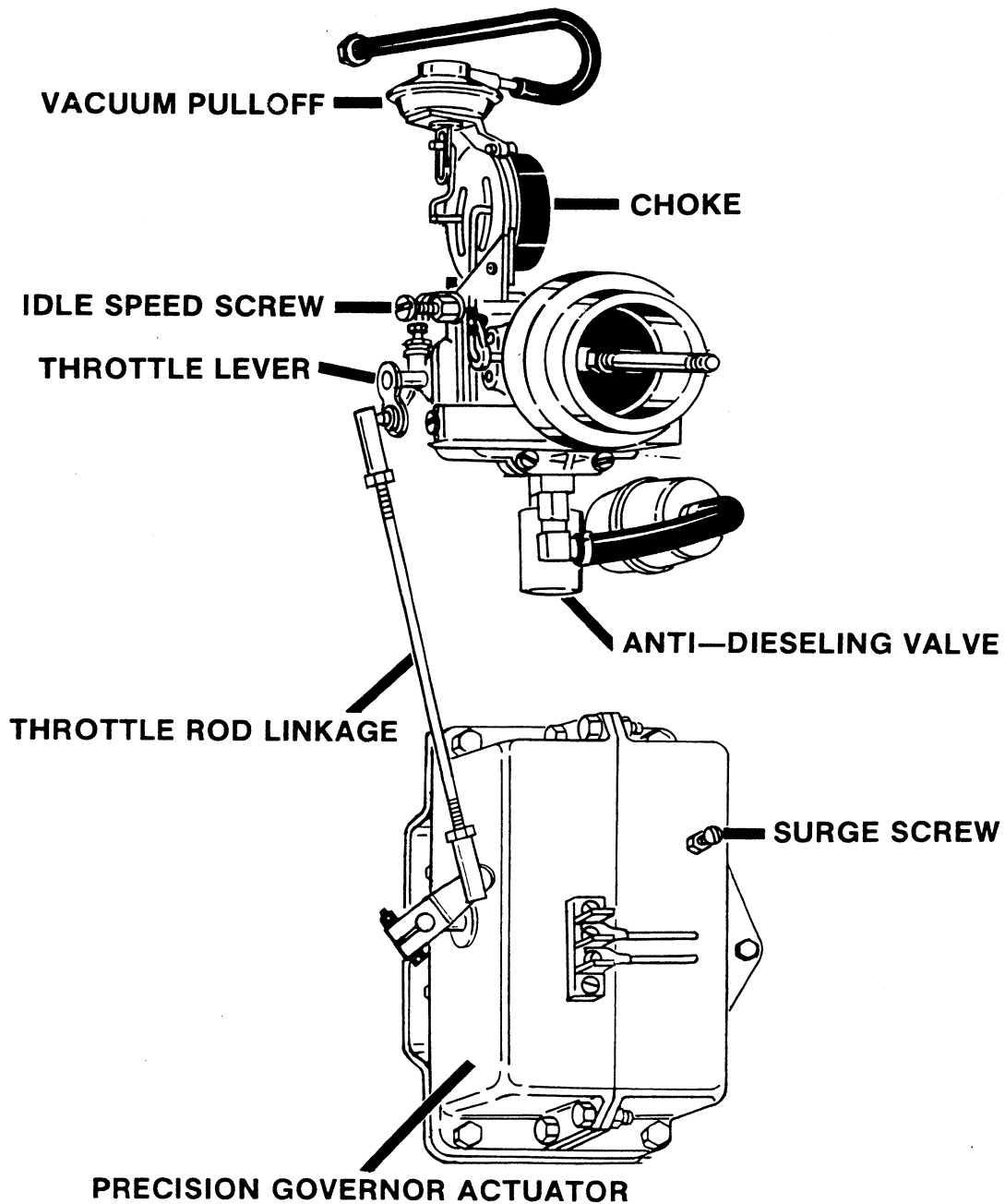


Figure 2-7. Precision Governor Adjustment, LSG423. (Sheet 1 of 2)

SECTION 2 — PROCEDURES

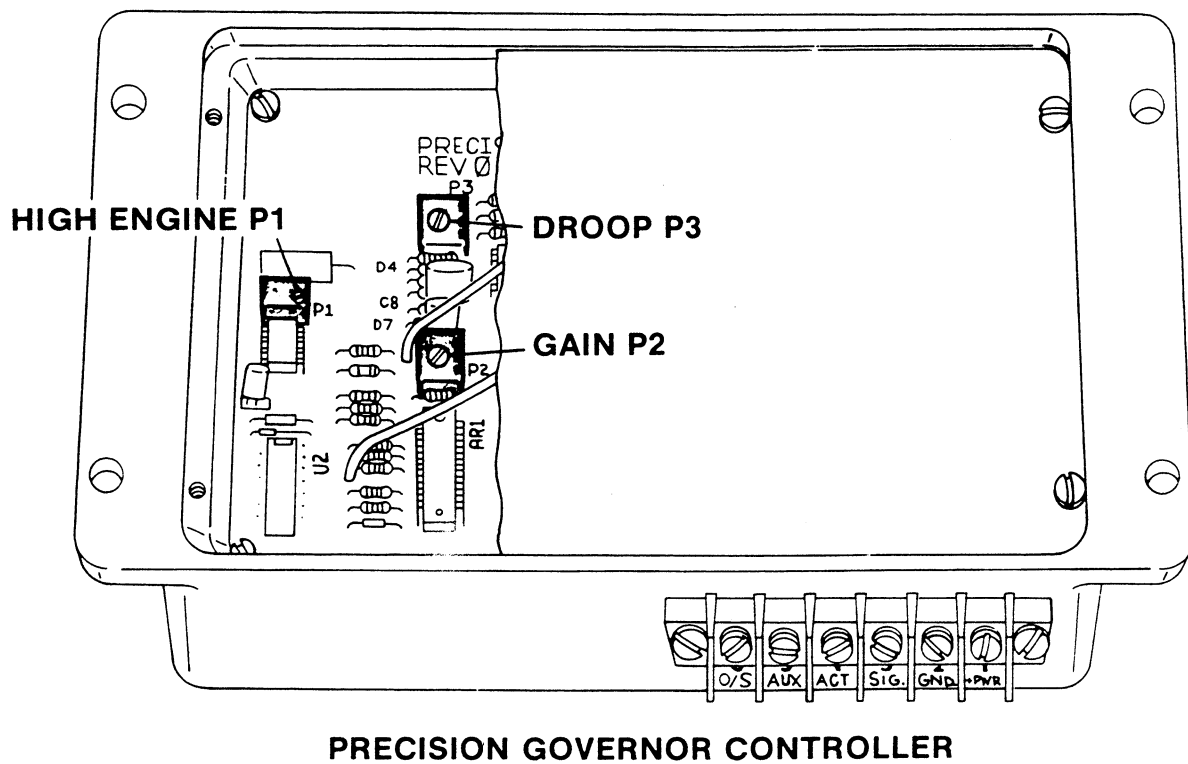
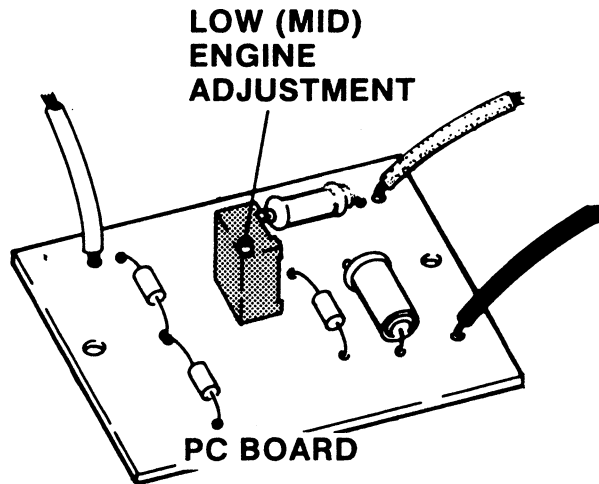


Figure 2-7. Precision Governor Adjustment, LSG423. (Sheet 2 of 2)

SECTION 2 — PROCEDURES

2-17. THROTTLE ADJUSTMENTS, F3L912W.

(Refer to Figure 2-8)

Note

Never run fuel tank dry. Diesel engines cannot be restarted after running out of fuel until fuel system has been air-vented or 'bled' of air. See Deutz Instruction Manual for procedure.

- a. Disconnect actuator cable from throttle lever on injection pump. With the aid of an assistant, start the engine and allow it to come up to operating temperature. Adjust throttle lever stop until engine runs at 1800 RPM. Shut down engine. Reattach actuator cable to throttle lever making sure that low engine setting remains the same. If necessary, adjust slide pin to contact low engine limit switch at 1800 RPM. Shut down engine.

- b. With the aid of an assistant, start engine from basket and allow to come up to operating temperature. Disconnect proportional dump valve wire. Activate footswitch. Turn on HIGH ENGINE switch. Hold drive controller in full drive position. Adjust slide pin to contact high engine limit switch at 2500 RPM. Shut off all switches and controllers. Reconnect proportional dump valve wire.

Note

Actuator cable travel must stop slightly before throttle lever makes contact with throttle lever stop. Failure to do so will burn out actuator.

SECTION 2 — PROCEDURES

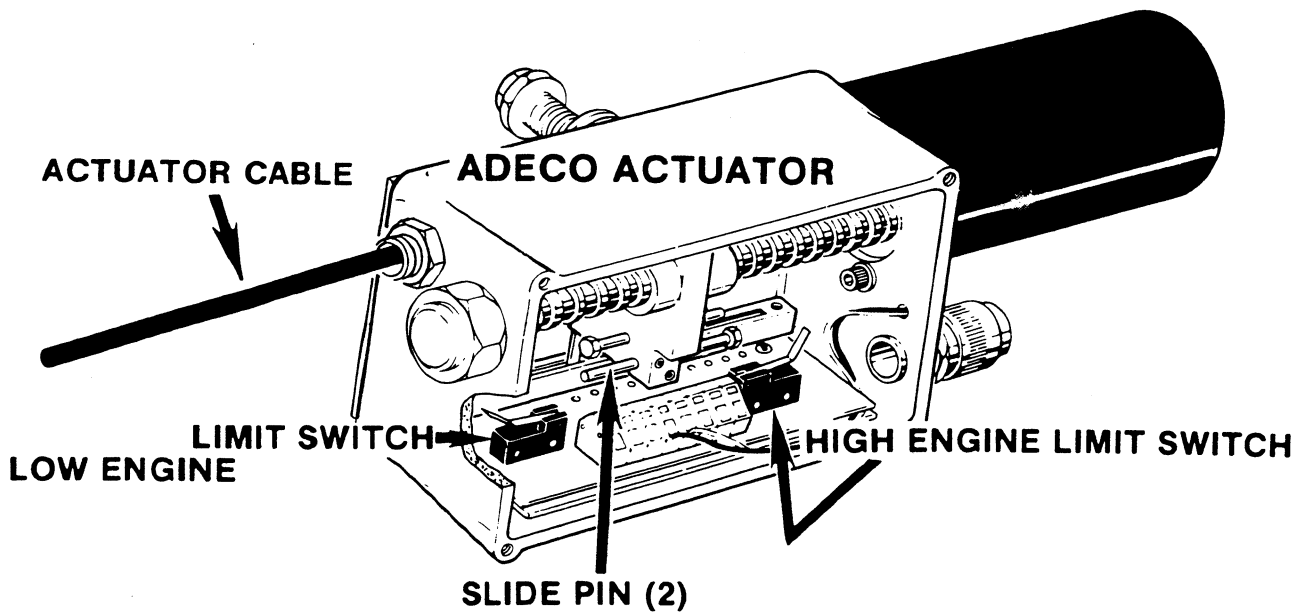
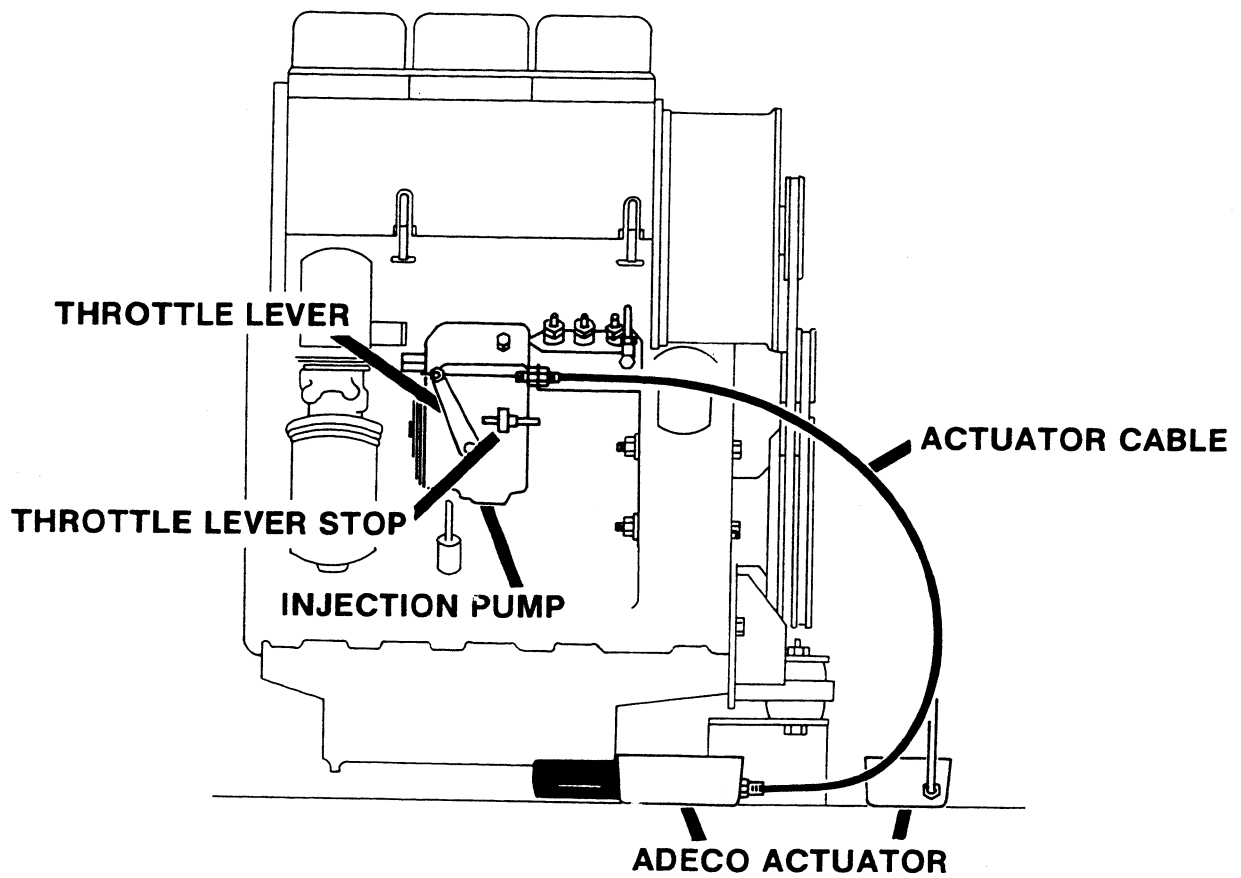


Figure 2-8. Adecu Actuator Adjustment, F3L-912.

SECTION 2 — PROCEDURES

2-18. THROTTLE CHECKS AND ADJUSTMENTS, V465D. (Refer to Figure 2-9 and 2-10)

a. Checks.

- (1). Check that carburetor throttle link is located at top of governor arm.
- (2). Check that spring is located at first or second springhole from top of governor arm. First hole is preferable. Second hole can be used when trying to stop surging.

b. Adjustments.

- (1). Disconnect the actuator rod from the arm. With the aid of an assistant, start the engine from the basket and allow it to come up to operating temperature. Adjust carburetor idle screw until engine runs at 1600 RPM. Shut down engine. Reattach actuator rod to arm making sure that low engine setting remains the same. If necessary, adjust slide pin to contact low engine limit switch at 1600 RPM. Shut down engine.
- (2). With the aid of an assistant, start engine from basket and allow to come up to operating temperature. Disconnect proportional dump valve wire. Activate footswitch. Turn on high engine switch. Hold drive controller in full drive position. Adjust slide pin to contact high engine limit switch at 2400 PRM. Shut off all switches and controllers. Reconnect proportional dump valve wire.
- (3). If the engine hunts or surges in the maximum speed no load condition, shut off engine. Disconnect carburetor throttle link from governor arm. Turn carburetor throttle link (clockwise) one turn. Start engine and activate high engine as in step (2) above. Be sure to disconnect proportional dump valve wire.
- (4). If surging continues, repeat step (3) above. Do not turn carburetor throttle link in any further than necessary or governor performance will be affected.
- (5). When surging is under control, check high engine RPM. If necessary reset to 2400 RPM as in step (2) above. Shut down engine.

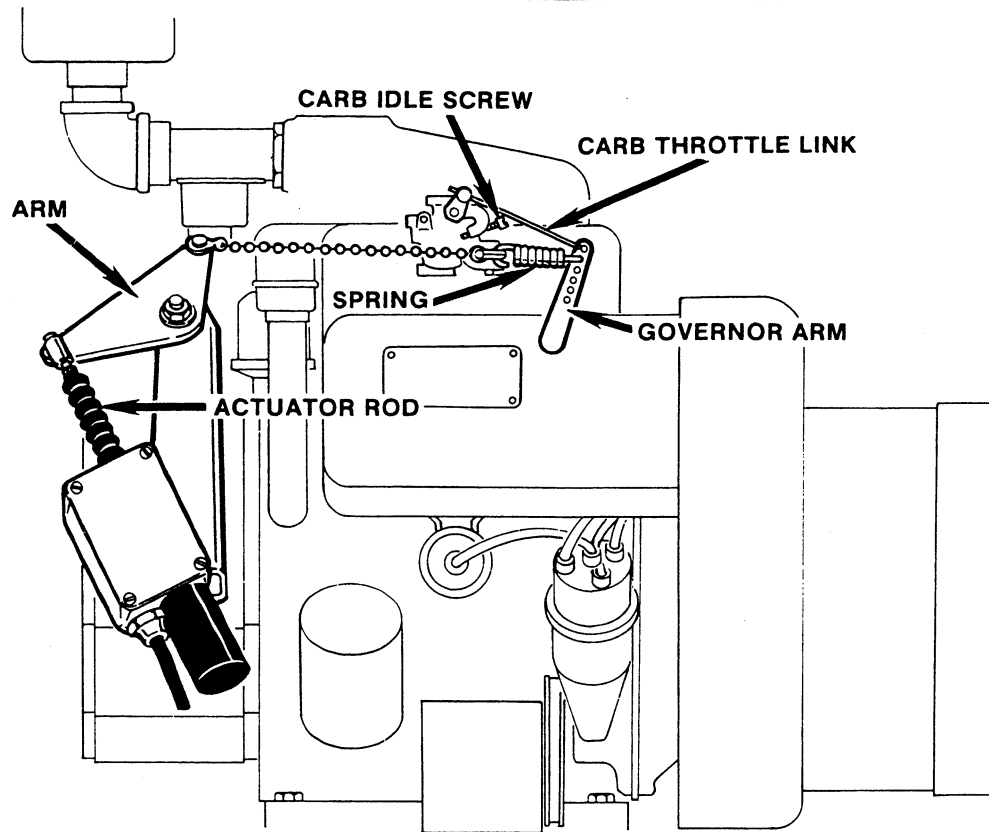


Figure 2-9. Throttle Adjustment, V465D. Typical.

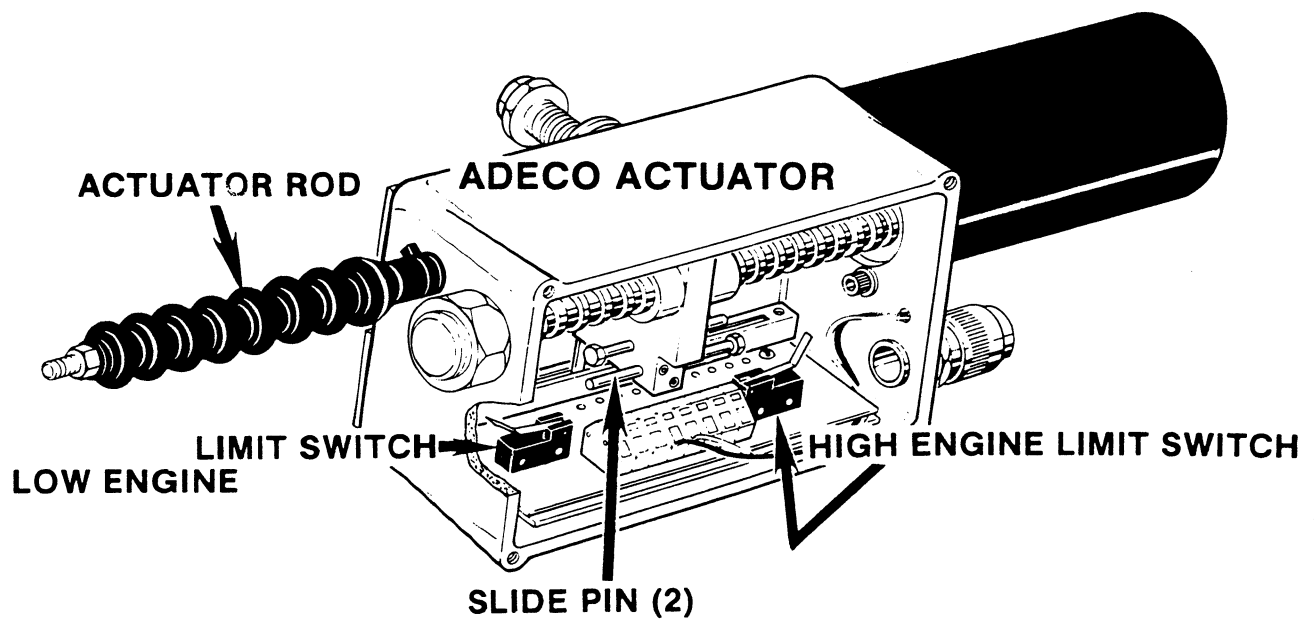


Figure 2-10. Adeco Actuator Adjustment, V465D.

2-19. PRESSURE SETTING PROCEDURES.

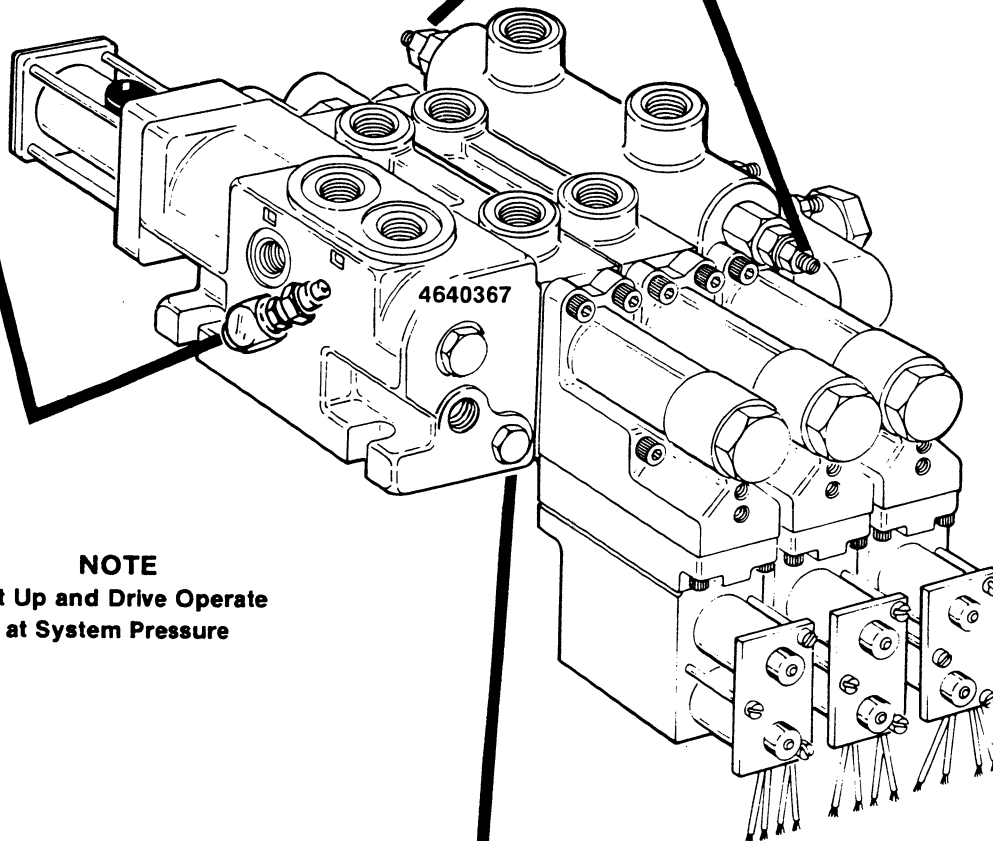
- a. Proportional valve pressure setting procedures for machines with or without a steering wheel are shown in Figures 2-10, 2-11 and 2-12.
- b. Solenoid valve pressure setting procedures for machines without a steering wheel are shown in Figure 2-13.
- c. Pressure and flow adjustment points for machines with steering wheels are shown in Figure 2-14.

ADJUSTMENT FOR SWING

1. Place Gauge At Swing Motor.
2. Engine At Low RPM.
3. Turntable Lock Engaged.
4. Activate Swing - Left;
Adjust To 1200 PSI.
5. Activate Swing - Right;
Adjust To 1200 PSI.

CHECK POINT FOR MAIN RELIEF

NOTE
Lift Up and Drive Operate
at System Pressure



ADJUSTMENT FOR MAIN RELIEF, DRIVE AND LIFT UP

1. Engine @ Low RPM.
2. Bottom Out Lift - Up.
3. Adjust To 2900 PSI. (System Pressure)

Figure 2-11. Racine Proportional Valve Pressure Setting. (Sheet 1 of 2)

SECTION 2 — PROCEDURES

ADJUSTMENTS FOR PILOT PRESSURE

1. Engine @ low RPM.
2. Connect 12 volt jumper wire to dump valve solenoid.
3. Pressure gauge should read between 250-400 PSI.
4. Shut down system, remove cap plug and shim up spring to increase pressure, shorten spring to decrease pressure.
5. Install cap plug and repeat steps 1 thru 3.

IMPORTANT

Take pilot pressure reading before attempting to make adjustment. Do not adjust if pilot pressure is between 250-400 PSI.

NOTE

The pilot pressure is factory set and normally should not require adjusting. Adjust only if you notice poor or sluggish response to proportional functions or loss of auxiliary power.

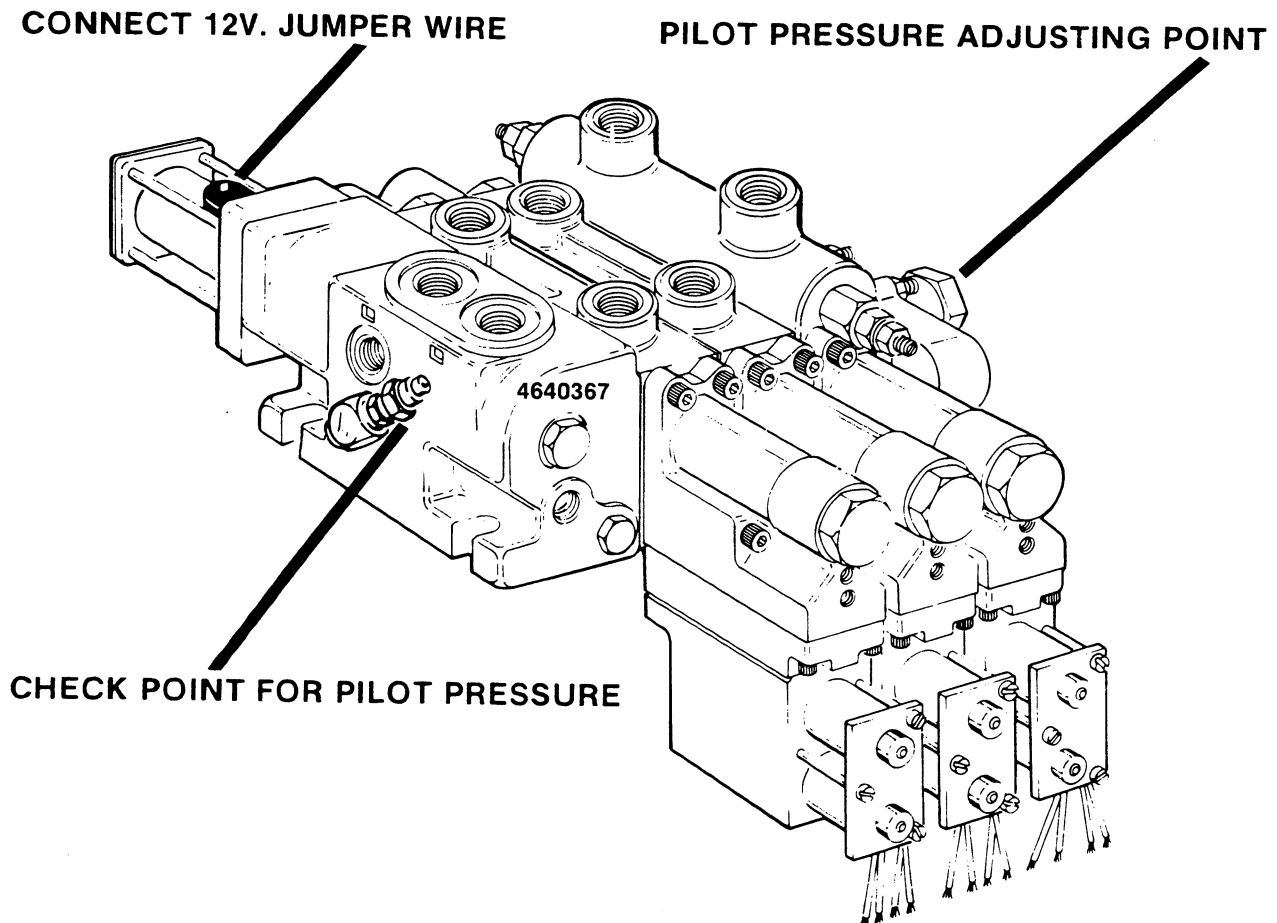
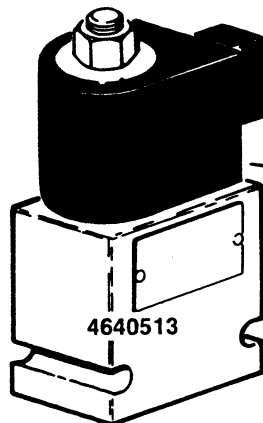


Figure 2-11. Racine Proportional Valve Pressure Setting. (Sheet 2 of 2)

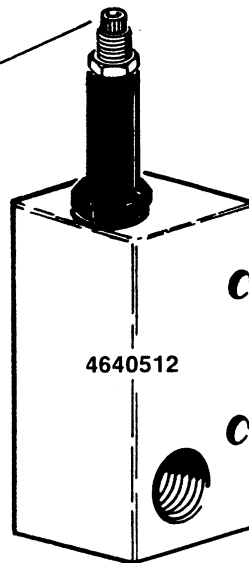
To Be Performed in Sequence, Step 1, Step 2, etc.

**DUMP
VALVE**



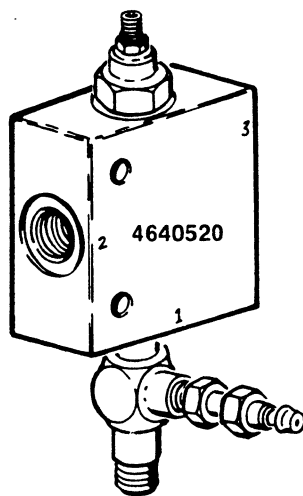
Connect 12 V.D.C. jumper wire to dump valve coil.

Adjust to 400 PSI ($\pm$ 50 PSI).
Monitor pressure gauge at
relief valve. Remove jumper wire.



**SEQUENCE
VALVE**

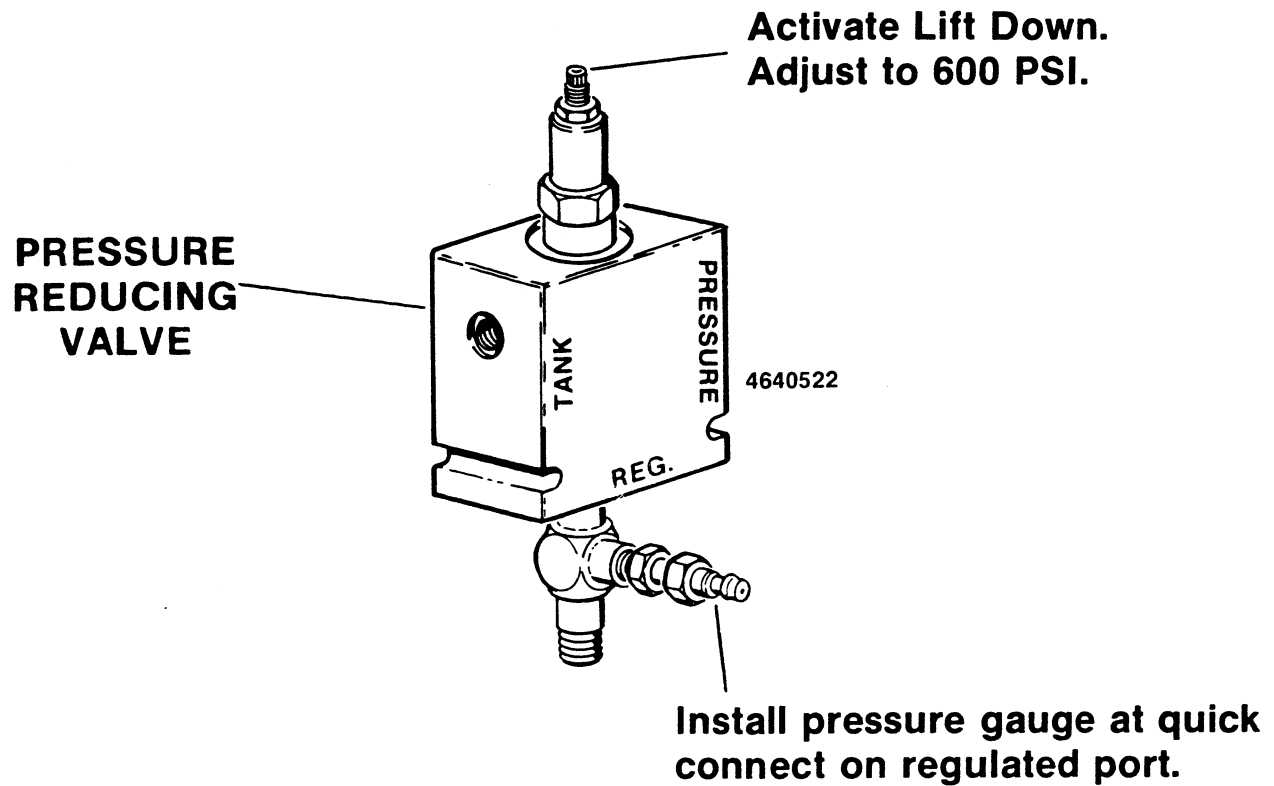
**RELIEF
VALVE**



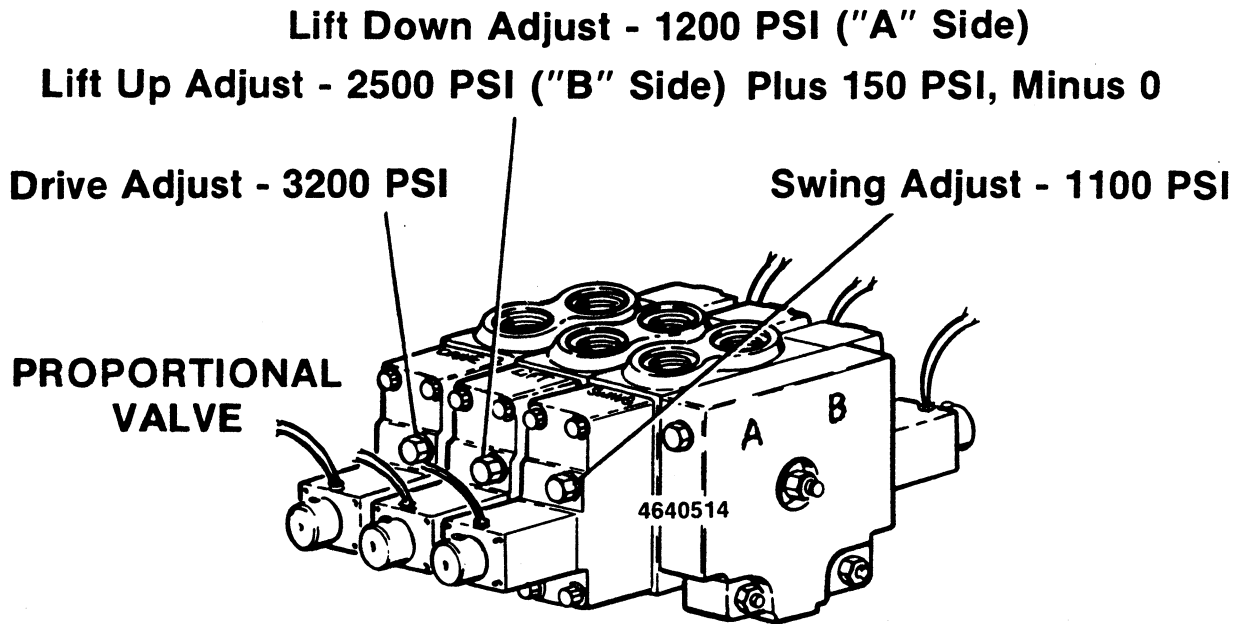
Install pressure gauge at quick
disconnect.

SEQUENCE VALVE ADJUST (STEP 1)

Figure 2-12. Vickers Proportional Valve Pressure Setting. (Sheet 1 of 4)



PILOT PRESSURE ADJUST (STEP 2)



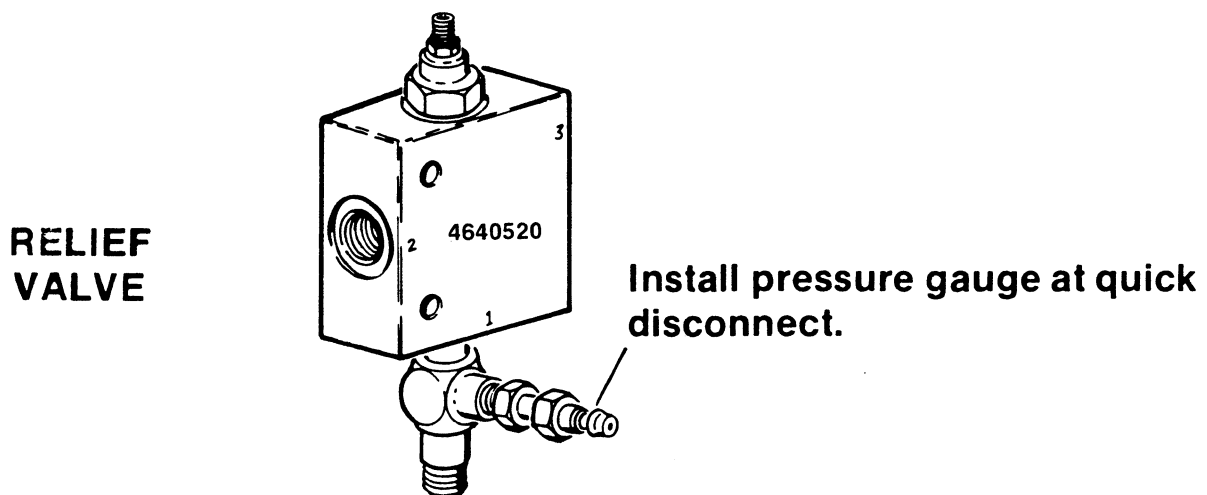
Note: All Pressures Plus Or Minus 150 PSI (Except Where Noted).

Swing Adjust - Right and Left - Monitor gauge at quick connect on relief valve. Lock turntable and activate Swing Right. Add shims to increase pressure, remove shims to decrease. Same procedure applies to Swing Left.

Lift Adjust - Lift Down - Monitor gauge at quick connect on relief valve. Bottom out Lift Down. Add shims to increase pressure, remove shims to decrease.

Lift Up - Bottom out Lift Up, add shims to increase pressure, remove shims to decrease.

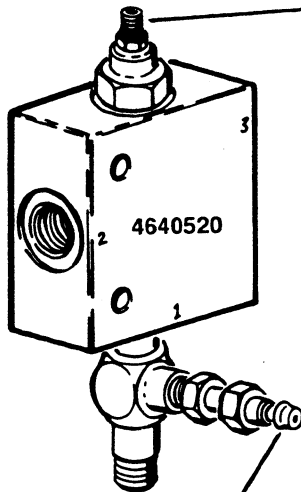
Drive Adjust - Disconnect and cap hose to drive motor, also plug port in valve. Have assistant activate drive forward. Monitor gauge at relief valve. Add shims to increase pressure, remove shims to decrease. Same procedure applies to drive reverse.



PROPORTIONAL VALVE ADJUST (STEP 3)

Figure 2-12. Vickers Proportional Valve Pressure Setting. (Sheet 3 of 4)

RELIEF VALVE



Note: This adjustment to be made after all proportional functions are set.

Disconnect and cap hoses to drive motor, also plug ports on drive section of proportional valve. Back out adjustment 2 turns (counter-clockwise). Have assistant activate drive. Slowly turn adjustment in (clockwise) and watch pressure gauge. Continue turning until gauge stops moving (approximately 3200 PSI). Turn adjustment in an additional $\frac{1}{2}$ turn, this will result in approximately 200 PSI higher than Drive relief setting.

Install pressure gauge at quick disconnect.

MAIN RELIEF ADJUST (Proportional Functions) (STEP 4)

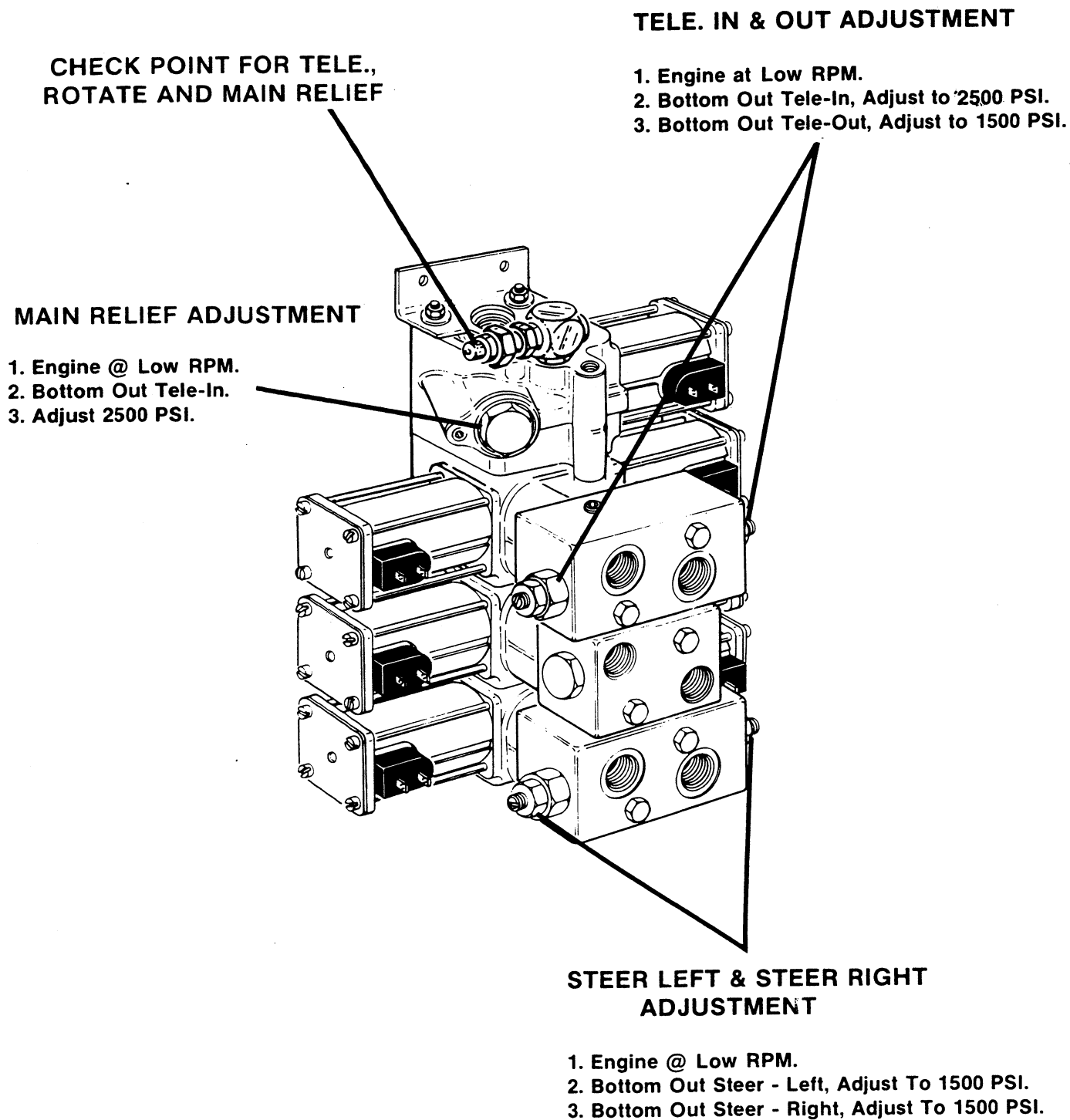
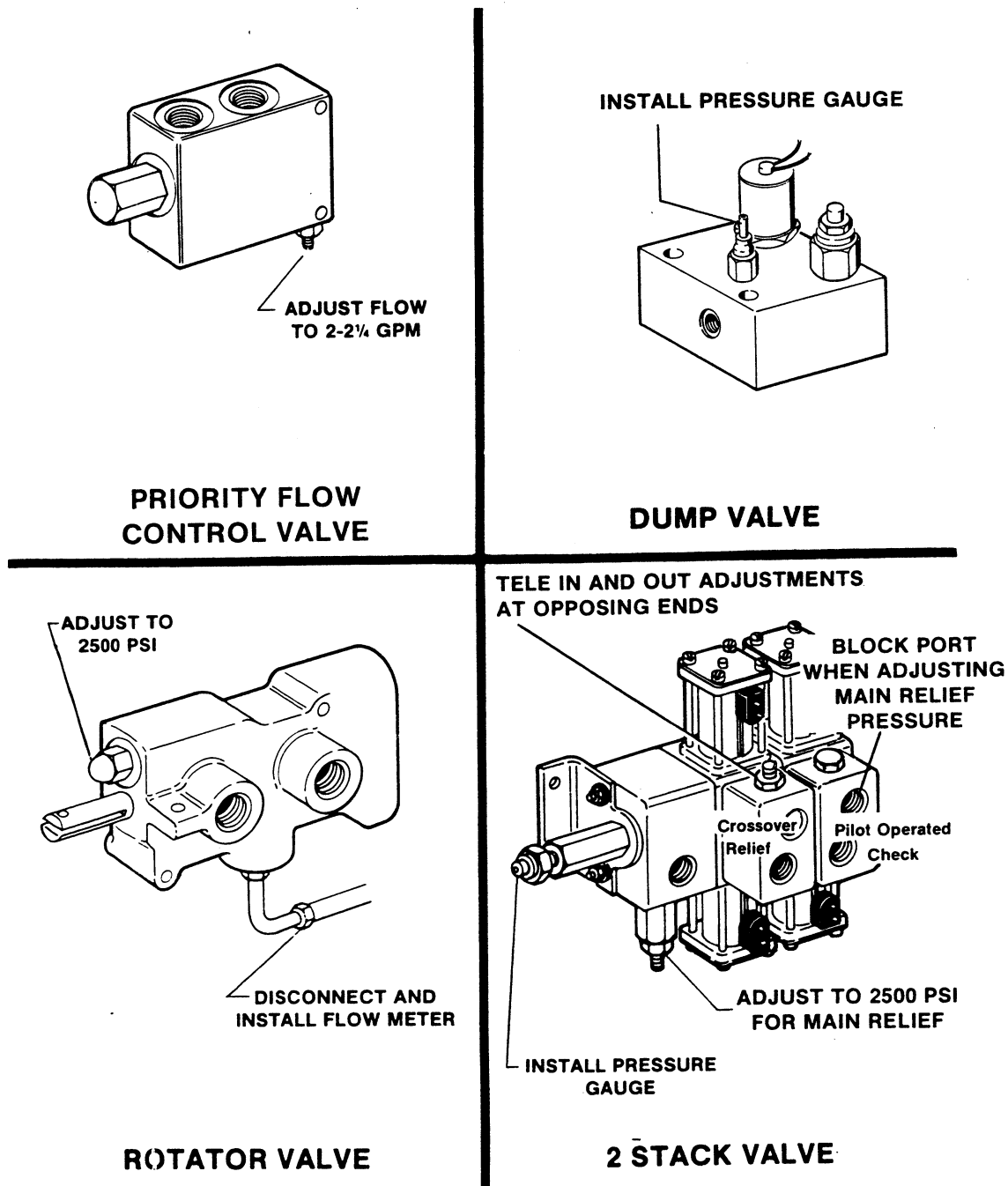


Figure 2-13. Solenoid Valve Pressure Setting, without Steer Wheel.

SECTION 2 — PROCEDURES

Figure 2-14. Pressure and Flow Settings with Steer Wheel.



1. ROTATE AND STEERING.

- a. TO SET FLOW. Install a flow gauge inline at rotator valve. With the aid of an assistant, make adjustments at the priority flow control valve for 2-2 $\frac{1}{4}$ G.P.M.
- b. TO SET PRESSURE. Install pressure gauge at quick connect on dump valve. With the aid of an assistant, make adjustments at rotator valve to 2500 PSI. Set with engine at low RPM and bottom out rotate left or right.

2. TELESCOPE AND MAIN RELIEF.

- a. TO SET MAIN RELIEF PRESSURE. Install pressure gauge at quick connect on 2 stack valve. Disconnect level hose, plug hose and block port on valve. Make adjustments at 2 stack to 2500 PSI, with engine at low RPM, activate level function.
- b. TO SET TELESCOPE PRESSURE. With a pressure gauge at the quick connect, and the engine at low RPM, bottom out tele-in and adjust to 2500 PSI. Then bottom out tele-out and adjust to 1500 PSI.

SECTION 2 — PROCEDURES

2-20. RACINE PROPORTIONAL AIR GAP ADJUSTMENT.

Note

The assembly in Figure 2-15 includes select fit parts in order to maintain a proper air gap. These parts must remain as an assembly or if disassembled, controlled to insure that these component parts are not intermixed with similar parts.

Note

In the event that parts do become exchanged or you suspect the air gap to be incorrect (too much air gap will result in loss of auxiliary power operation and less than full spool shift; too little air gap will result in erratic operation), it may be checked and adjusted using the procedure below.

- a. *With all parts assembled as shown in Figure 2-15, use a depth mike or other measuring instrument to determine the distance from the end of the guide tube to the exposed end of the plunger. Record this dimension.

- b. Remove plunger and poppet. With poppet removed, install plunger and check distance from the end of the guide tube to the exposed end of the plunger.

- c. Subtract the first dimension from the second dimension, this will be the amount of air gap.

- d. Correct air gap is .018" - .020", with .018" preferred. If air gap is excessive, it may be reduced by using a brass drift and hammer. Lightly tap end of plunger with all parts assembled. Recheck air gap.

- e. If air gap is less than recommended, replace nose cone assembly.

*All parts must be clean and properly assembled before making these checks.

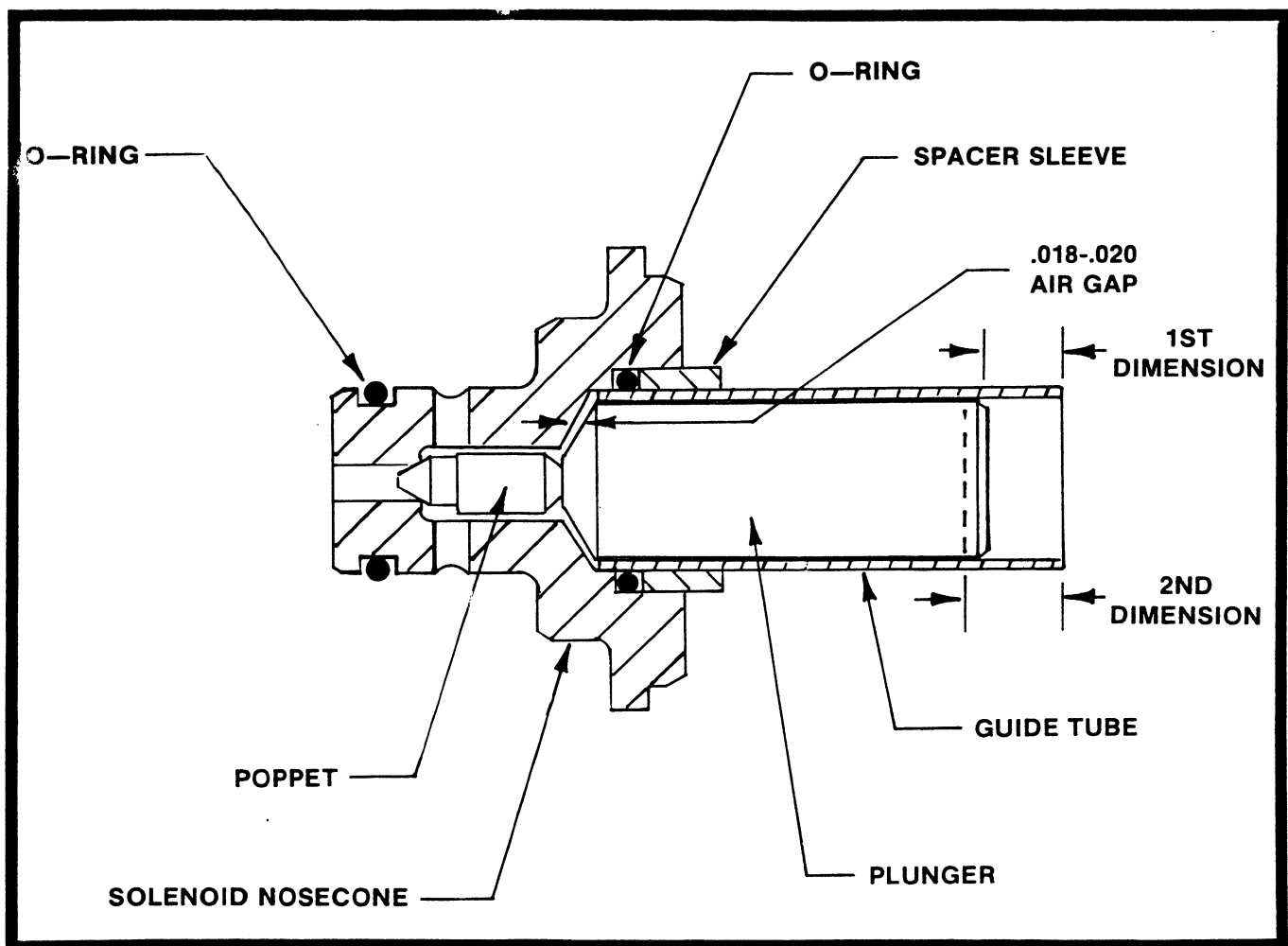


Figure 2-15. Racine Proportional Air Gap Adjustment.

SECTION 2 — PROCEDURES

2-21. SWING BEARING.

a. Wear Tolerance.

- (1). From the underside of the machine, at rear center, with the boom fully elevated and fully retracted (See Figure 2-16a), using a magnetic base dial indicator, measure and record the distance between the swing bearing and frame. (See Figure 2-17.)
- (2). At the same point, with the boom at horizontal and fully extended (See Figure 2-16b) using a magnetic base dial indicator, measure and record the distance between the swing bearing and frame. (See Figure 2-17.)
- (3). If you determine a difference greater than .057" (1.45 mm) the swing bearing needs replacing.

b. Replacement and Devcon Application Procedures.

(1). Removal.

- (a). From the ground control station, operate the boom lift control and raise the boom adequately to provide access to the rotary coupling.

WARNING

NEVER WORK BENEATH THE BOOM WITHOUT FIRST PROVIDING ADEQUATE OVERHEAD SLING SUPPORT AND/OR BLOCKING.

- (b). Attach an adequate support sling to the boom and draw all slack from the sling. Block the boom if feasible.
- (c). From the under side of the machine frame, remove the bolts and lockwashers which attach the retaining yoke of the rotary coupling to the coupling housing.

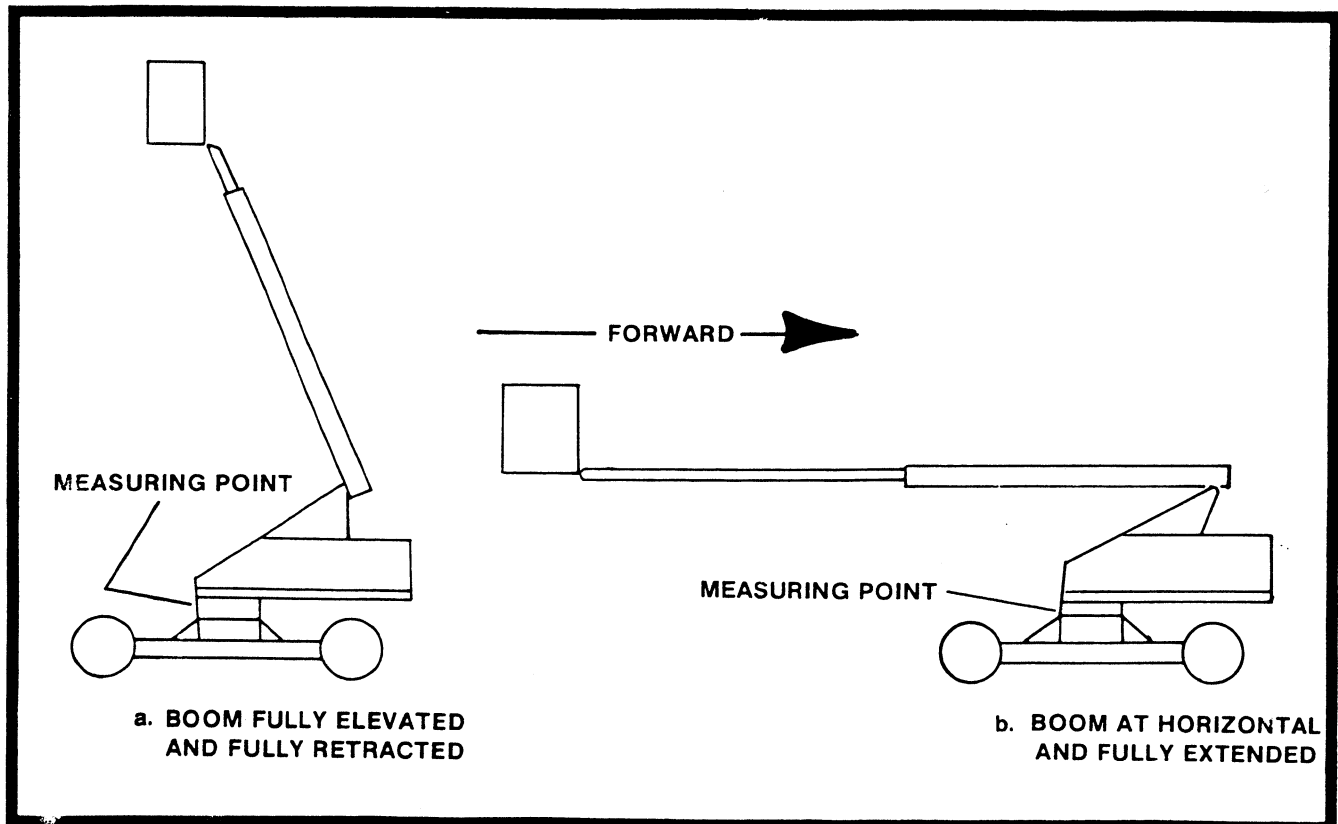


Figure 2-16. Swing Bearing Tolerance Boom Placement.

SECTION 2 — PROCEDURES

CAUTION

HYDRAULIC LINES AND PORTS SHOULD BE CAPPED IMMEDIATELY AFTER DISCONNECTING LINES TO AVOID THE ENTRY OF CONTAMINANTS INTO THE SYSTEM.

- (d). Tag and disconnect the hydraulic lines from the fittings on the top and sides of the rotary coupling. Use a suitable container to retain any residual hydraulic fluid. Immediately cap lines and ports.
- (e). Attach suitable overhead lifting equipment to the base of the turntable weldment.
- (f). Use a suitable tool to scribe a line on the inner race of the swing bearing and on the underside of the turntable. This line will aid in aligning the bearing upon installation. Remove the bolts, nuts and washers which attach the turntable to the bearing inner race. Discard the nuts and bolts.
- (g). Use the lifting equipment to carefully lift the complete turntable assembly from the bearing. Ensure that no damage occurs to the turntable, bearing or frame-mounted components.
- (h). Carefully place the turntable on a suitably supported trestle.

- (i). Use a suitable tool to scribe a line on the outer race of the swing bearing and the frame. This line will aid in aligning the bearing upon installation. Remove the bolts and washers which attach the outer race of the bearing to the frame. Discard the bolts. Use suitable lifting equipment to remove the bearing from the frame; move the bearing to a clean suitably supported work area.

(2). Installation.

Note

Manufacturing tolerances of frames and turntables are inspected prior to the factory installation of swing bearings to determine the need for use of Devcon filler. When servicing machine swing bearing, apply Devcon filler only to those machines having Devcon previously applied at the factory. If new turntable or frame is being installed contact manufacturer for procedures to determine the need for Devcon application.

- (a). Use suitable standard tools and equipment to carefully remove any hardened epoxy residue from the bearing mounting area of frame and turntable.
- (b). Apply a layer of Devcon (or equivalent) filler approximately 0.125 inches (.318 cm) thick on the bearing mounting plate on the frame.

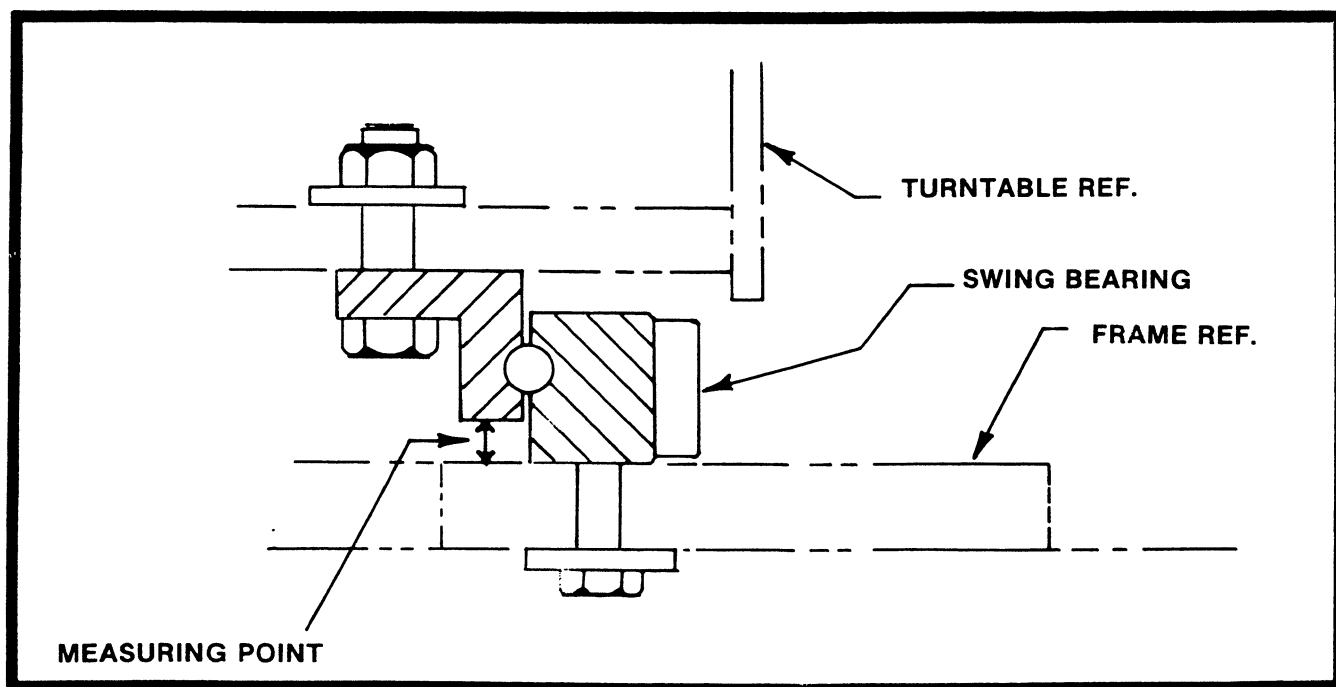


Figure 2-17. Swing Bearing Tolerance Measuring Point.

SECTION 2 — PROCEDURES

- (c). Use suitable lifting equipment to carefully lower the swing bearing into position on the frame. Ensure that the scribed line of the outer race of the bearing aligns with the scribed mark on the frame (if a new swing bearing is used, ensure that the filler plug fitting is at 90 degrees from the fore and aft centerline of the frame).
- (d). Ensure that all frame and bearing attachment holes are aligned, and install four diametrically opposed bolts or clamps to secure the bearing to the frame. Tighten the bolts or clamps evenly in a diametrical pattern to a torque of 20 ft. lbs.
- (e). Allow Devcon filler to cure at room temperature (approximately 70 degrees F., 21 degrees C.) for 10 to 16 hours.
- (f). After the appropriate interval, release the clamps or remove the bolts. Use a suitable lifting device to carefully remove the bearing from the frame.
- (g). Carefully remove any excess filler from the frame mounting area, from the bearing attachment holes, and from between the gear teeth.
- (j). Ensure that all turntable and bearing attachment holes are aligned, and install four (4) diametrically opposed clamps or bolts and nuts to secure the bearing to the turntable. Tighten the nuts and bolts or clamp evenly in a diametrical pattern to a torque of 20 ft. lbs. (2.78 Kgm).
- (k). Allow the Devcon filler to cure at room temperature (approximately 70 degrees F., 21 degrees C.) for 10 to 16 hours.
- (l). After the appropriate interval, place a suitable hydraulic jack under the bearing and release the clamps or remove the nuts and bolts; use the hydraulic jack to carefully remove the bearing from the turntable.
- (m). Carefully remove excess filler from the turntable mounting area, from the bearing attachment holes and from between the gear teeth.
- (n). Position the bearing on the machine frame in the same position as noted in step (c) above.

WARNING

ENSURE THAT TURNTABLE IS ADEQUATELY SUPPORTED WHILE APPLYING DEVCON AND WHILE INSTALLING THE BEARING. EXTREME CARE MUST BE TAKEN DURING THE FOLLOWING SIX (6) STEPS TO AVOID SERIOUS OR FATAL INJURY TO PERSONNEL.

- (h). Apply a layer of Devcon (or equivalent filler) approximately 0.125 inches (.318 cm) thick to the underside of the bearing mounting area of the turntable base plate.
- (i). Use suitable hydraulic jacks to carefully raise the swing bearing to the underside of the turntable mounting plate. Ensure that the scribed line of the inner race of the bearing aligns with the scribed mark on the turntable (if a new swing bearing is used, ensure that the filler plug fitting is at 90 degrees from the fore and aft centerline of the turntable).

CAUTION

JLG INDUSTRIES RECOMMENDS THAT ALL REMOVED BEARING NUTS AND BOLTS BE DISCARDED AND REPLACED WITH NEW NUTS AND BOLTS. SINCE THE SWING BEARING IS THE ONLY STRUCTURAL LINK BETWEEN THE FRAME AND TURNTABLE, IT IS IMPERATIVE THAT SUCH REPLACEMENT HARDWARE MEETS JLG SPECIFICATIONS. USE OF GENUINE JLG HARDWARE IS HIGHLY RECOMMENDED.

- (o). Apply a light coating of Loctite #277 to the new bearing bolts, and loosely install the thirty-six (36) bolts and washers through the frame and outer race of bearing.

CAUTION

IF COMPRESSED AIR OR ELECTRICALLY-OPERATED IMPACT WRENCH IS USED FOR TIGHTENING THE BEARING ATTACHMENT BOLTS THE TORQUE SETTING ACCURACY OF THE TOOL SHOULD BE CHECKED PRIOR TO USE.

- (p). Following the Torque Sequence diagram shown in Figure 2-18 tighten the bolts to an initial torque of 60 foot pounds (8.34 Kgm). Then following the same sequence tighten the bolts to a final torque of 80 foot pounds (11.12 Kgm).

SECTION 2 — PROCEDURES

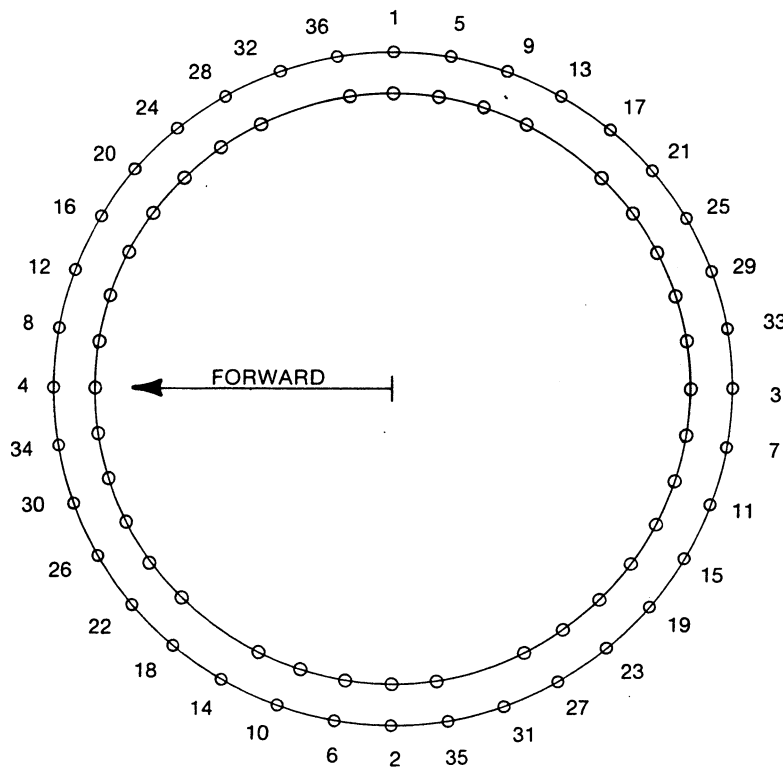


Figure 2-18. Swing Bearing Torquing Sequence.

- (q). Remove the lifting equipment from the bearing.
- (r). Use suitable lifting equipment to carefully position the turntable assembly above the machine frame.
- (s). Carefully lower the turntable onto the swing bearing, ensuring that the turntable and bearing align as noted in step (i) above.

CAUTION

IF COMPRESSED AIR OR ELECTRICALLY-OPERATED IMPACT WRENCH IS USED FOR TIGHTENING THE BEARING ATTACHMENT BOLTS, THE TORQUE SETTING ACCURACY OF THE TOOL SHOULD BE CHECKED PRIOR TO USE.

- (t). Apply a light coating of Loctite #277 to the new bearing bolts, and install the thirty-six bolts, washers and nuts through the turntable and inner race of the bearing.

- (u). Following the Torque Sequence diagram shown in Figure 2-18, tighten the bolts to an initial torque of 127.5 foot pounds (17.72 Kgm). Then following the same sequence tighten the bolts to a final torque of 170 foot pounds (23.63 Kgm).
- (v). Remove the lifting equipment.
- (w). Install the rotary coupling retaining yoke; apply a light coating of Loctite Sealant Number TL277-41 to the attaching bolts and secure the yoke to the rotary coupling with the bolts and lockwashers.
- (x). Connect the hydraulic lines to the rotary coupling as tagged prior to removal.
- (y). Use the manual descent valves to lower the platform to the stowed position.
- (z). Using all applicable safety precautions, activate the hydraulic system and functionally check the swing system for proper and safe operation.

SECTION 2 — PROCEDURES

c. Swing Bearing Torquing Procedures.

- (1). Outer Race - 80 FT LB (11.12 Kgm) Wet,
110 FT LB (15.21 Kgm) Dry.
- (2). Inner Race - 170 FT LB (23.63 Kgm) Wet,
220 FT LB (30.42 Kgm) Dry.

- (3). Swing Bearing Torquing Sequence, see
Figure 2-18.

WARNING

RETORQUE INNER SWING BEARING BOLTS TO 220 FT LB AND OUTER SWING BEARING BOLTS TO 110 FT LB AFTER FIRST 200 HOURS OF OPERATION AND EVERY 500 HOURS THEREAFTER.

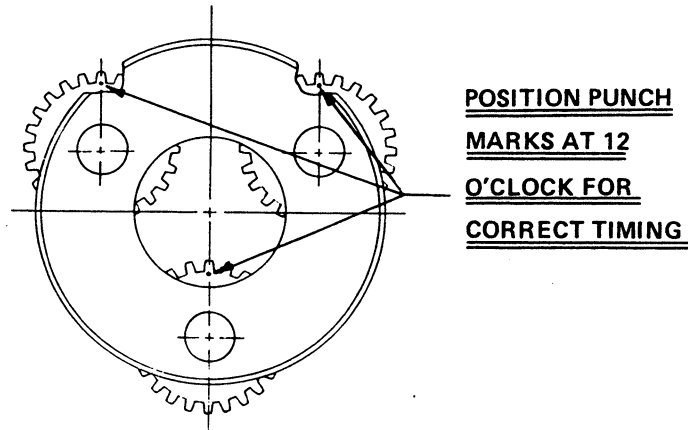


Figure 2-19. Drive Hub Carrier Timing.

SECTION 2 — PROCEDURES

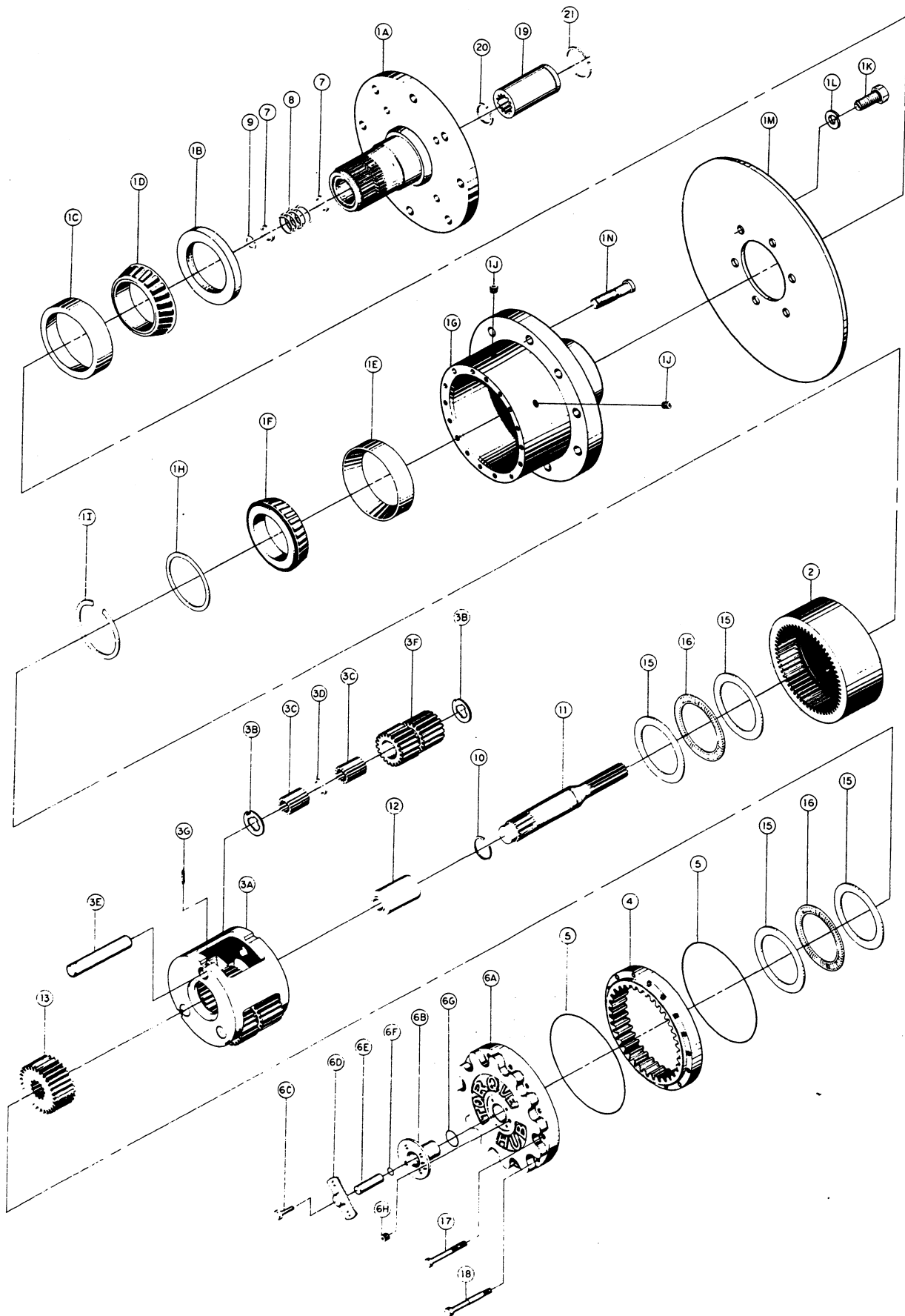


Figure 2-20. Drive Torque Hub Assembly.

SECTION 2 — PROCEDURES

2-22. TORQUE HUB. (See Figure 2-20)

a. Disassembly.

- (1). Loosen all 12 cover bolts (17, 18) and drain the oil from the unit.
- (2). Remove the 12 cover bolts and lift off the cover subassembly (6). Discard the o-ring seal (5) from the cover counterbore.
- (3). Lift out the carrier subassembly (3) and thrust bearing set (15, 16). A thrust washer may stick inside the cover.
- (4). Pry the ring gear (4) loose and remove it. Discard the o-ring seal from the hub counterbore.
- (5). Remove the input shaft (11), input gear (13) and thrust spacers (12) that are on the input shaft.
- (6). Lift out the internal gear (2) and thrust bearing set (15, 16). A thrust washer may stick to the bottom of the carrier.
- (7). Remove the retaining ring (11) from the spindle and discard, then lift the hub (1G) off the spindle. Eye protection should be worn during retaining ring removal.
- (8). The inside bearing cone and the bearing shim can now be removed.
- (9). The seal (1B) can be pried out of the hub with a screw driver or pry bar. This will also allow the outside bearing to be removed.

Note

If bearing replacement is necessary, the bearing cups can be removed with a slide hammer puller or driven out with a punch.

- (10). To remove the cluster gears (3F) from the carrier, drive the anti-roll pin (3G) into the planet shaft (3E) of the cluster gear. After the planet shaft is removed the roll pin should be driven out of the planet shaft.

Note

When rebuilding the unit, the o-rings and retaining rings should always be replaced.

b. Assembly.

- (1). Using an arbor type press if available (if not a hammer may be used) install the wheel studs. The hub flange should be supported from the underside during this operation.

- (2). Using an arbor type press if available press bearing cups with large inside diameters facing out, into hub counterbores.
- (3). Place bearing cone into bearing cup in small end of hub.
- (4). Press seal (1B) into hub counterbore with flat metal side facing in. Use a flat object to assure that seal is pressed evenly and is flush with hub face.
- (5). Lower hub onto spindle with large open end up.
- (6). Place bearing cone over end of spindle and into bearing cone.
- (7). Place bearing shim over end of spindle and against bearing cone.
- (8). Secure retaining ring (11) completely into spindle groove and against bearing shim. Be sure that retaining ring is entirely in groove.

Note

Eye protection should be worn during retaining ring installation.

- (9). Apply lube-seal to pipe plugs and install in hub.
- (10). Install the disengage spacer (7) and spring (8) into the counterbore of the spindle.
- (11). Install another spacer (7) and the correct retaining ring (9) into the spindle counterbore and retaining ring groove.

Note

Eye protection should be worn during retaining ring installation.

- (12). Install the internal gear (2) matching the bore spline to the spindle spline.
- (13). Install the thrust washer (15) thrust bearing (16) set on the portion of the spindle which extends into the internal gear.
- (14). Place the o-ring into the counterbore provided on the hub.
- (15). Install retaining ring (10) into input shaft (11) retaining ring groove.
- (16). Install input shaft into the spindle. Check action of spring at this point.
- (17). The thrust spacer (12) is installed on the input shaft.

SECTION 2 — PROCEDURES

- (18). Locate the four counter reamed holes in the hub face and mark them for later identification.
- (19). Place carrier assembly (3) on a flat surface with the large gears up and positioned as shown in Figure 2-2. Find the punch marked tooth on each large gear and locate at 12 o'clock (straight-up) from each planet pin (3E).
- (20). With shoulder side of ring gear (4) facing down place ring gear over (to mesh with) large gears. Be sure that punch marks remain in correct location during installation. The side of ring gear with an 'x' stamped on it should be up.
- (21). While holding ring gear and cluster gears in mesh, place small side of cluster gears into mesh with the internal gear. On the ring gear locate the hole marked 'x' over one of the marked counterbored holes in hub.
- (22). The input gear (13) is installed meshing with the larger diameter cluster gear. The counterbored side of the input gear is installed down or to the inside of the unit.
- (23). After inserting at least one shoulder bolt (18) in the proper location, rotate the carrier. This is to check freedom of rotation and recheck timing.
- (24). Another thrust washer/thrust bearing set is now installed into the counterbore in the face of the carrier.
- (25). Place o-ring (5) into cover assembly counterbore. Slight stretching may be necessary. Use grease or petroleum jelly to hold in place.
- (26). Place cover assembly on ring gear with oil level, check plug in cover located approximately 90° from oil fill plug.
- (27). Locate four sholder bolts 90° apart into counterbored hole in hub which were marked earlier. Torque each bolt to 47 ft. lb.
- (28). Install eight bolts into remaining holes and torque to 47 ft. lb. use the 180° to 90° method in torquing all bolts.
- (29). Place coupling (19) into the spindle and onto input shaft.
- (30). Fill unit one-half full of EPGL90 lubricant before operation.

2-23. CONTROLLERS.

a. PQ.

Refer to separate publication (3120304) for complete troubleshooting, wiring and replacement parts.

b. OEM.

Refer to separate publications (OEM Bulletins 106HL, 107HL and 109HL) for description, troubleshooting and field adjustment.

2-24. OSCILLATING AXLE BLEEDING PROCEDURE.

- a. Make a hydraulic hose using approximately 6 feet of 1/4" wire braid hose with a quick connect fitting on one end and a 1/4" JIC female fitting on the other.
- b. Swing the boom over the front of the machine and engage the turntable lock. Using ground control raise the boom up out of the way.
- c. Remove the cover between frame slabs through which the cam valve wheel protrudes.
- d. Remove cap from fitting on cam valve and connect your hose (see a above) at this point.
- e. Attach the other end of hose to the quick connect on the swing brake.
- f. Using a floor jack (or overhead crane) raise one front wheel approximately 6" off the ground.
- g. Use a bar as a lever to press down on the cam valve plunger which will allow the axle to fully oscillate against the stop.
- h. With the aid of an assistant, start the engine from ground control.

WARNING

ENSURE TURNTABLE LOCK IS ENGAGED.

- i. While your assistant activates swing from ground control, depress plunger on cam valve and open both bleeders on the lockout cylinder of the elevated wheel purging any air.
- j. Remove the jack from the elevated wheel and using the bar again press down on the cam valve plunger allowing the axle to center.
- k. Next raise the other front wheel as you did in step f and repeat steps g through j.

SECTION 2 — PROCEDURES

- l. Shut down the engine, remove the hose, and replace the cap on the cam valve fitting. Install frame cover over cam valve and disengage turntable lock.
- m. The boom can now be returned to its normal position.

2-25. OSCILLATING AXLE LOCKOUT TEST.

IMPORTANT

LOCKOUT SYSTEM TEST MUST BE PERFORMED QUARTERLY, ANY TIME A SYSTEM COMPONENT IS REPLACED, OR WHEN IMPROPER SYSTEM OPERATION IS SUSPECTED.

Note

Ensure boom is fully retracted, lowered and centered between drive wheels prior to beginning lockout cylinder test.

- a. Place a 6" high block with ascension ramp in front of the left front wheel.
- b. Activate the machines hydraulic system from the platform control station.
- c. Place the engine speed and drive speed control switches to their respective "LOW" positions.
- d. Place the drive controller to the "FORWARD" position and carefully drive the machine up the ascension ramp until the left front wheel is on top of the 6" block.
- e. Carefully activate swing controller and position boom over right side of machine.
- f. With boom over right side of machine, place the drive controller to the "REVERSE" position and carefully drive the machine off of the block and ramp.
- g. Have an assistant check to see that the left front wheel remains locked in position off of the ground.
- h. Carefully activate swing controller and return boom to the stowed position (centered between drive wheels). As the boom nears the stowed position the lockout cylinders should release and allow the wheel to rest on the ground.
- i. Repeat steps (a) thru (h) and check system by driving right front wheel on block and swinging boom over left side of machine.
- j. If the lockout cylinders do not function properly, have qualified personnel correct the malfunction prior to any further operation.

2-26. SWING BRAKE, MICO. (See Figure 2-21)

a. Disassembly.

- (1). Separate end cover (4) from housing (26) by removing capscrews (1) and lockwashers (2).

WARNING

END COVER IS UNDER SPRING TENSION OF APPROXIMATELY 1500 POUNDS (681 KG). THE FOUR CAPSCREWS SHOULD BE LOOSENEED EVENLY TO RELIEVE THIS FORCE. IF A HYDRAULIC PRESS IS AVAILABLE (3000 LBS (1362 KG) MAXIMUM), THE COVER CAN BE HELD IN POSITION WHILE REMOVING THE CAPSCREWS AND LOCKWASHERS.

- (2). Tap cover with a soft mallet in order to dislodge bearing (7) from cover.
- (3). Remove o-ring (6), square-ring (5), pipe plug (3), and bleeder screw (13), from end cover.
- (4). Remove piston (10) from end cover by inserting two 1/4-20UNC bolts into threaded holes in piston. By turning and pulling, piston can be removed from bore.
- (5). Remove o-ring (8), back-up ring (9), o-ring (11) and back-up ring (12) from piston.
- (6). Remove separators (19) from housing (26).
- (7). Remove shaft assembly, consisting of shaft (15), discs (16,20), friction plates (18), springs (17), snap ring (14), and bearings (7,24) from housing by pressing or using a soft mallet on male end of shaft.
- (8). Remove springs (17) from between tabs of discs (16,20).
- (9). Remove bearings (7,24) from shaft (15) with appropriate bearing puller. The discs and friction discs will then slide off male end of shaft. Remove snap ring and shaft.
- (10). Remove dowel pins (23), springs (21,22) and o-ring (25) from housing.

b. Inspection.

- (1). Clean all parts thoroughly.

SECTION 2 — PROCEDURES

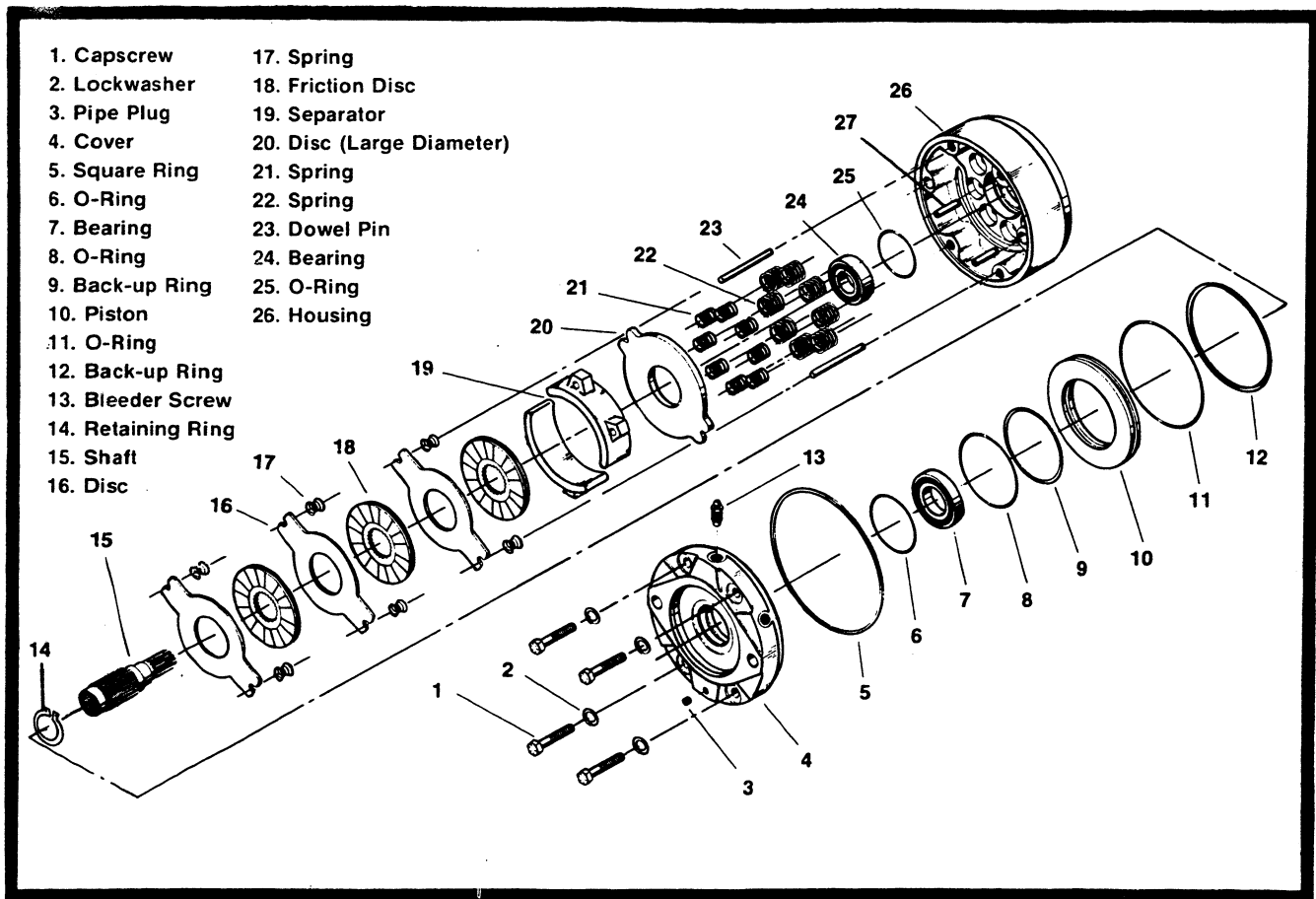


Figure 2-21. Swing Brake Assembly, Mico.

- (2). Closely inspect all parts for excessive wear, cracks, and chips. Replace parts as necessary.

- (3). Discard seals and o-rings.

- (4). Closely inspect bearings and bearing contact surfaces. Replace as necessary.

Note

Bearings may be reused if, after thorough inspection, they are found to be in good condition.

c. Assembly.

Note

Lubricate all seals and o-rings with clean hydraulic oil prior to assembly.

- (1). Insert new o-ring (25), dowel pins (23), and springs (21,22) in housing (26).
- (2). Install new bearing (24) in housing and press until bearing bottoms on shoulder in housing.

- (3). Position new large diameter disc (20) in housing with tabs guided by dowel pins (23) until disc rests on springs (21,22).

IMPORTANT

DISCS (16,20), AND FRICTION DISCS (18) SHOULD REMAIN DRY DURING INSTALLATION. NO OIL RESIDUE SHOULD BE ALLOWED TO CONTAMINATE DISC SURFACES.

- (4). Place a new friction disc (18) on bottom disc (20) centering it as closely as possible. Insert one spring (17) on each dowel pin (23).
- (5). Add additional new discs (16), new friction discs (18) and springs (17) as required for specific model.
- (6). Install snap ring (14) on shaft (15). Insert shaft (15) thru friction discs (18) until shaft contacts bearing (24). Press shaft (15) until it shoulders on inner race of bearing (24). A small preload will exist on snap ring (14) at this point.

SECTION 2 — PROCEDURES

- (7). Insert separators (19) over spiral pins in housing (26). Separators will contact top of bottom disc (20) when properly installed.
- (8). Install new o-ring (8), new backup ring (9), new o-ring (11), and new backup ring (12) on piston (10). Insert piston (10) into end cover (4) being careful not to shear o-rings or backup rings. Inserting 1/4-20UNC bolts in piston may simplify installation.
- (9). Install new o-ring (6), new bearing (7), new square ring, pipe plug (3), and bleeder screw (13) in end cover.
- (10). Position end cover (4) on housing aligning dowel pin (23) with holes in end cover.
- (11). Install capscrews (1) and lockwashers (2). Tighten evenly to draw end cover (4) to housing and bearing (7) onto shaft (15). Torque capscrews to 55 ft. lbs. (7.6 Kgm).

Note

If available, a hydraulic press will simplify installation of end cover on housing. Clamp cover in position while tightening the capscrews.

- (12). Press on inner ring of bearing (7) until it shoulders on shaft (15) to eliminate binding on bearings. Be certain to restrain opposite end of shaft to avoid excessive thrust loading on bearing (24).

IMPORTANT

PRESS FORCE SHOULD BE LIMITED TO 2000 LBS (907.2 KG) MAXIMUM TO AVOID POSSIBLE DAMAGE TO SNAP RING (14).

IMPORTANT

IF HYDROSTATIC BENCH TESTING IS PERFORMED ON THE BRAKE ASSEMBLY, RELEASE PRESSURE SHOULD NOT EXCEED 2000 PSI (140.6 KG/CM²) UNLESS TWO ADDITIONAL BOLTS ARE USED FOR SUPPLEMENTAL CLAMPING.

d. Bleeding.

- (1). Install brake 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 (7.03 Kg/cm²) during bleeding.
- (3). Apply sufficient pressure to release brake and check for proper operation.

2-27. DRIVE BRAKE, MICO.

(See Figure 2-22)

a. Disassembly.

- (1). Remove end cover (4) from housing (25) by removing capscrews (1) and lockwashers (2).

WARNING

END COVER IS UNDER SPRING TENSION OF APPROXIMATELY 1500 POUNDS (681 KG). THE FOUR CAPSCREWS SHOULD BE LOOSENEED EVENLY TO RELIEVE THIS FORCE. IF A HYDRAULIC PRESS IS AVAILABLE (3000 LBS (1362 KG) MAXIMUM), THE COVER CAN BE HELD IN POSITION WHILE REMOVING THE CAPSCREWS AND LOCKWASHERS.

- (2). Tap cover with a soft mallet in order to dislodge bearing (7) from cover.
- (3). Remove o-ring (6), square ring (5), pipe plug (3), and bleederscrew (13) from end cover.
- (4). Remove piston (10) from end cover by inserting two 1/4-20UNC bolts into threaded holes in piston. By turning and pulling, piston can be removed from bore.
- (5). Remove o-ring (8), back-up ring (9), o-ring (11), and back-up ring (12) from piston.
- (6). Remove separators (19) from housing (25).
- (7). Remove shaft assembly (consisting of shaft (14), discs (15,19) friction discs (17), springs (16), and bearings (7,23) from housing by pressing or using a soft mallet on male end of shaft.
- (8). Remove springs (16) from between tabs of discs (15,19).
- (9). Remove bearings (7,23) from shaft using an appropriate bearing puller. The discs and friction discs will then slide off either end of shaft.
- (10). Remove dowel pins (22), springs (20,21) and oil seal (24) from housing (25).

b. Inspection.

- (1). Clean all parts thoroughly.

SECTION 2 — PROCEDURES

- (2). Closely inspect all parts for excessive wear, cracks, and chips. Replace parts as necessary.
- (3). Discard seals and o-rings.
- (4). Closely inspect bearings and bearing contact surfaces. Replace as necessary.

Note

Bearings may be re-used if, after thorough inspection, they are found to be in good condition.

c. Assembly.

Note

Lubricate all seals and o-rings with clean hydraulic oil prior to assembly.

- (1). Insert new oil seal (24), dowel pins (22), and springs (20,21) in housing (25).
- (2). Install new bearing (23) on male end of shaft (14) and press until it shoulders on shaft.
- (3). Insert shaft and bearing in housing (25) and press until bearing bottoms on shoulder in housing.
- (4). Position large diameter disc (19) in housing, with tabs guided by dowel pins (22), until disc rests on springs (20,21).

IMPORTANT

DISCS (15,19) AND FRICTION DISCS (17) SHOULD REMAIN DRY DURING INSTALLATION. NO OIL RESIDUE SHOULD BE ALLOWED TO CONTAMINATE DISC SURFACES.

- (5). Place friction disc (17) on shaft until it contacts bottom disc (19). Insert one spring (16) on each dowel pin (22).
- (6). Add additional discs (15), friction discs (17), and springs (16) as required to complete assembly. Alternate discs and friction discs during assembly.
- (7). Insert separators (18) over spiral pins in housing. When properly installed, separators will contact top of bottom disc.
- (8). Install o-ring (8), back-up ring (9), o-ring (11), and back-up ring (12) on piston (10). Insert piston into end cover (4), being careful not to shear o-rings or back-up rings. Inserting 1/4-20UNC bolts in piston may simplify installation.
- (9). Install o-ring (6), bearing (7), square-ring (5), pipe plug (3), and bleaderscrew (13) in end cover.
- (10). Position end cover on housing, aligning dowel pins with holes in end cover, and push end cover until top friction disc aligns with spline shaft.

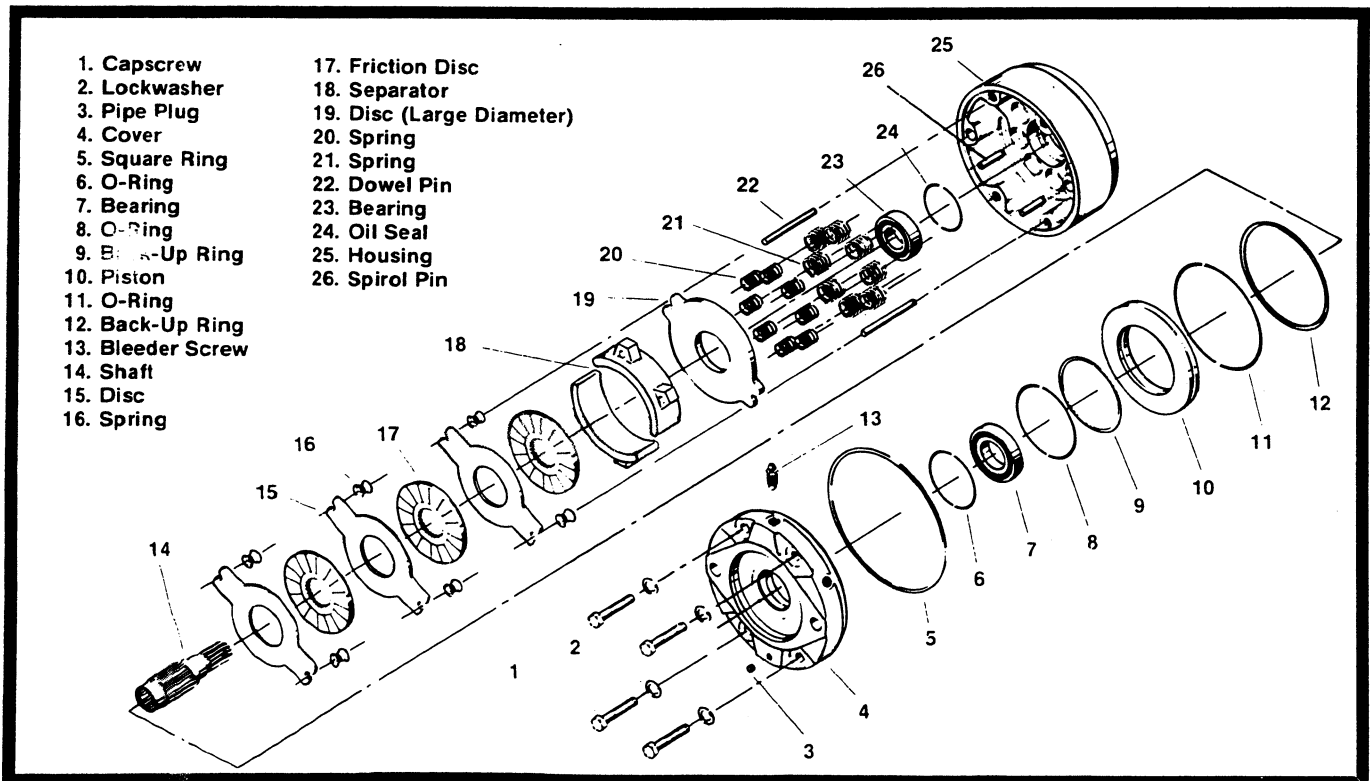


Figure 2-22. Drive Brake Assembly, Mico.

SECTION 2 — PROCEDURES

- (11). Install capscrews (1) and lockwashers (2). Tighten evenly to draw end cover to housing and bearing onto shaft. Torque capscrews to 55 ft. lbs. (7.6 Kgm).

Note

If available, a hydraulic press will simplify installation of end cover on housing. Clamp cover in position while tightening capscrews.

- (12). To eliminate binding on bearings, press on inner ring of bearing (7) until it shoulders on shaft. Restrain opposite end of shaft to avoid excessive thrust loading of bearing (24).

IMPORTANT

IF HYDROSTATIC BENCH TESTING IS PERFORMED ON THE BRAKE ASSEMBLY, RELEASE PRESSURE SHOULD NOT EXCEED 2000 PSI (140.6 KG/CM²) UNLESS TWO ADDITIONAL BOLTS ARE USED FOR SUPPLEMENTAL CLAMPING.

d. Bleeding.

- (1). Install brake 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.

2-28. SWING BRAKE, AUSCO.

(See Figure 2-23)

a. Disassembly.

- (1). With shaft protruding downward, remove bolts (22) alternately and evenly to reduce spring tension.
- (2). Remove power plate (21) and gasket (2).
- (3). Bearing (18) is pressed onto shaft (7) and must be removed before removal of rotating discs (11) and stationary discs (12).
- (4). Further disassembly is not recommended unless necessary for the replacement of specific parts.
- (5). If further disassembly is required, remove shaft (7) and stack sub-assembly from housing (1) by lightly tapping or pressing on the small external spline end of the shaft and removing the shaft, bearings and stack from housing.

- (6). Remove bearing (18), stationary disc (12), rotating disc (11), springs (10) and primary disc (9).
- (7). Remove bearing (3) from shaft using care not to damage seal (4). Remove seal (4).
- (8). Remove springs (6) and spring retainer (5) from housing.
- (9). Remove piston (13) from power plate by introducing low pressure air (15 PSI) into the hydraulic inlet. Direct piston away from operator.
- (10). Remove o-rings (15) and (17) and back-up rings (14) and (16) from piston O.D. and I.D. grooves. Back-up rings will be damaged and should not be removed if replacement is not planned.
- (11). Pressure relief valve (23) can be removed and inspected to assure spring loaded ball moves freely and is contamination free.

b. Inspection.

- (1). Clean all parts thoroughly.
- (2). Closely inspect all parts for excessive wear, cracks, and chips. Replace parts as necessary.
- (3). Discard seals and o-rings.
- (4). Closely inspect bearings and bearing contact surfaces. Replace as necessary.

Note

Bearings may be re-used if, after thorough inspection, they are found to be in good condition.

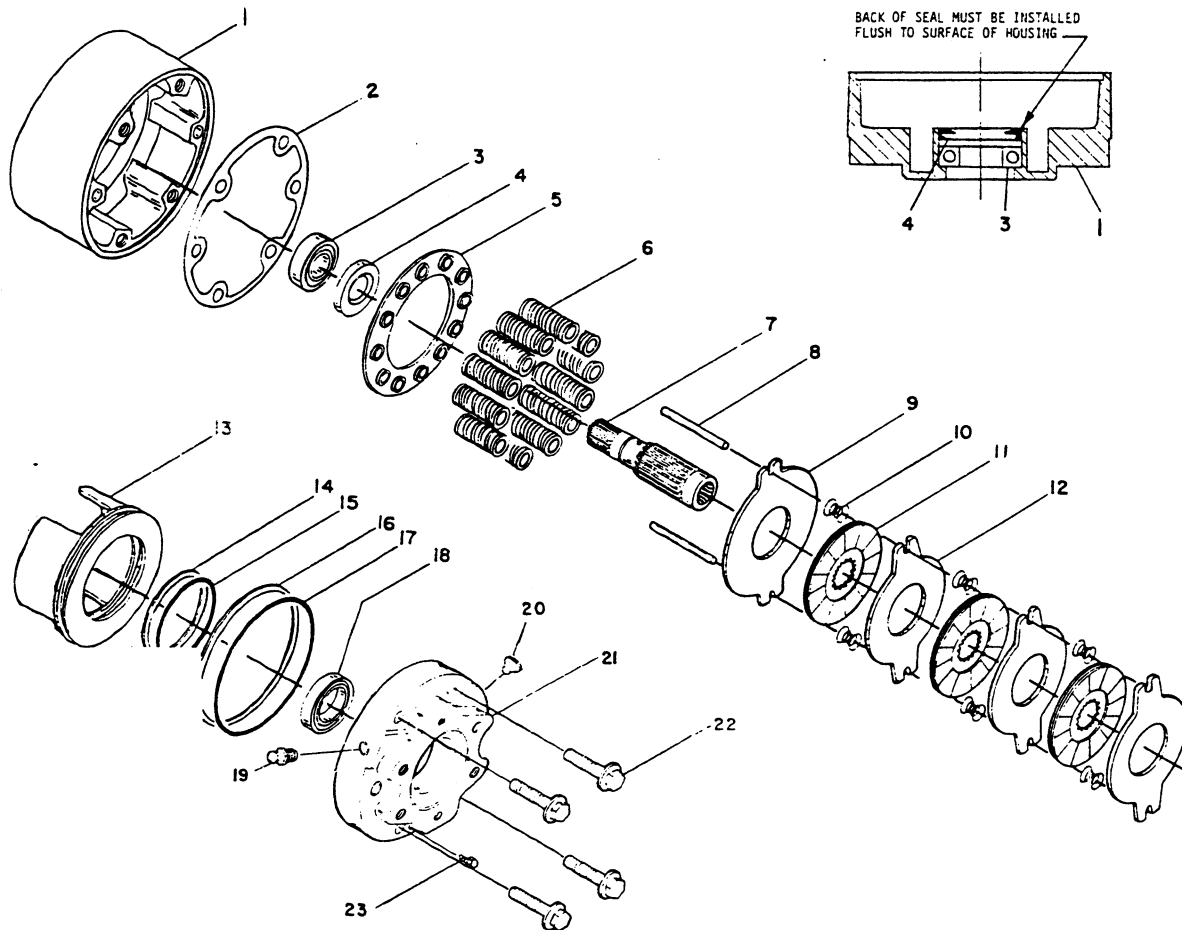
c. Assembly.

Note

Lubricate all seals, o-rings, cylinder of the power plate and piston with clean hydraulic oil prior to assembly.

- (1). Assemble piston (13) into power plate (21) using a shop press, being careful not to damage the o-rings or back-up rings. Visually align the center of the cutouts in piston (13) with torque pin (8) holes in power plate (21). Avoid pushing the piston all the way to the bottom of the cylinder in the power plate. Try to keep the top surface of the piston flush to 1/8" (0.32 cm) below the machined surface of the power plate.

SECTION 2 — PROCEDURES



- | | |
|----------------------|---------------------------|
| 1. Housing | 13. Piston |
| 2. Gasket | 14. Back-Up Ring |
| 3. Bearing | 15. O-Ring |
| 4. Seal | 16. Back-Up Ring |
| 5. Spring Retainer | 17. O-Ring |
| 6. Springs | 18. Bearing |
| 7. Shaft | 19. Bleeder Screw |
| 8. Torque Pin | 20. Plug |
| 9. Primary Disc | 21. Power Plate |
| 10. Springs | 22. Bolts |
| 11. Rotating Discs | 23. Pressure Relief Valve |
| 12. Stationary Discs | |

Figure 2-23. Swing Brake Assembly, Ausco.

SECTION 2 — PROCEDURES

- (2). When pressing the bearing onto the shaft, press on the inner race of the bearing and support the shaft properly.
 - (3). Rotating discs must be clean and dry. Worn or heavily scored rotating discs must be replaced.
 - (4). Press bearings (3) into housing (1). Bearing must be seated against shoulder in housing.
 - (5). Using a shop press install seal (4) by pressing evenly around O.D. of seal. Use care to avoid cocking.
 - (6). Install shaft (7) into housing. Support the inner race of bearing (3) when pressing shaft into bearing.
 - (7). Install gasket (2). Align properly. After installing all the remaining internal components of the brake, install bearing (18). Properly support the shaft when pressing the bearing onto shaft.
 - (8). Install the power plate sub-assembly. Use a shop press to evenly lower plate into position. There should be no gap at the O.D. when the power plate is properly seated against housing. If a shop press is not available, use the assembly bolts (22). Tighten sequentially one turn at a time until the power plate is properly seated. Torque to 50-60 ft. lbs. (6.91-8.30 Kgm).
 - (9). If replacement of pressure relief valve is necessary, install 1/2 to 3/4 turns beyond finger tight.
 - (10). Bleed air from brake via bleeder screw.
 - (5). Remove bearing from housing.
 - (6). Remove piston (14) from the power plate (20) by introducing low pressure air (15 PSI) into the hydraulic inlet. Make sure piston is directed away from the operator. Remove o-rings (16) and (18) and back-up rings (15) and (17) from the piston O.D. and I.D. grooves. Back-up rings will be damaged and should not be removed if replacement is not planned.
 - (7). Bleeder (19) can be removed and inspected to assure spring loaded ball moves freely and is free of contamination.
- b. Inspection.**
- (1). Clean all parts thoroughly.
 - (2). Closely inspect all parts for excessive wear, cracks and chips. Replace parts as necessary.
 - (3). Discard seals and o-rings.
 - (4). Closely inspect bearings and bearing contact surfaces. Replace as necessary.

Note

Bearings may be reused if, after thorough inspection, they are found to be in good condition.

c. Assembly.

Note

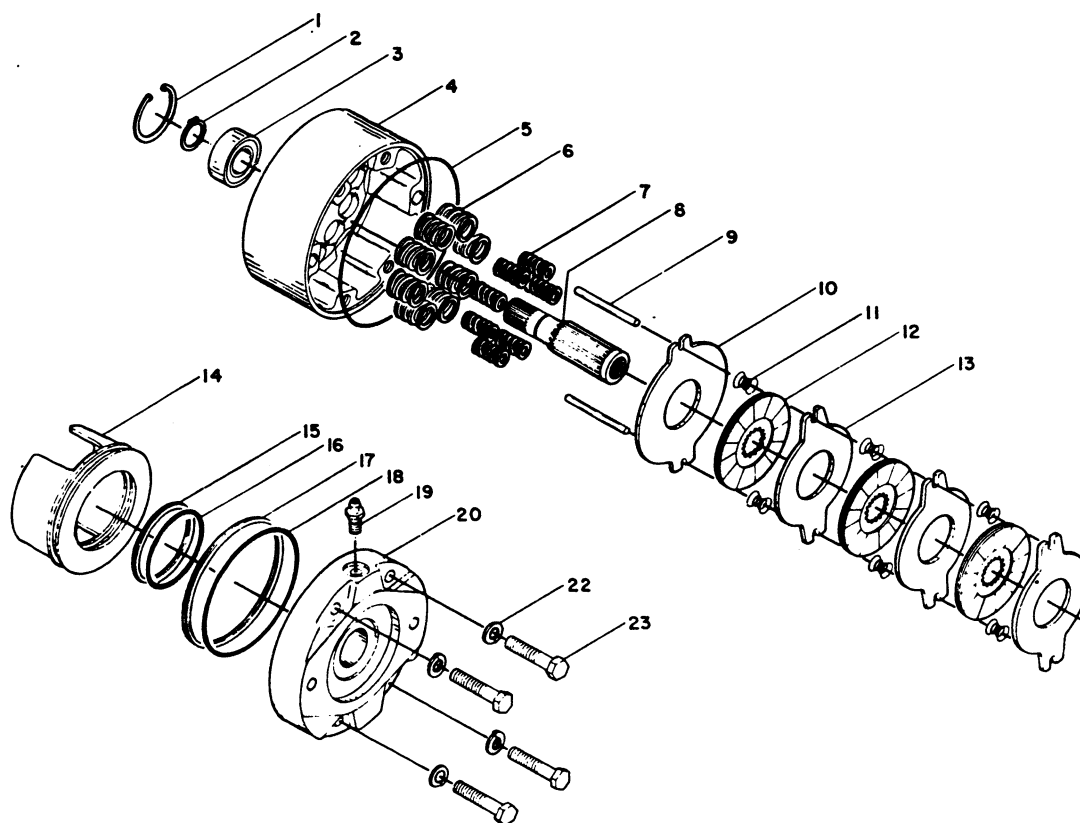
Lubricate all seals, o-rings, cylinder of the power plate and piston with clean hydraulic oil prior to assembly.

2-29. DRIVE BRAKE, AUSCO. (See Figure 2-24)

a. Disassembly.

- (1). With shaft protruding downward, remove bolts (23) alternately and evenly to reduce spring tension.
- (2). Remove power plate (20), o-ring (5), stationary discs (13), springs (11), rotating discs (12), primary disc (10), pins (9), springs (6) and (7), and spring retainer (if so equipped).
- (3). Further disassembly is not recommended unless necessary for the removal of specific parts.
- (4). If further disassembly is required, remove snap rings (1) and (2), then remove shaft (8) from bearing (3) by lightly tapping shaft with a plastic mallet.
- (1). Use the reverse of the disassembly procedure with the following notes and additions.
- (2). Worn o-rings and damaged or worn teflon back-up rings must be replaced prior to assembly.
- (3). If replacement of bleeder (19) is necessary, install 1/2 to 3/4 turns beyond finger tight.
- (4). Assemble piston (14) into power plate (20) using a shop press, being careful not to damage the o-rings or teflon back-up rings. Visually align the center of the cut-outs in the piston with the torque pin (9) holes in the power plate.
- (5). Rotating discs (12) must be clean and dry, with no presence of oil on any lining material or mating surfaces of the stationary discs (13).

SECTION 2 — PROCEDURES



1. Snap Rings
2. Snap Rings
3. Bearing
4. Housing
5. O-Ring
6. Spring
7. Spring
8. Shaft
9. Pins
10. Primary Disc
11. Springs
12. Rotating Discs
13. Stationary Discs
14. Piston
15. Back-Up Ring
16. O-Ring
17. Back-Up Ring
18. O-Ring
19. Bleeder
20. Power Plate
21. Not Used
22. Lockwasher
23. Bolts

Figure 2-24. Drive Brake Assembly, Ausco.

SECTION 2 — PROCEDURES

- (6). Install bolts (23). Tighten sequentially, one turn at a time, until power plate (20) is properly seated. Torque to 50-60 ft. lbs. (6.91-8.30 Kgm).

2-30. BASKET ROTATOR BRAKE. (If Equipped)

The basket rotator has been made in two different configurations, a shaft pivot rotator, and a hollow pivot rotator. With both configurations, the adjusting nuts are tightened to where the platform brake develops a friction force requiring approximately 80 lbs. (36.3 Kg) pull on a platform corner to slip the brake discs. On those machines with a shaft pivot rotator, two spanner nuts are used to adjust rotator brake tension. The nuts are adjusted upward to increase tension, and are adjusted downward to decrease tension. On those machines with a hollow pivot rotator, four locknuts are used to adjust rotator brake tension. It is important to adjust the four locknuts equally to maintain even brake tension. The nuts are adjusted downward to increase brake tension, and are adjusted upward to decrease brake tension.

2-31. DUAL FUEL SYSTEM.

CAUTION

IT IS POSSIBLE TO SWITCH FROM ONE FUEL SOURCE TO THE OTHER WITHOUT ALLOWING THE ENGINE TO STOP. EXTREME CARE MUST BE TAKEN AND THE FOLLOWING INSTRUCTIONS MUST BE FOLLOWED.

a. Changing from Gasoline to LP-Gas.

- (1). Start the engine from the ground control station.
- (2). Open the hand valve on the LP gas supply tank by turning counterclockwise.

CAUTION

BE SURE ALL GASOLINE IS EXHAUSTED BEFORE SWITCHING TO LP GAS.

- (3). While the engine is operating, place the three position LPG/Gasoline switch at the ground control station to the center "off" position. Allow the engine to operate, without load, until the engine begins to "stumble" from lack of gasoline.
- (4). As the engine begins to "stumble" place the switch to the "LPG" position, allowing the LP fuel to be sent to the fuel regulator.

b. Changing from LP Gas to Gasoline.

- (1). With engine operating on LP under a no load condition, throw the "LPG/Gasoline" switch at the ground control station across to the "Gasoline" position.
- (2). If engine "stumbles" because of lack of gasoline, place the switch to the "LPG" position until engine regains smoothness, then return the switch to the "Gasoline" position. Repeat as necessary until engine runs smoothly on gasoline.
- (3). Close the hand valve on the LP gas supply tank by turning clockwise.

SECTION 2 — PROCEDURES

2-32. PREVENTIVE MAINTENANCE AND INSPECTION SCHEDULE.

a. The preventive maintenance and inspection checks for the Model 60HT are listed and defined in the following table. This table is divided into two basic parts, the "AREA" to be inspected and the "INTERVAL" at which the inspection is to take place. Under the "AREA" portion of the table, the various systems along with the components that make up that system are listed. The "INTERVAL" portion of the table is divided into five columns representing the various inspection time periods. The numbers listed within the interval column represent the applicable inspection code for which that component is to be checked.

b. The checks and services listed in this schedule are not intended to replace any local or regional regulations that may pertain to this type of equipment nor should the lists be considered as all inclusive. Variances in interval times may occur due to climate and/or conditions and depending on the location and use of the machine.

c. The inspection and maintenance code numbers are as follows:

1. Check for proper and secure installation.
2. Check for visible damage and legibility.

3. Check for proper fluid level.

4. Check for any structural damage; cracked or broken welds; bent or warped surfaces.

5. Check for leakage.

6. Check for presence of excessive dirt or foreign material.

7. Check for proper operation and freedom of movement.

8. Check for excessive wear or damage.

9. Check for proper tightness and adjustment.

10. Drain, clean and refill.

11. Check for proper operation while engine is running.

12. Check for proper lubrication.

13. Check for evidence of scratches, nicks or rust and for straightness of rod.

14. Check condition of element; replace as necessary.

15. Check for proper inflation.

16. Clean or replace suction screen.

PREVENTIVE MAINTENANCE AND INSPECTION SCHEDULE

AREA	INTERVAL				
	(10 HRS) DAILY	(50 HRS) WEEKLY	(200 HRS) MONTHLY	(500 HRS) 3 MONTH	(1000 HRS) 6 MONTH
BOOM					
1. Basket Door	1,4	12			
2. Basket	1,4				
3. Basket Rotator	12	5,11	8		
4. Footswitch	1,11				
5. Controllers	1,11				
6. Switches	1,11				
7. Capacity Indicator	2,7				
8. Placards and Decals	1,2				
9. Control Tags	1,2				
10. Steering Wheel	1,11	5	8		
11. Valves		5,6			
12. Carrier (Hose and Cable)	1	4,8			
13. Hydraulic Hoses and Tubing	1	5			
14. Pins		12	8		
15. Bushings		12	8		
16. Wear Pads			8		
17. Chains			8	12	
18. Chain Adjusters			9		
19. Sheaves		12	8		
20. Cylinders	12	1,5,6,13			

SECTION 2 — PROCEDURES

PREVENTIVE MAINTENANCE AND INSPECTION SCHEDULE (CONT'D)

AREA	INTERVAL				
	(10 HRS) DAILY	(50 HRS) WEEKLY	(200 HRS) MONTHLY	(500 HRS) 3 MONTH	(1000 HRS) 6 MONTH
TURNTABLE					
1. Engine Oil (Refer to mfg. manual for detailed maint. schedule)	3	5			
2. Battery	3	5			
3. Radiator		3,5			
4. Air Cleaner	1	14			
5. Exhaust System	1		1,5		
6. Engine Mounts			1		
7. Gauges/Ground Controls	1,2,11				
8. Main Hydraulic Pump	1	5			
9. Auxiliary Power Pump	1	5			
10. Valves	1	5			
11. Hydraulic Filters	14	5			
12. Hydraulic Hoses and Tubing	1	5			
13. Hydraulic Oil Tank *	3	5	4		16
14. Breather Hydraulic Tank		6,14			
15. Fuel Tank	3,5		4		
16. Cylinders	12	1,5,6,13	4		
17. Shields	1				
18. Turntable Locking Pin	1,7		4		
19. Horizontal Limit Switch	1,7				
20. Oil Coupling		5			
21. Placards and Decals	1,2				
22. Swing Bearing		1,12		9	
23. Swing Torque Hub		1,3,5,6		10	
24. Swing Brake		1,5,6	8		

*Inspection and Maintenance Code 10
to be performed annually.

AREA	INTERVAL				
	(10 HRS) DAILY	(50 HRS) WEEKLY	(200 HRS) MONTHLY	(500 HRS) 3 MONTH	(1000 HRS) 6 MONTH
CHASSIS					
1. Wheel and Tire Assembly	1	8,15,9			
2. Drive Motors		1,5,6			
3. Drive Torque Hubs		1,3,5,6		10	
4. Drive Brakes		1,5,6	8		
5. Steer Cylinder	1	5,6,12,13			
6. Steer Components	1	4,6,12	8		
7. Lockout Cylinders	1	5,12,13			
8. Front Axle Pin	1	12	8		
9. Hydraulic Hoses and Tubing	1	5			
10. Placards and Decals	1,2				
11. Shields	1				
12. Wheel Bearings			8	12	
13. Swing Bearing/Pinion Gear				9,12	

*Inspection and Maintenance Code 10 to be performed annually.

IMPORTANT

JLG INDUSTRIES REQUIRES THAT A COMPLETE ANNUAL INSPECTION BE PERFORMED IN ACCORDANCE WITH THE 'ANNUAL MACHINE INSPECTION REPORT' FORM.

SECTION 2 — PROCEDURES

Note

This machine requires periodic safety and maintenance inspections by a JLG Dealer. A decal located on the frame affords a place to record (stamp) inspection dates.

JLG Industries requires that a complete annual inspection be performed in accordance with the 'Annual Machine Inspection Report' form. Forms are supplied with each new machine and are also available from JLG Customer Service. Form must be completed and returned to JLG Industries.

SECTION 3 — TROUBLESHOOTING

3-1. GENERAL.

- a. This section contains troubleshooting information to be used for locating and correcting most of the operating problems which may develop in the Model 60HT aerial platform. If a problem should develop which is not presented in this section or which is not corrected by listed corrective actions, technically qualified guidance should be obtained before proceeding with any maintenance.
- b. Troubleshooting and maintenance information pertaining to the prime mover (engine) that are not contained in this manual are contained in the applicable engine maintenance manual.

3-2. TROUBLESHOOTING INFORMATION.

- a. The troubleshooting procedures applicable to the Model 60HT aerial platform are listed and defined in Tables 3-1 through 3-6. As an aid to table use, the aerial platform is divided into six major groups, each covered separately within this section. These groups are as follows: platform assembly, boom assembly, turntable assembly, frame assembly, hydraulic system and electrical system.
- b. Each malfunction within an individual group or system is followed by a listing of probable causes which will enable determination of the applicable remedial action. The probable causes and the remedial action should, where possible, be checked in order listed in the tables.
- c. It should be noted that there is no substitute for a thorough knowledge of the equipment and related systems.

- d. It should also be recognized that the majority of the problems arising in the machine will be centered in the hydraulic and electrical systems. For this reason, every effort has been made to ensure that all likely problems in these areas are given the fullest possible treatment. In the remaining machine groups only those problems which are symptomatic of greater problems of which have more than one probable cause and remedy are included. This means that problems for which the probable cause and remedy may be immediately obvious are not listed in this section.
- e. The first rule for troubleshooting any circuit that is hydraulically operated and electrically controlled is to determine if the circuit is lacking hydraulic oil or electrical control power. This can be ascertained by overriding the bypass valve (mechanically or electrically) so that oil is available to the function valve, then overriding the function valve mechanically. If the function performs satisfactorily, the problem exists with the control circuit.

3-3. HYDRAULIC CIRCUIT CHECKS.

The first reference for improper function of a hydraulic system, where the cause is not immediately apparent, should be the Troubleshooting Chart. The best place to begin the problem analysis is at the power source (pump). Once it is determined that the pump is serviceable, then a systematic control of the circuit components, beginning with the control would follow. For aid in troubleshooting, refer to the illustrated parts manual for hydraulic diagrams of the various circuits.

SECTION 3 — TROUBLESHOOTING

Table 3-1. Platform Assembly Troubleshooting

TROUBLESHOOTING CHART	
TROUBLE	PROBABLE CAUSE
Platform Leveling System. Automatic leveling inoperative.	Hydraulic system oil low. Dual pilot check valves dirty/inoperative. Restricted or broken hydraulic line or fitting on slave cylinder or master leveling cylinder. Spit valve(s) leaking. Worn seal(s) in slave or master leveling cylinder. Slave or master leveling cylinder not functioning properly. Counterbalance valve on slave leveling cylinder improperly adjusted or not functioning properly. Spit valve leaking. Worn seal(s) in slave cylinder or master leveling cylinder. Circuit breaker open.
Platform will not maintain level attitude.	Hydraulic system oil low. Damaged wiring on control switch or solenoid valve. Control switch not functioning properly. Restricted or broken hydraulic line or fitting. Control valve not functioning properly. Slave cylinder not functioning properly. Damaged wiring on control switch or solenoid valve. Spit valve leaking or dirty. Restricted or broken hydraulic line or fitting. Slave cylinder not functioning properly.
Platform will not adjust "up" to level.	Replenish oil as necessary. Clean or replace as necessary. Clean, repair, or replace line or fitting. Clean, repair, or replace spit valve(s). Replace seal(s). Repair or replace cylinder. Replace valve. Clean or replace valve. Replace seal(s). Determine and correct cause. Reset circuit breaker. Replenish oil as necessary. Repair or replace wiring. Replace switch. Clean, repair, or replace line or fitting. Repair or replace valve. Repair or replace cylinder. Repair or replace wiring. Repair or replace spit valve. Clean, repair, or replace line or fitting. Repair or replace cylinder.
Platform will not adjust "down" to level.	

(See: Platform will not adjust "up" to level.)

SECTION 3 — TROUBLESHOOTING

Table 3-2. Boom Assembly Troubleshooting.
TROUBLESHOOTING CHART

TROUBLE	PROBABLE CAUSE	REMEDY
Boom Elevation System.		
No response to control.	Lift control inoperative. Dump valve (bypass) not operating. Hydraulic system oil low. Restricted or broken supply line on valve bank or hydraulic pump. Control valve not functioning properly. Lift cylinder not functioning properly. Hydraulic pump not functioning properly.	Repair or replace control lever. Determine cause and repair/replace valve. Replenish oil as necessary. Clean or replace line. Repair or replace valve. Repair or replace cylinder. Repair or replace pump.
Boom will not raise.	Load capacity exceeded (personnel or equipment on platform). Electrical Malfunction. Hydraulic system oil low. Restricted or broken hydraulic line or fitting. Control valve not functioning properly. Pressure relief valve not functioning properly. Bypass valve (dump) not functioning. Lift cylinder not functioning properly. (See: Boom will not raise.) Pressure relief valve not functioning properly. Hydraulic system oil low. Restricted or broken hydraulic line or fitting.	Reduce load.(Refer to capacity placard.) See electrical systems troubleshooting. Replenish oil as necessary. Clean, repair, or replace line or fitting. Repair or replace valve. Re-adjust or replace valve. Repair or replace valve. Repair or replace cylinder. Re-adjust or replace valve. Replenish oil as required. Clean, repair, or replace line or fitting.
Boom will not lower.	Lack of lubricant on cylinder shafts and/or boom pivot.	Lubricate as required. (Refer to Lubrication Chart.)
Boom raises and lowers erratically.		

Table 3-2. Boom Assembly Troubleshooting.
TROUBLESHOOTING CHART
PROBABLE CAUSE

TROUBLE

REMEDY

Boom raises and lowers erratically (continued).

Microswitch on controller improperly adjusted.	Adjust microswitch on controller for proper operation.
Ignition interference in electrical circuit.	
Counterbalance valve on lift cylinder improperly adjusted or not functioning properly.	Replace valve.
Control valve not functioning properly.	Repair or replace valve.
Worn seals in lift cylinder.	Replace seals.
Cylinder not functioning properly.	Repair or replace cylinder.
Manual lowering valve not functioning properly.	Repair or replace valve.
Worn seals in lift cylinder.	Replace seals.
Holding valve on cylinder not functioning properly.	Repair or replace valve.
Damaged wiring on mercury switch.	Repair or replace wiring.
Horizontal limit switch not adjusted or sticking.	Repair, replace or adjust limit switch.
Damaged mercury switch.	Replace switch, repair or replace holder.

Boom drifts down.

High engine does not operate below horizontal.

SECTION 3 — TROUBLESHOOTING

Table 3-2. Boom Assembly Troubleshooting.

TROUBLESHOOTING CHART

TROUBLE	PROBABLE CAUSE	REMEDY
Telescope System.	No response to control.	Determine and correct cause; reset circuit breaker.
		Replenish oil as necessary.
		Repair or replace wiring.
		Replace switch or valve.
		Clean or replace line.
		Repair or replace cylinder.
		Repair or replace pump.
		Repair or replace wiring.
		Close manual descent valves.
		Repair or replace valve.
Boom will not extend.		Replace switch.
		Clean, repair, or replace line or fitting.
		Check pressure/re-adjust as necessary.
		Repair or replace cylinder.

Table 3-2. Boom Assembly Troubleshooting.

TROUBLESHOOTING CHART

TROUBLE	PROBABLE CAUSE	REMEDY
Boom extends and retracts erratically.	Hydraulic system oil low.	Replenish oil as necessary.
	Wear pads not adjusted or worn.	Adjust or replace pads as required.
	Control switch not functioning properly.	Replace switch.
	Restricted or broken hydraulic line or fitting.	Clean, repair, or replace line or fitting.
	Control valve not functioning properly.	Repair or replace valve.
	Worn seals in telescope cylinder.	Replace seals.
	Cylinder not functioning properly.	Repair or replace cylinder.
	Distorted boom section(s).	Replace distorted section(s).
	Chain sprockets/sheaves worn.	Replace worn/damaged components.
	Counterbalance valve not functioning properly.	Replace counterbalance valve.
Fly section inoperative.	Broken drive chain.	Repair or replace chain.
	Broken drive sprocket or bent sprocket shaft.	Replace shaft assembly.
Fly section extends and retracts erratically.	Drive chain out of adjustment.	Adjust chain as required.
	Wear pads out of adjustment or worn.	Adjust or replace pads as required.
	Damaged/worn drive sprocket or chain links.	Repair or replace chain or sprocket as required.
	Fly section distorted.	Replace fly section.

SECTION 3 — TROUBLESHOOTING

Table 3-2. Boom Assembly Troubleshooting.

TROUBLESHOOTING CHART

TROUBLE	PROBABLE CAUSE	REMEDY
Boom Swing System.	No response to control.	Replenish oil as necessary.
		Repair or replace swing switches.
		Clean or replace line.
		Repair or replace valve.
		Repair or replace motor.
		Repair or replace brake.
		Repair or replace speed reducer.
		Remove objects, check for damage, and repair or replace component(s) as required.
		Repair or replace motor/brake.
		Clean, repair, or replace line or fitting.
Boom will swing in only one direction.	Control valve not functioning properly.	Repair or replace valve.
	Foreign object(s) wedged between speed reducer pinion and swing gear.	Remove object(s), check for damage and repair or replace component(s) as required.
	Swing control switch not functioning properly.	Ascertain cause and repair or replace swing switch.
	Brake shuttle valve defective.	Replace shuttle valve.

Table 3-2. Boom Assembly Troubleshooting.

TROUBLESHOOTING CHART

TROUBLE	PROBABLE CAUSE	REMEDY
Boom Swing System (Cont'd)		
Boom swings erratically in either direction.	Hydraulic system oil low.	Replenish oil as necessary.
	Lack of lubricant on swing gear or speed reducer pinion.	Lubricate as required. (See Lubrication Chart.)
	Microswitch on controller improperly adjusted.	Adjust microswitch on controller for proper operation.
	Swing motor not functioning properly.	Repair or replace motor.
	Speed reducer not functioning properly.	Repair or replace speed reducer.
	Worn or broken teeth on swing gear or speed reducer pinion.	Replace gear(s) as required.
	Swing brake not functioning properly.	Repair or replace swing brake.
	Orifice plugged or missing in swing motor.	Clean or replace orifice.
	Shuttle valve defective.	Repair or replace shuttle valve.

SECTION 3 — TROUBLESHOOTING

Table 3-3. Turntable Assembly Troubleshooting.

TROUBLESHOOTING CHART

TROUBLE	PROBABLE CAUSE	REMEDY
Power Plant.		
Engine will not start.	Station power selector switch not in required position.	Actuate switch as required.
	Circuit breaker open.	Determine and correct cause; reset circuit breaker.
	Anti-diesel valve on carb not working. (Gas)	Repair or replace anti-dieseling valve.
	Defective starter motor.	Replace starter motor.
	Damaged wiring in ignition circuit (broken wire on starter).	Replace or repair wiring.
	Ignition switch not functioning properly.	Replace switch.
	Defective start solenoid.	Replace start solenoid.
	Ignition circuit shorted to ground.	Repair circuit as required.
	Battery cable(s) not making contact.	Clean and tighten cable(s).
	No fuel.	Replenish fuel as necessary.
	Anti-diesel valve on carb. not working. (Gas)	Repair or replace anti-dieseling valve.
	Restricted or broken fuel line.	Clean or replace.
	Battery defective or requires charging.	Replace or charge battery, as required.

Engine will not start. (Ignition O.K.)

Table 3-3. Turntable Assembly Troubleshooting.

TROUBLESHOOTING CHART

TROUBLE	PROBABLE CAUSE	REMEDY
Engine will not accelerate above low/idle speed.	Damaged wiring on speed control switch or governor solenoid.	Repair or replace wiring.
	Diesel, engine run not adjusted.	Adjust engine run linkage to function properly.
	Speed control switch not functioning properly.	Replace switch.
	Governor not functioning properly.	Repair or replace governor.
	Boom mercury switch not functioning properly or improperly adjusted.	Adjust, repair, or replace boom mercury switch.

SECTION 3 — TROUBLESHOOTING

Table 3-3. Turntable Assembly Troubleshooting.
TROUBLESHOOTING CHART

TROUBLE	PROBABLE CAUSE	REMEDY
Control Valves.		
Valve spool sticking.	Dirt in oil causing excessive temperature build-up.	Change oil using recommended viscosity and flush system.
	Incorrect valve mounting causing warping of the unit.	Loosen valve and check mounting. Repair as necessary.
	Valve spool scored.	Remove valve and repair or replace as necessary.
	Return spring weak or broken.	Remove valve and repair or replace as necessary.
	Relief valve malfunctioning causing excessive pressure within valve.	Check pressure delivery to and from valve and repair or replace as necessary.
Valve leaking.	Dirt or other foreign material under seal.	Remove and repair valve as necessary.
	Valve spool scored.	Remove valve and repair or replace as necessary.
	Excessive back pressure caused by restricted return line to reservoir.	Remove line and clear obstruction or replace line as necessary.
	Damaged valve seals.	Remove valve and repair or replace as necessary.
Fuel System.		
Strong fuel odor during machine operation.	Fuel tank overfilled.	Check fuel tank and immediately wipe up any spilled fuel.
	Fuel tank damaged.	Drain all fuel from tank and remove tank for replacement or repair.
	Fuel line from tank damaged.	Replace fuel line.
	Adjustments on fuel system not set properly.	Adjust fuel system per manufacturers specifications.

SECTION 3 — TROUBLESHOOTING

Table 3-4. Chassis Assembly Troubleshooting.
TROUBLESHOOTING CHART

TROUBLE	PROBABLE CAUSE	REMEDY
Front Frame Axle Area. One or both front wheels will not steer.	Steering link or tie rod broken or attaching hardware missing.	Replace steering link, tie rod or hardware as necessary.
	Steer cylinder leaking.	Repair or replace steer cylinder.
	Cylinder pressure not set properly.	See solenoid valve pressure settings.
	Wheel hub or bearings damaged or not lubricated.	Replace hub or bearings as necessary and repack bearings with approved grease.
	Hub attachment nut loose or missing.	Secure or replace hub attachment nut cotter pin as necessary.
Rear Frame Axle Area Difficulty encountered when moving machine	Load capacity exceeded.	Reduce load. Apply loads only in accordance with load capacity indicator.
	Machine being moved up too steep a grade.	Remove machine from grade and check that drive system operates correctly.
	Drive wheel tire treads worn smooth.	Replace tires as necessary and inflate to specified pressure.
	System pressure too low.	Re-adjust pressure.

SECTION 3 — TROUBLESHOOTING

Table 3-4. Chassis Assembly Troubleshooting.

TROUBLESHOOTING CHART

TROUBLE	PROBABLE CAUSE	REMEDY
Drive System.	No response to control.	Replenish oil as necessary.
	Hydraulic pump not functioning properly.	Repair or replace pump.
	Restricted or broken pump supply line.	Clean, repair or replace line.
	Restricted or broken line on valve bank or rotary coupling.	Clean, repair or replace line.
	Rotary coupling leaking internally. (Seals worn.)	Repair or replace coupling.
No response to control (continued).	Drive motor(s) not functioning properly.	Repair or replace motor(s).
	Air in wheel brake circuit.	Bleed circuit, determine and correct cause.
	Damaged wiring on control switch.	Repair or replace wiring.
	Control switch not functioning properly.	Replace switch.
	Brake(s) not releasing.	Determine cause and repair or replace.
Machine drives erratically.	Microswitch on controller improperly adjusted.	Adjust microswitch on controller for proper operation.
	Flow divider defective.	Replace flow divider.
	Counterbalance valve defective.	Replace counterbalance valve.

SECTION 3 — TROUBLESHOOTING

Table 3-4. Chassis Assembly Troubleshooting.

TROUBLESHOOTING CHART

TROUBLE	PROBABLE CAUSE	REMEDY
Cessna 2 Speed Drive Circuit or Vickers.		
Machine will not travel in forward.	Hydraulic system oil low.	Replenish oil as necessary.
	Restricted or broken hydraulic line or fitting.	Clean, repair or replace line or fitting.
	Control valve not functioning properly.	Repair or replace valve.
	Drive motor(s) not functioning properly.	Repair or replace motor(s).
	Circuit breaker open.	Determine and correct cause; reset circuit breaker.
	Counterbalance valve sticking on return side.	Adjust return counterbalance out 3 turns - cycle drive - return to original position.
Machine overspeeds when descending a grade.	Counterbalance valve improperly adjusted or defective.	Adjust or replace valve.
Motor turns slowly in the direction of the last command.	Failed controller resulting in a command at neutral position.	Replace controller.
	Failed pilot valve.	Replace pilot valve.
	Sticking spool due to contamination	Remove end cap and check spool freedom. Repair as necessary.
	Controller adjustment off null	Adjust drive controller null.
	Flow divider defective.	Replace flow divider.

SECTION 3 — TROUBLESHOOTING

Table 3-4. Chassis Assembly Troubleshooting.
TROUBLESHOOTING CHART

TROUBLE

PROBABLE CAUSE

REMEDY

Motor turns slowly at maximum

Valve spool is not traveling far enough due to:

Low pressure gain of pilot valve.

Check filter in the inlet section for restriction.

Two speed valve not shifting.

Repair or replace valve.

Low control pressure supply.

Replace pressure regulator if necessary.

Plugged pilot valve.

Change pilot valve.

Poor response, function shuts off slowly when command is removed.

Restricted tank return line.

Check for restrictions in tank return line.

Low spool spring preload

Check for correct spring and shims in end caps.

Sticking spool due to contamination.

Remove end cap and check spool freedom.

Ramp potentiometer adjustment improper.

Re-adjust ramping time on controller.

Table 3-4. Chassis Assembly Troubleshooting.
TROUBLESHOOTING CHART

TROUBLE Steering System.	PROBABLE CAUSE	REMEDY
No response to control.	Circuit breaker open.	Determine and correct cause; reset circuit breaker.
	Steer/Tow selector in "tow" position.	Actuate control to "steer" position. (Valve knob "in".)
	Hydraulic system oil low.	Replenish oil as necessary.
	Damaged wiring on control switch or solenoid valve.	Repair or replace wiring.
	Control switch not functioning properly.	Replace switch.
	Restricted or broken hydraulic line on valve bank, hydraulic pump or rotary coupling.	Clean, repair or replace line.
	Swivel coupling leaking internally. (Seals defective.)	Repair or replace coupling.
	Control valve not functioning properly.	Repair or replace valve.
	Steer cylinder not functioning properly.	Repair or replace cylinder.
Machine hard to steer or steering is erratic.	Hydraulic system oil low.	Replenish oil as necessary.
	Restricted hydraulic line or fitting.	Clean, repair or replace line or fitting.
	Lack of lubrication.	Lubricate as required. (Refer to Lubrication Chart.)
	Restricted crossover relief valve.	Clean or replace valve.
	Steer system pressure low.	Adjust pressures.
	Bent linkage (tie rod(s) or steering hitch).	Repair or replace linkage as required.
	Hydraulic pump not functioning properly.	Repair or replace pump.
	Steer cylinder not functioning properly.	Repair or replace cylinder.

SECTION 3 — TROUBLESHOOTING

Table 3-4. Chassis Assembly Troubleshooting.

TROUBLESHOOTING CHART

TROUBLE	PROBABLE CAUSE	REMEDY
Steering inoperative.	Circuit breaker open.	Determine and correct cause; reset circuit breaker.
	Damaged wiring on control switch or solenoid valve.	Repair or replace wiring.
	Solenoid valve not functioning properly.	Repair or replace valve.
	Control switch not functioning properly.	Replace switch.
	Relief valve improperly set or not functioning properly.	Reset, repair or replace valves as required.
	Steer cylinder not functioning properly.	Repair or replace cylinder.
	Wiring on control switch is damaged.	Repair or replace wiring.
	Wiring on solenoid valve damaged.	Repair or replace wiring.
	Coil in solenoid damaged.	Replace coil.
	Bent cylinder rod.	Repair cylinder.
	Damaged tie rod.	Replace tie rod.
	Crossover relief valve sticking.	Repair crossover relief valve.
Machine wanders; steering not firm.	Crossover relief valve set too low or not functioning properly.	Reset, repair or replace valve as required.
	Steer linkages loose.	Tighten linkage.
	Steer wheel toe-in not set properly.	Adjust toe-in as described in Section 2.
	Spindle bushings badly worn.	Replace bushings.
	Blow o-ring in swivel or oil manifold.	Replace o-ring.

TROUBLE**Hydraulic Systems-General**

Hydraulic pump noisy.

Pump cavitating. (Vacuum in pump due to oil starvation.)

System overheating.

Pump not delivering oil.

Table 3-5. Hydraulic Systems Troubleshooting.

TROUBLESHOOTING CHART**PROBABLE CAUSE**Air entering system through broken line or fitting.
(Suction side.)

Defective bearing in pump.

Air bubbles in oil. (Reservoir oil level too low.)

Oil filter(s) dirty.

Restricted suction line.

Restricted reservoir air vent.

Oil viscosity too high.

Oil viscosity too high.

Bypass valve not operating properly.

Main relief valve set too low.

Hydraulic system oil low.

Defective drive motors or line restriction.

Restricted suction line.

Air entering system through broken line or fitting.

Broken pump drive shaft/pump coupling.

REMEDY

Repair or replace line or fitting.

Repair or replace pump.

Replenish oil as necessary.

Clean and/or replace filter(s) as necessary.

Clean, repair, or replace line.

Clean vent.

Drain system and replace with recommended oil. (Refer to Hydraulic Oils.)

Drain system and replace with recommended oil. (Refer to Hydraulic Oils.)

Repair or replace valve.

Reset valve as required.

Replenish oil as necessary.

Repair or replace drive motors or restrictions.

Clean, repair, or replace line.

Repair or replace line or fitting.

Repair or replace pump/pump coupling

SECTION 3 — TROUBLESHOOTING

SECTION 3 — TROUBLESHOOTING

Table 3-5. Hydraulic Systems Troubleshooting.

TROUBLESHOOTING CHART

TROUBLE	PROBABLE CAUSE	REMEDY
Function sluggish during operation. (System pressure too low.)	Main relief valve set too low.	Reset valve as required.
	Main relief valve stuck in open position.	Clean, repair, or replace valve. (Check system oil for contamination.)
	Oil viscosity too low.	Drain system and replace with recommended oil. (Refer to Hydraulic Oils.)
	Leak in component, line or fitting.	Repair or replace component, line or fitting.
	Scored valve spool; scored cylinder.	Replace valve; replace cylinder.
System(s) operate erratically.	Sticking or binding valve spools, pistons, rods, etc.	Clean, repair, or replace components as required.
Auxiliary Hydraulic System.		
Auxiliary hydraulic pump inoperable.	Circuit breaker open.	Determine and correct cause; reset circuit breaker.
	Footswitch not depressed.	Depress footswitch.
	Battery requires charging or will not hold a charge.	Charge or replace battery as required.
	Damaged wiring on control switch or auxiliary pump	Repair or replace wiring.
	Control switch not functioning properly.	Replace switch.
	Restricted or broken hydraulic line or fitting.	Clean, repair or replace line or fitting.
	Pump motor solenoid not functioning properly.	Replace or repair solenoid.
	Pump motor not functioning properly.	Repair or replace motor.
	Low pilot pressure.	Adjust pilot pressure between 250 - 400 psi.
	Low voltage to controls.	Recharge or replace battery.

Table 3-6. Electrical Systems Troubleshooting.

TROUBLESHOOTING CHART

TROUBLE	PROBABLE CAUSE	REMEDY
P.Q. Hand Controller. (Racine Valve)		
Actuation of a function of the valve continues when the handle is in the center position.	Improper null of the valve with the control handle safety deadman switch failed.	Check the safety deadman switch and replace. Re-adjust the null of the valve.
Regardless of which way the handle is moved, only one function occurs.	Improper null of the handle with the handle safety deadman switch failed.	Check the safety deadman switch and replace. Readjust the null of the potentiometer.
Functions occur very rapidly when handle is moved in one direction and very slowly when moved in the opposite direction.	Improper wiring or loose wiring to the solenoids or potentiometer.	Check all wiring for proper connections.
	Printed circuit board failure.	Replace printed circuit board or use a handle assembly from the circuit that is presently working to check valve.
	Controller Potentiometer off center or defective.	Repair or replace potentiometer.
	Improper null of the handle.	Check and re-adjust null.
	Defective control handle	Repair or replace controller.

SECTION 3 — TROUBLESHOOTING

Table 3-6. Electrical Systems Troubleshooting.

TROUBLESHOOTING CHART

TROUBLE	PROBABLE CAUSE	REMEDY
Valve will not function when handle is moved in either direction.	Blown fuse.	Replace fuse.
	No electrical power to handle.	Check electrical input to handle (12 v).
	No electrical signal to valve.	Check electrical valve output of printed circuit board and electrical signal at the valve.
	Select relay bad.	Replace select relay.
	Failed printed circuit handle.	Replace square wave generator or use a handle assembly that is presently working in the system.
	Broken wires.	See wiring diagram.
	Failed open control handle safety deadman switch.	Check and replace safety deadman switch.
	Improper ground.	Check for proper grounding of handle.
Functions occur in the opposite direction than required in regard to handle movement.	Valve coils are reversed.	Reverse the control valve coils.
Control valve does not respond to command.	Controller does not provide signal (60 ma maximum required).	Replace controller.
	Open wire in control cable.	Replace cable.
	Shorted terminal connector.	Check for terminal and contacting case or poor clamping of wire ends on terminal strip.
Cylinder drifts or drive motor slowly rotates when controller is returned to neutral (high null bias).	Controller failed resulting in a command at neutral position.	Adjust or replace microswitch.

Table 3-6. Electrical Systems Troubleshooting.

TROUBLE	TROUBLESHOOTING CHART	PROBABLE CAUSE	REMEDY
Boom Elevation System.			
No response to control.		Control lever inoperative.	Repair or replace control lever.
		Circuit breaker open.	Determine and correct cause; reset circuit breaker.
		Damaged wiring on control solenoid valve.	Perform continuity check and repair or replace control, wiring or solenoid.
		Valve coils improperly grounded.	Check and repair connections.

SECTION 3 — TROUBLESHOOTING

Table 3-6. Electrical Systems Troubleshooting.

TROUBLESHOOTING CHART

TROUBLE	PROBABLE CAUSE	REMEDY
Engine Starter System. Engine will not crank.	Discharged battery or loose battery terminals.	Check and charge battery or replace battery as necessary. Clean and secure battery terminals.
	Starter relay faulty or faulty relay connections.	Using a test meter, check relay coil terminals for presence of electrical power and for energization of relay coil. Also check relay terminals for correct ing of contacts. Replace relay as necessary.
	Failed starter lockout.	Replace starter lockout.
	Malfunctioning starter solenoid or motor.	Replace solenoid or motor in accordance with applicable manufacturer's manual.
	Malfunctioning ignition switch.	Using a test meter, check ignition switch for correct switching of contacts. Replace switch as necessary.
	Faulty ignition and/or starter circuit wiring.	Check wiring continuity. Refer to Chapter 5 for wiring diagram.

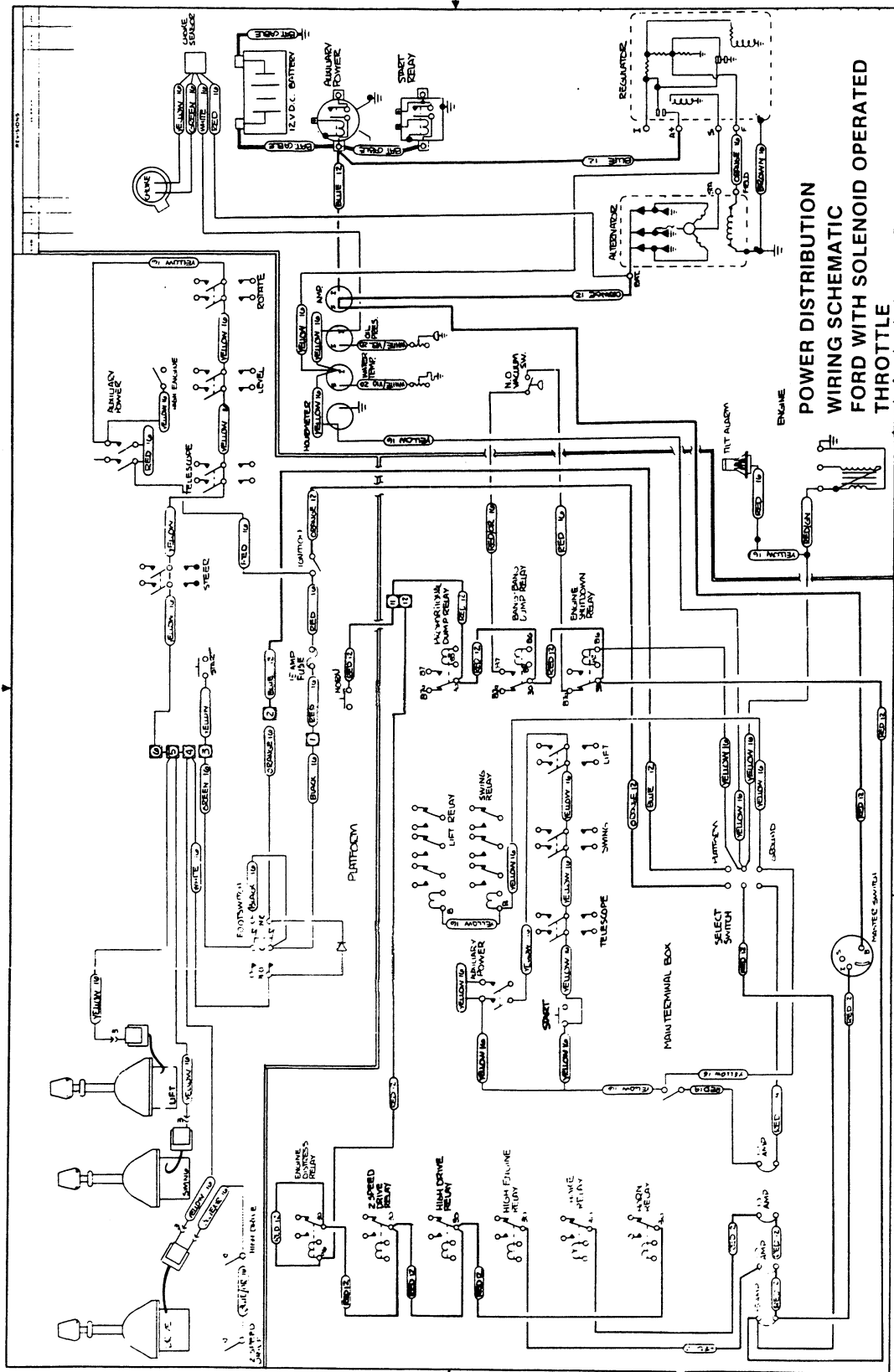
SECTION 3 — TROUBLESHOOTING

Table 3-6. Electrical Systems Troubleshooting.

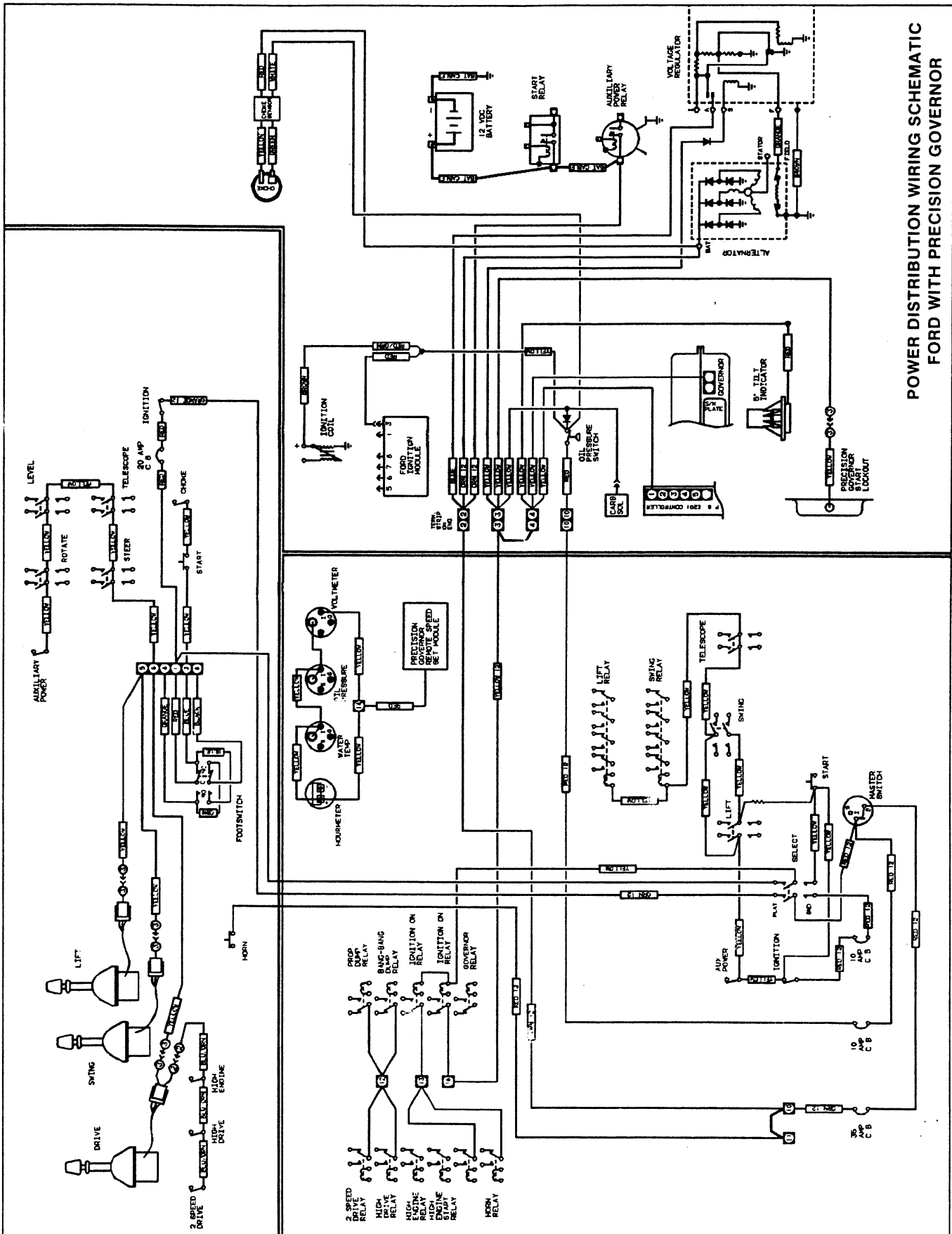
TROUBLESHOOTING CHART

TROUBLE	PROBABLE CAUSE	REMEDY
Instruments and Indicators.	Ammeter inoperative.	Repair or replace wiring.
	Damaged wiring in circuit.	Replace ammeter.
	Ammeter not functioning properly.	Check charging system for correct output. Repair or replace as necessary.
Travel warning horn inoperative.	Defective charging circuit components.	See wiring diagram.
	Wired backward.	Determine and correct cause; reset circuit breaker.
	Circuit breaker open.	Repair or replace wiring.
Hourmeter inoperative.	Damaged wiring in horn circuit.	Replace horn.
	Damaged horn.	Repair or replace wiring.
	Damaged wiring in hourmeter circuit.	Replace vacuum switch.
Tilt alarm circuit.	Defective vacuum switch.	Replace hourmeter.
	Inoperative hourmeter.	Repair or replace wiring.
	Damaged wiring in tilt alarm circuit.	Replace tilt alarm.
Hi-Low drive speed circuit (Cessna).	Tilt alarm inoperative.	Adjust tilt alarm as described in Section 2.
	Tilt alarm not adjusted properly.	Replace switch.
	Switch damaged or inoperative.	Repair or replace wiring.
	Damaged or disconnected wiring in circuit.	

SECTION 3 -- TROUBLESHOOTING

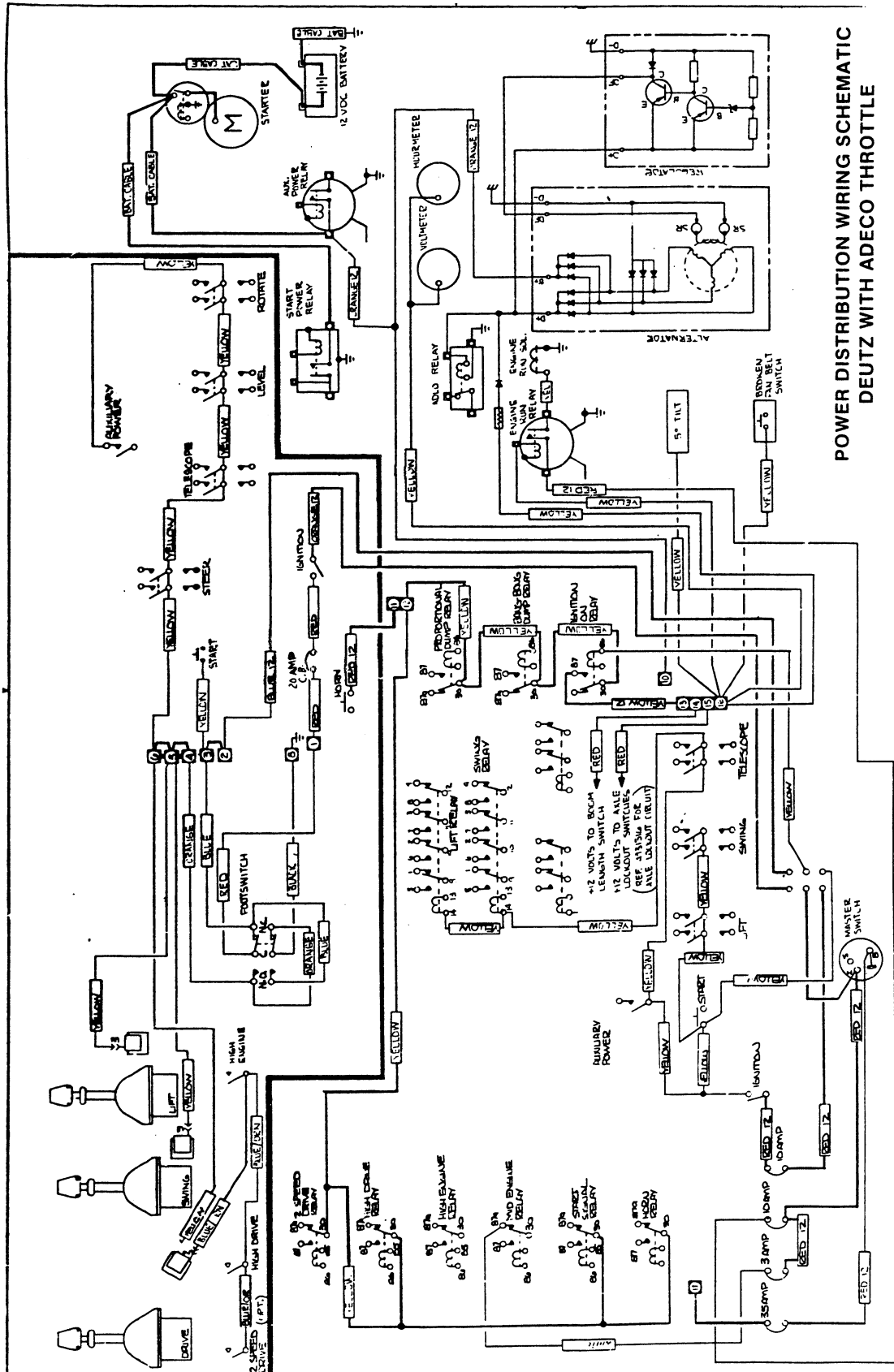


SECTION 3 — TROUBLESHOOTING



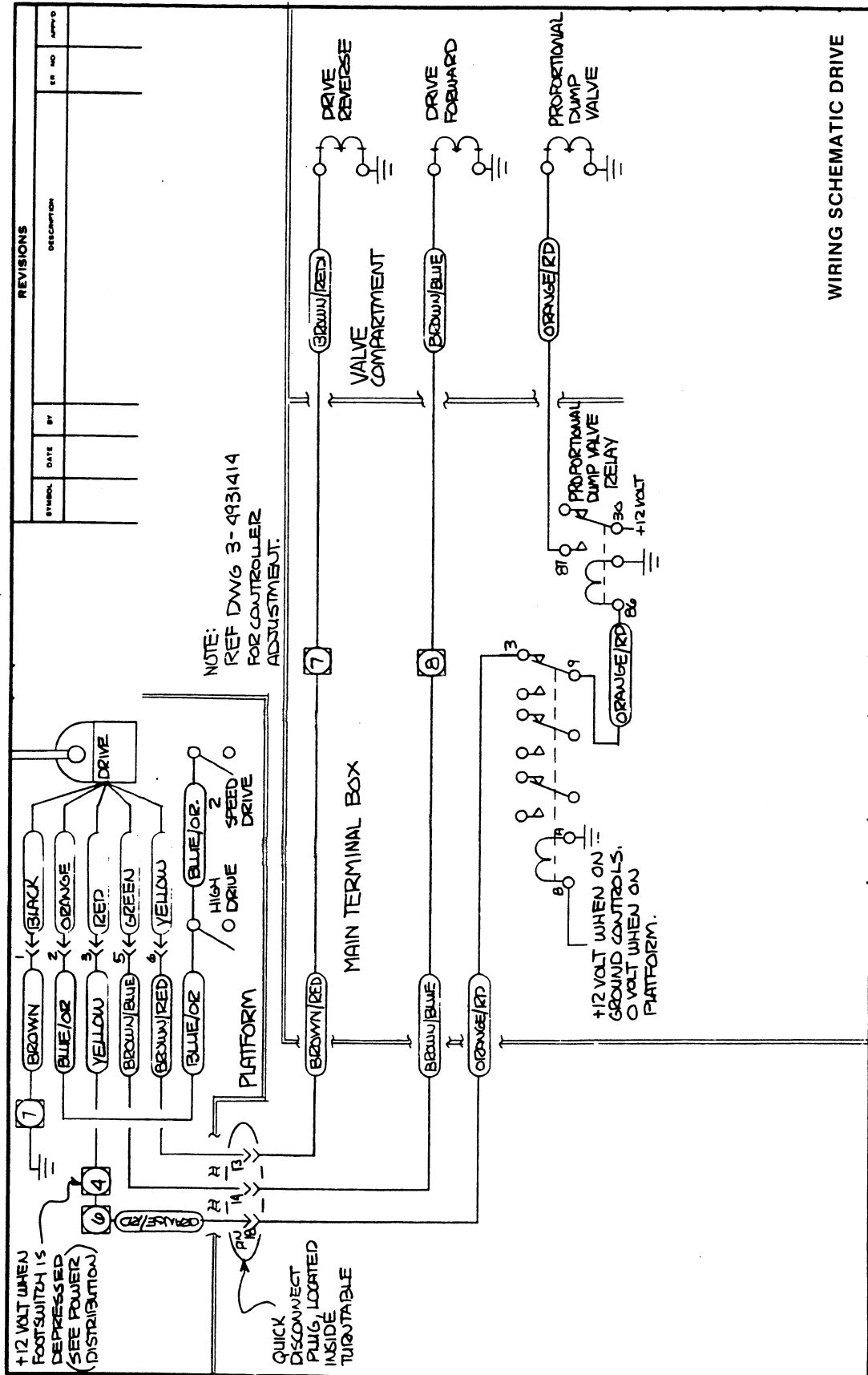
POWER DISTRIBUTION WIRING SCHEMATIC
FORD WITH PRECISION GOVERNOR

SECTION 3 — TROUBLESHOOTING

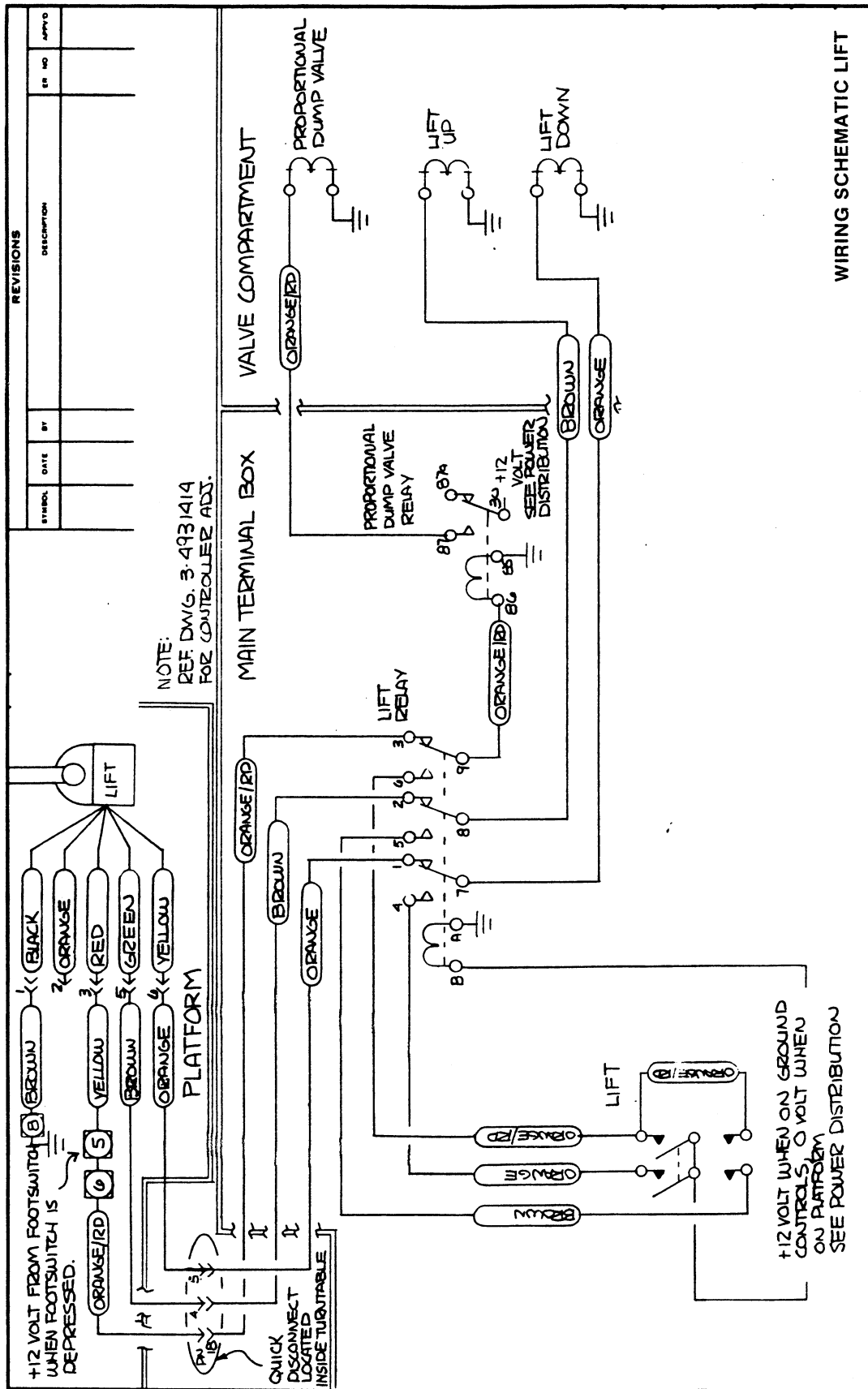


POWER DISTRIBUTION WIRING SCHEMATIC
DEUTZ WITH ADECO THROTTLE

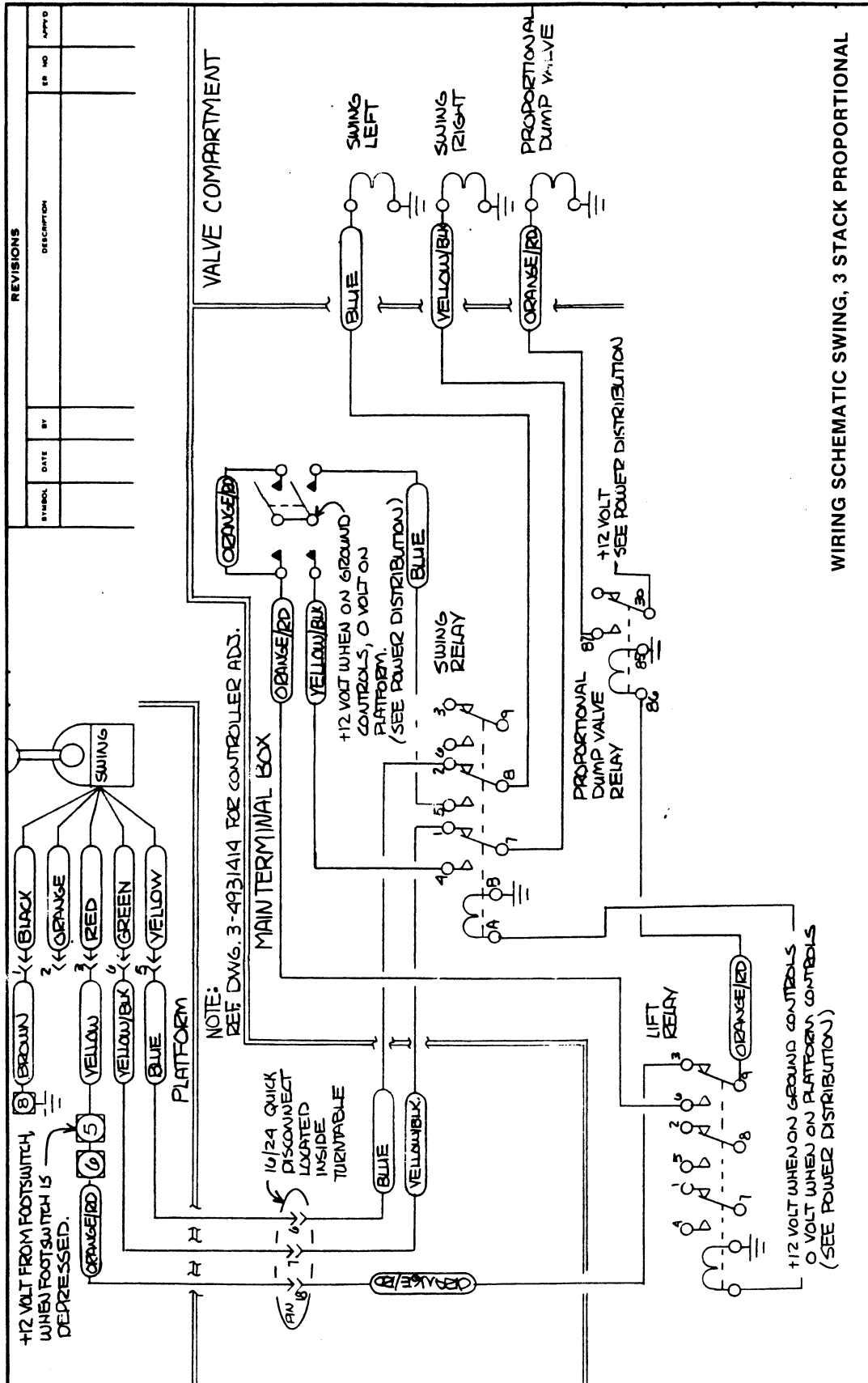
SECTION 3 — TROUBLESHOOTING



SECTION 3 — TROUBLESHOOTING

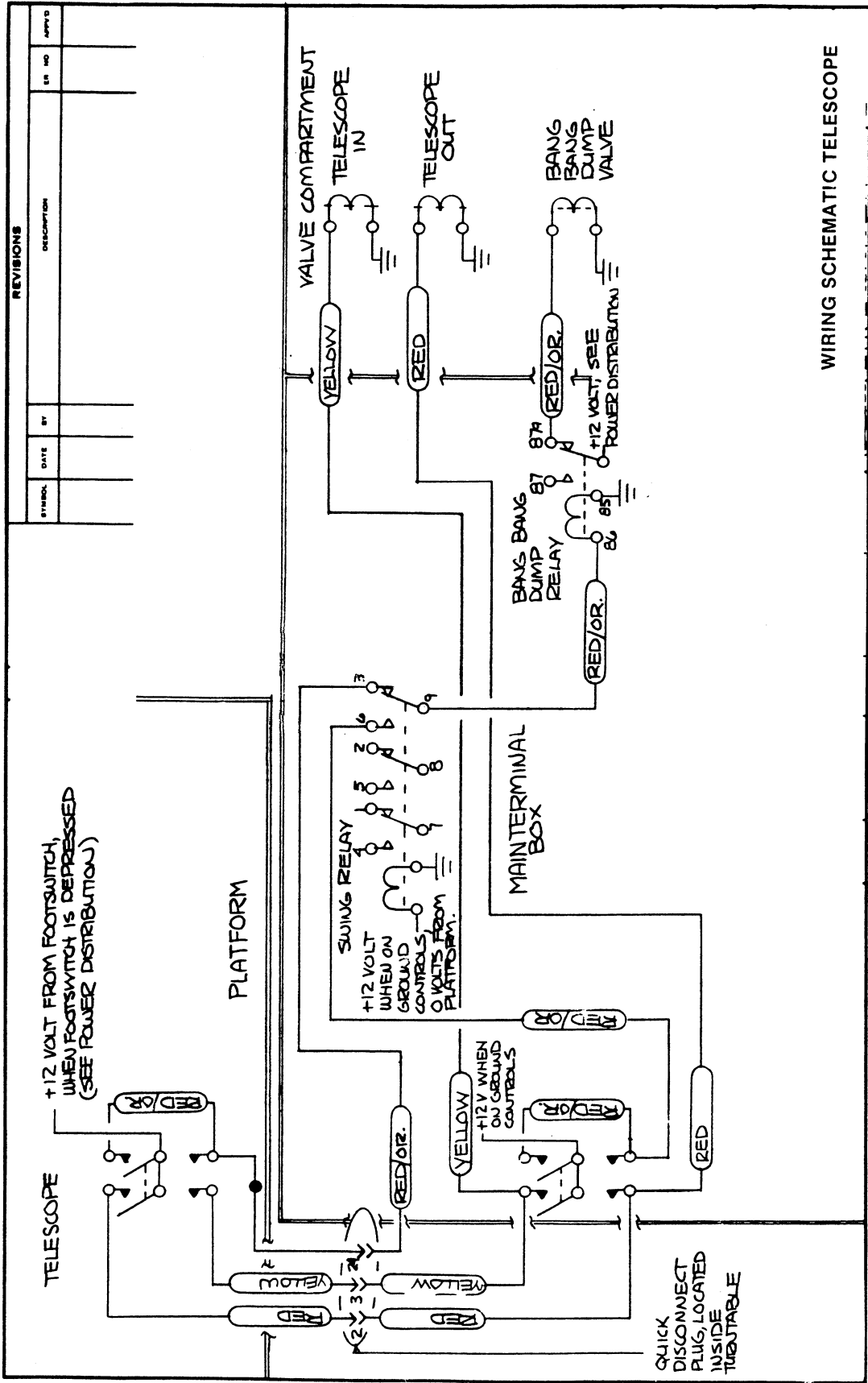


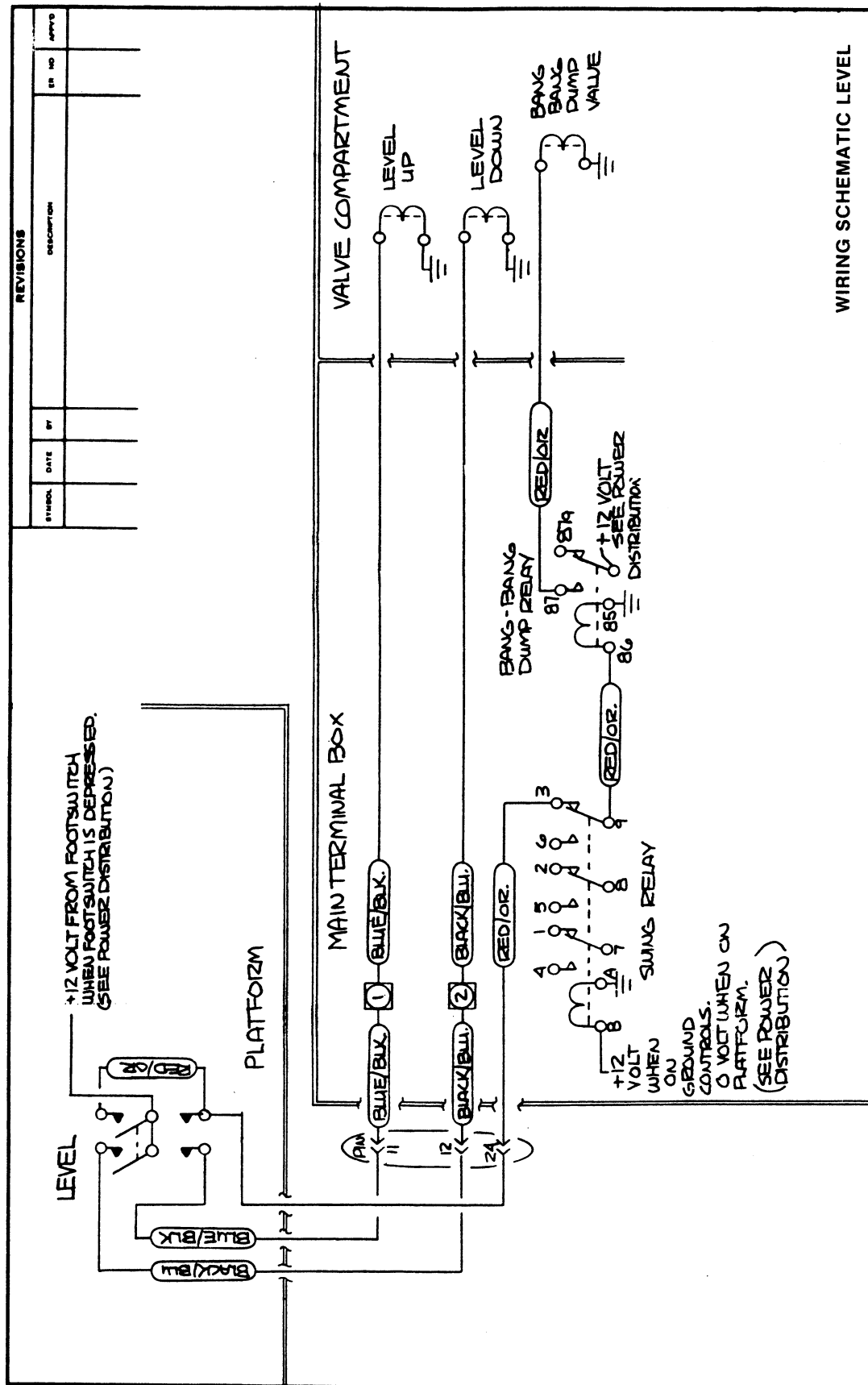
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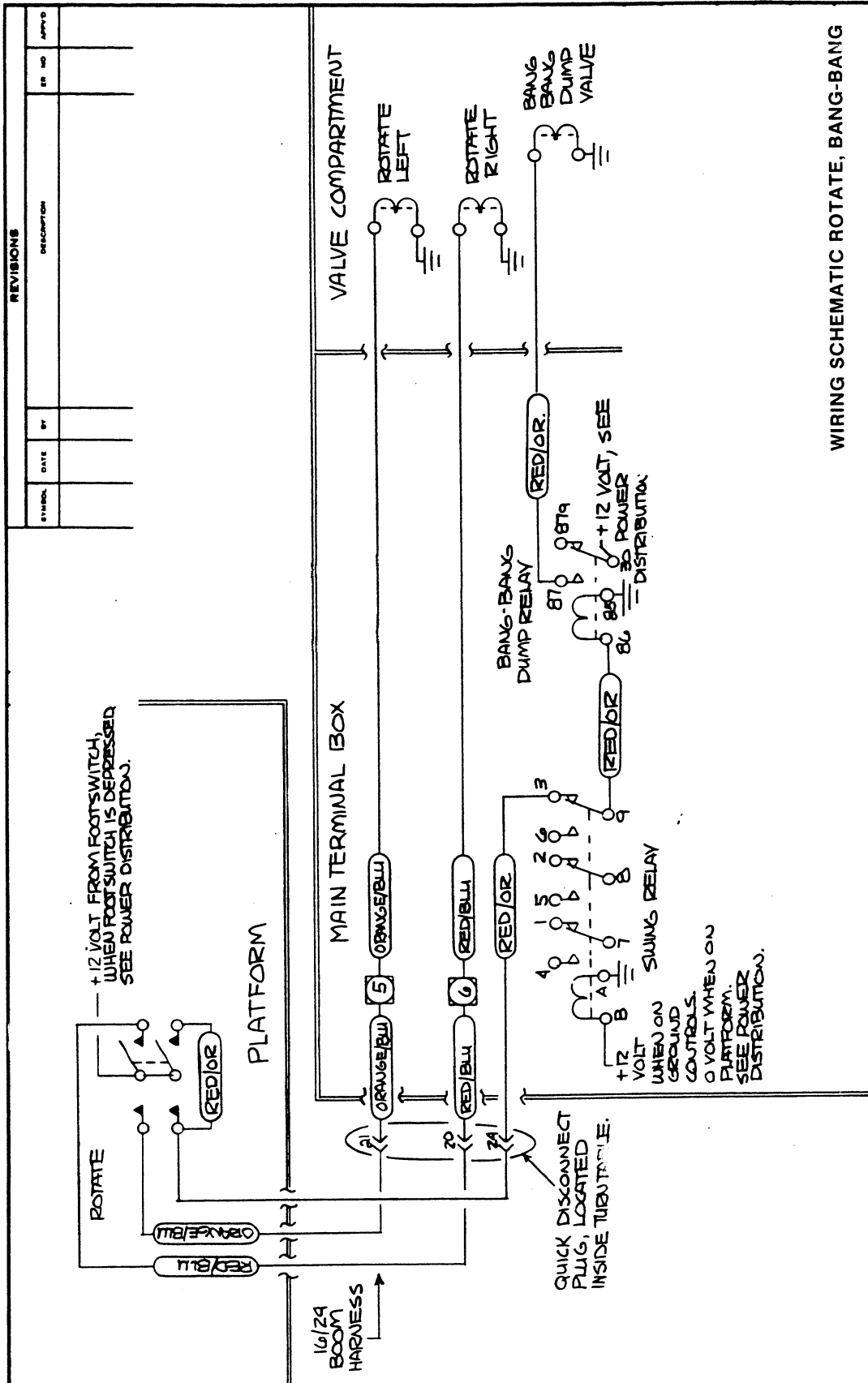
WIRING SCHEMATIC SWING, 3 STACK PROPORTIONAL

SECTION 3 — TROUBLESHOOTING



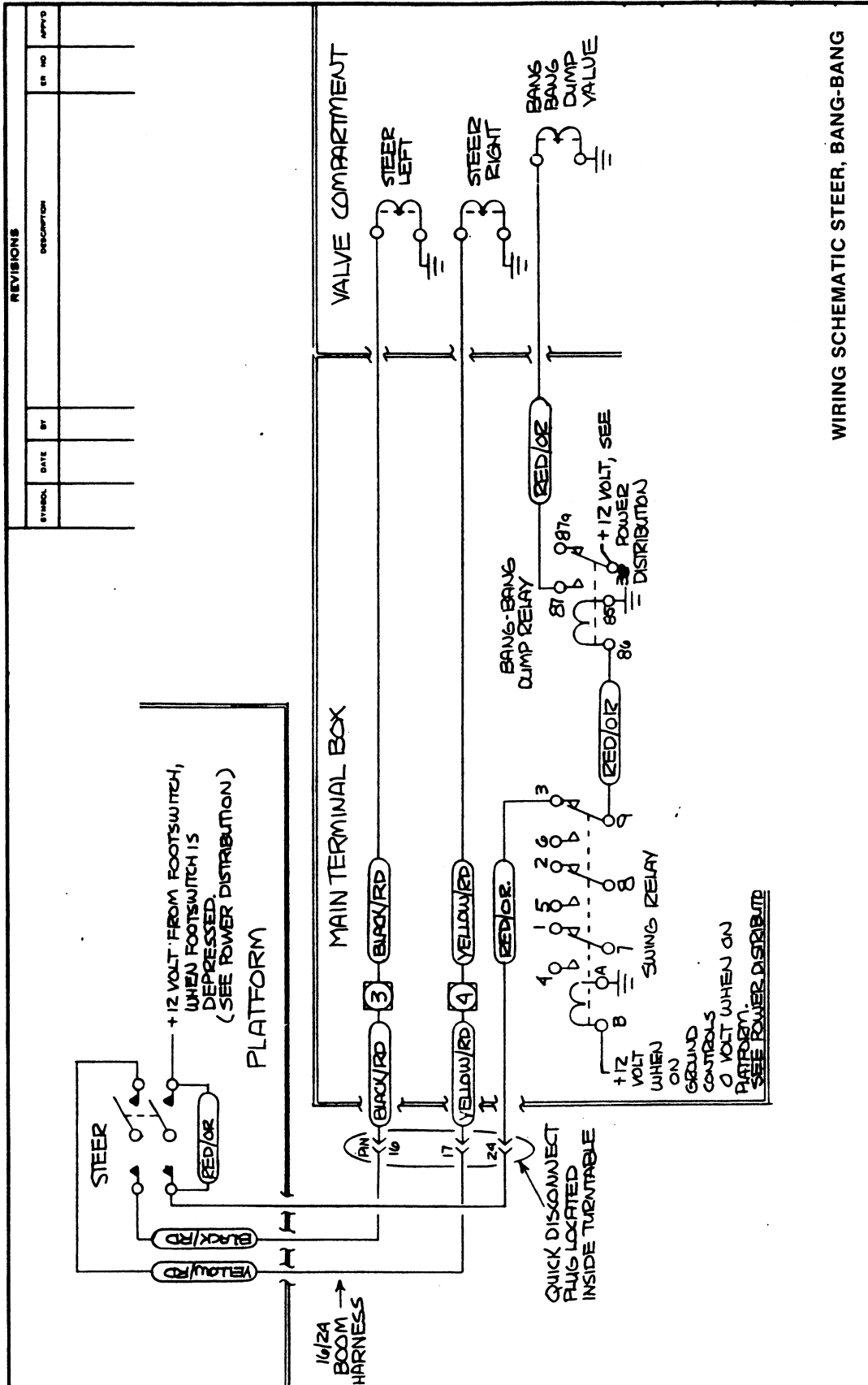


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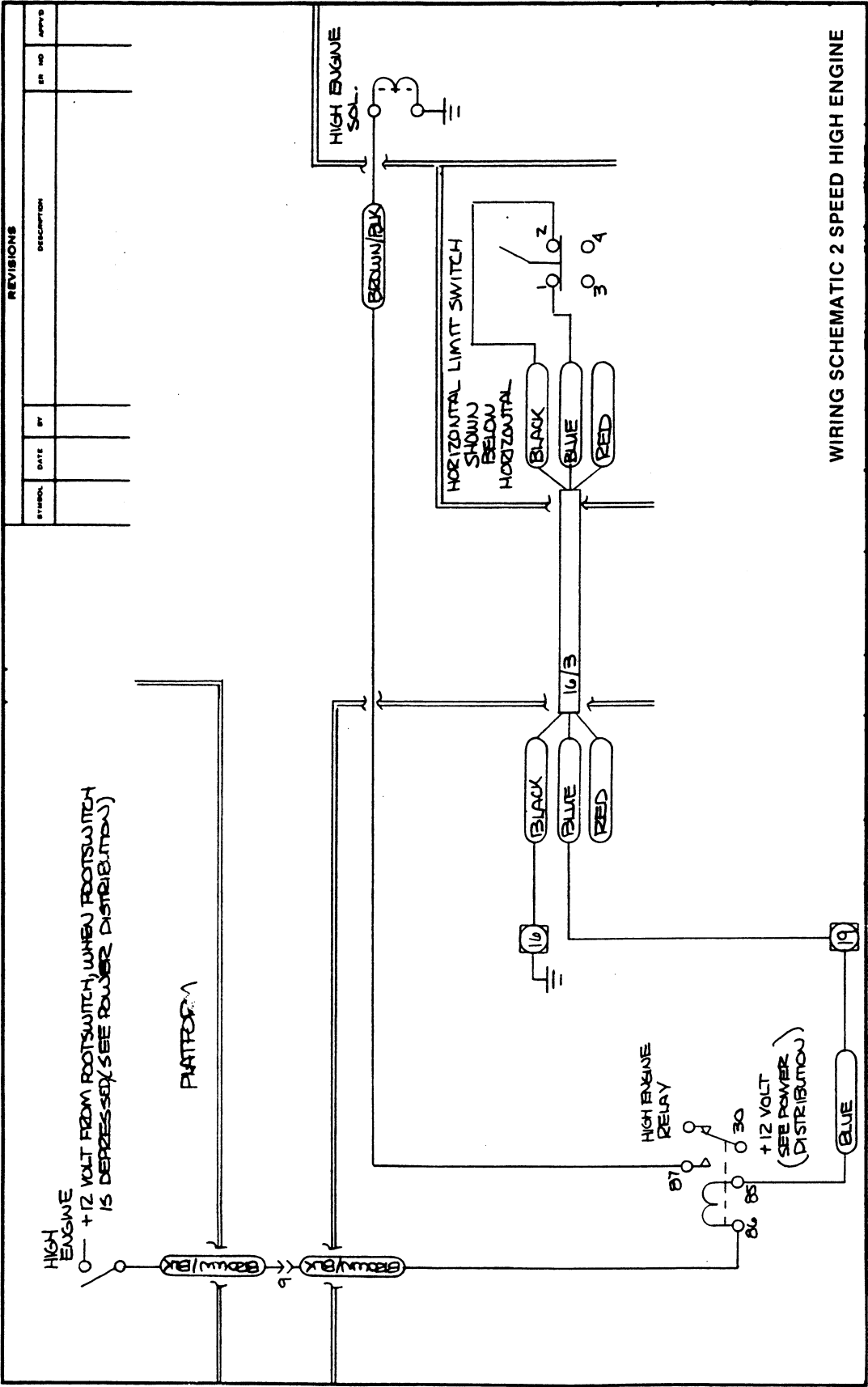
WIRING SCHEMATIC ROTATE, BANG-BANG

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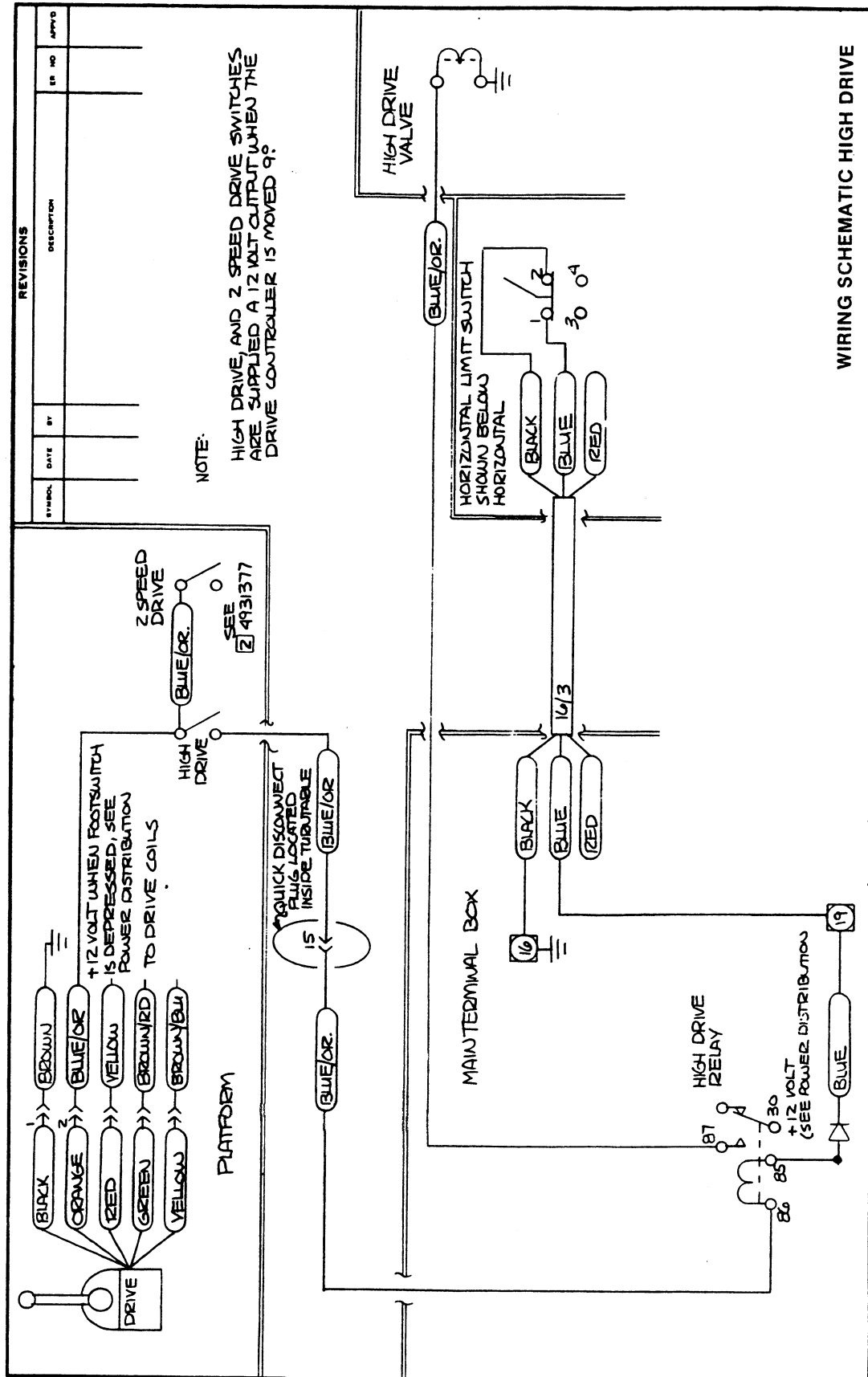


WIRING SCHEMATIC STEER, BANG-BANG

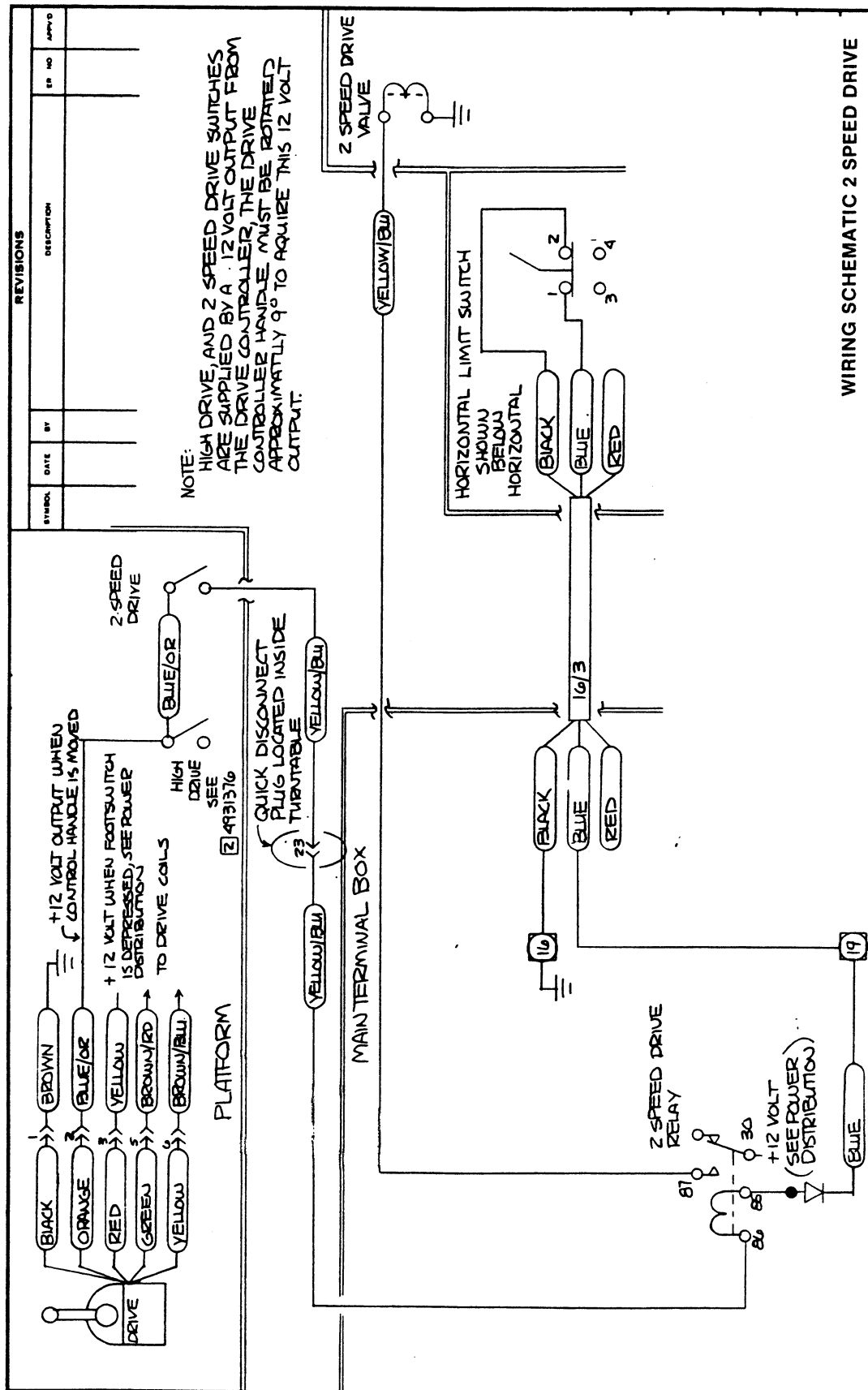
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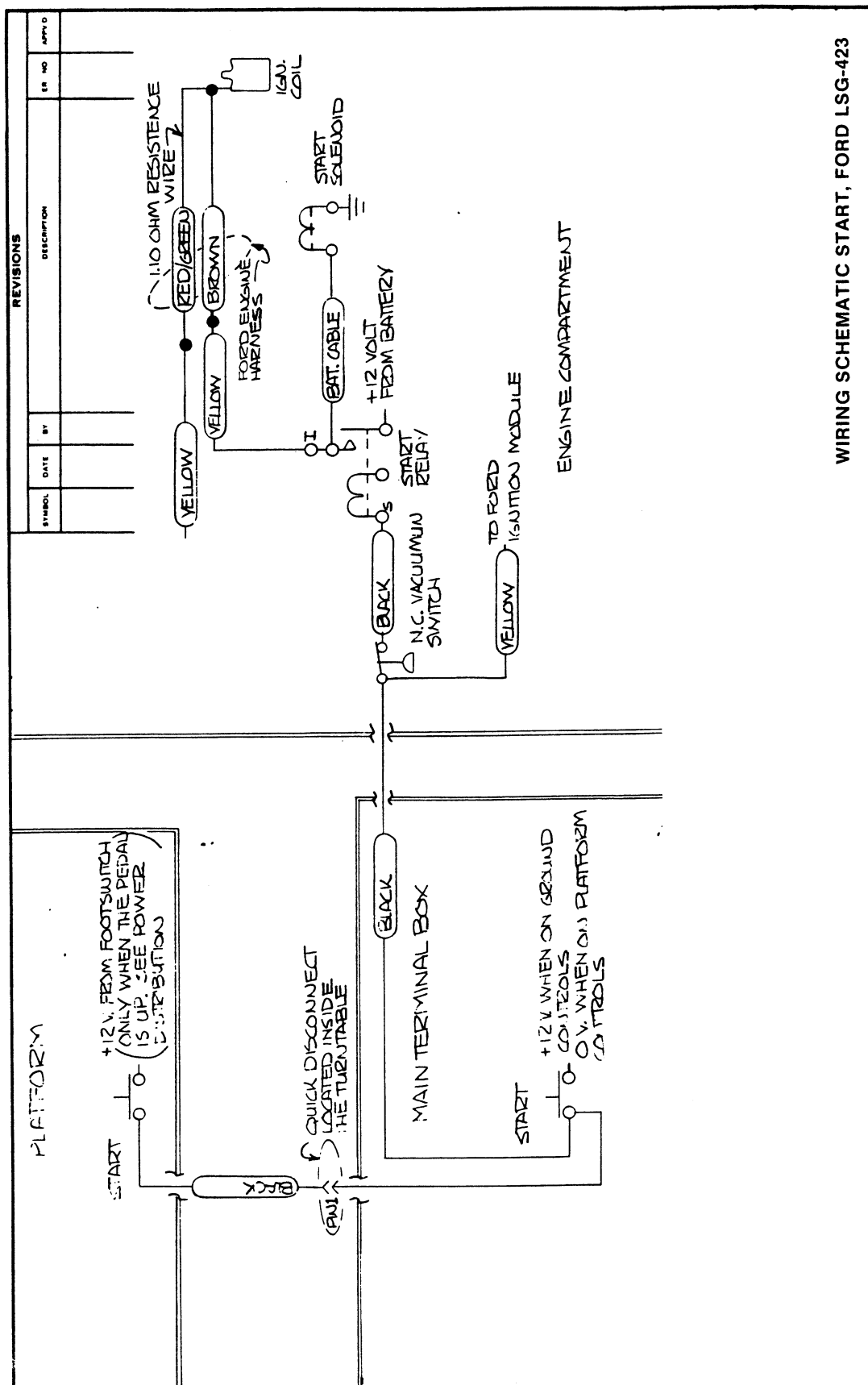


SECTION 3 — TROUBLESHOOTING

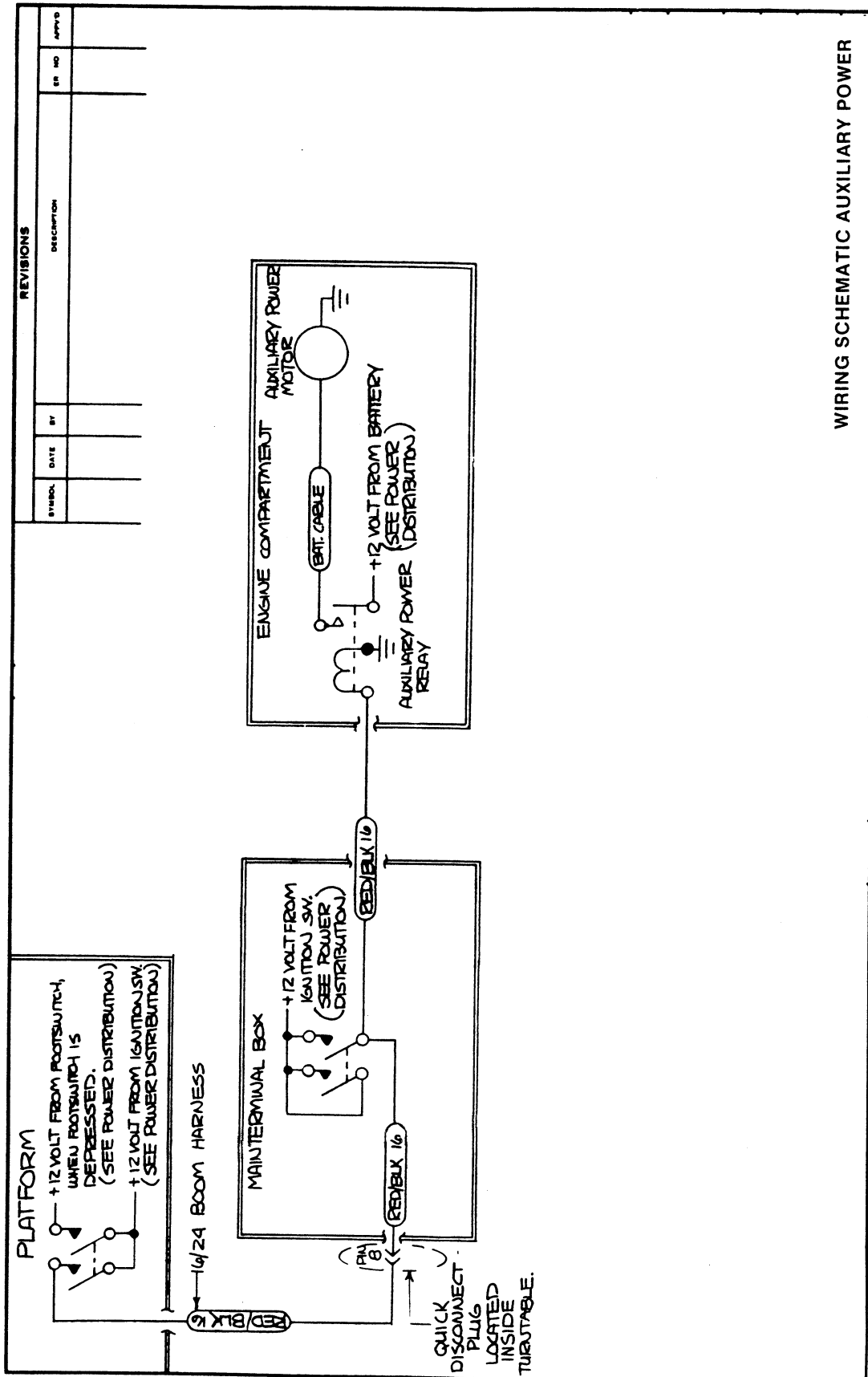


SECTION 3 — TROUBLESHOOTING

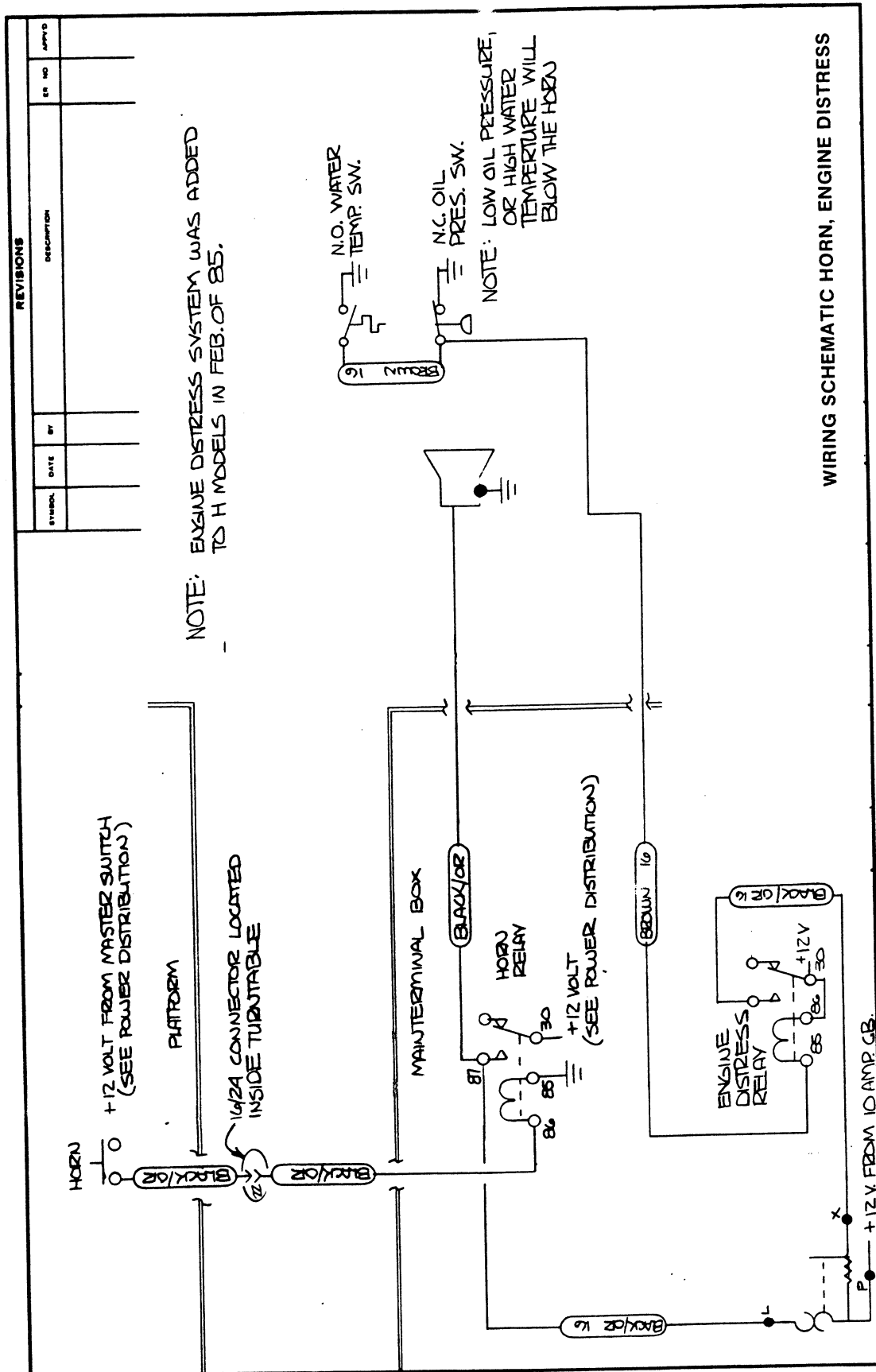




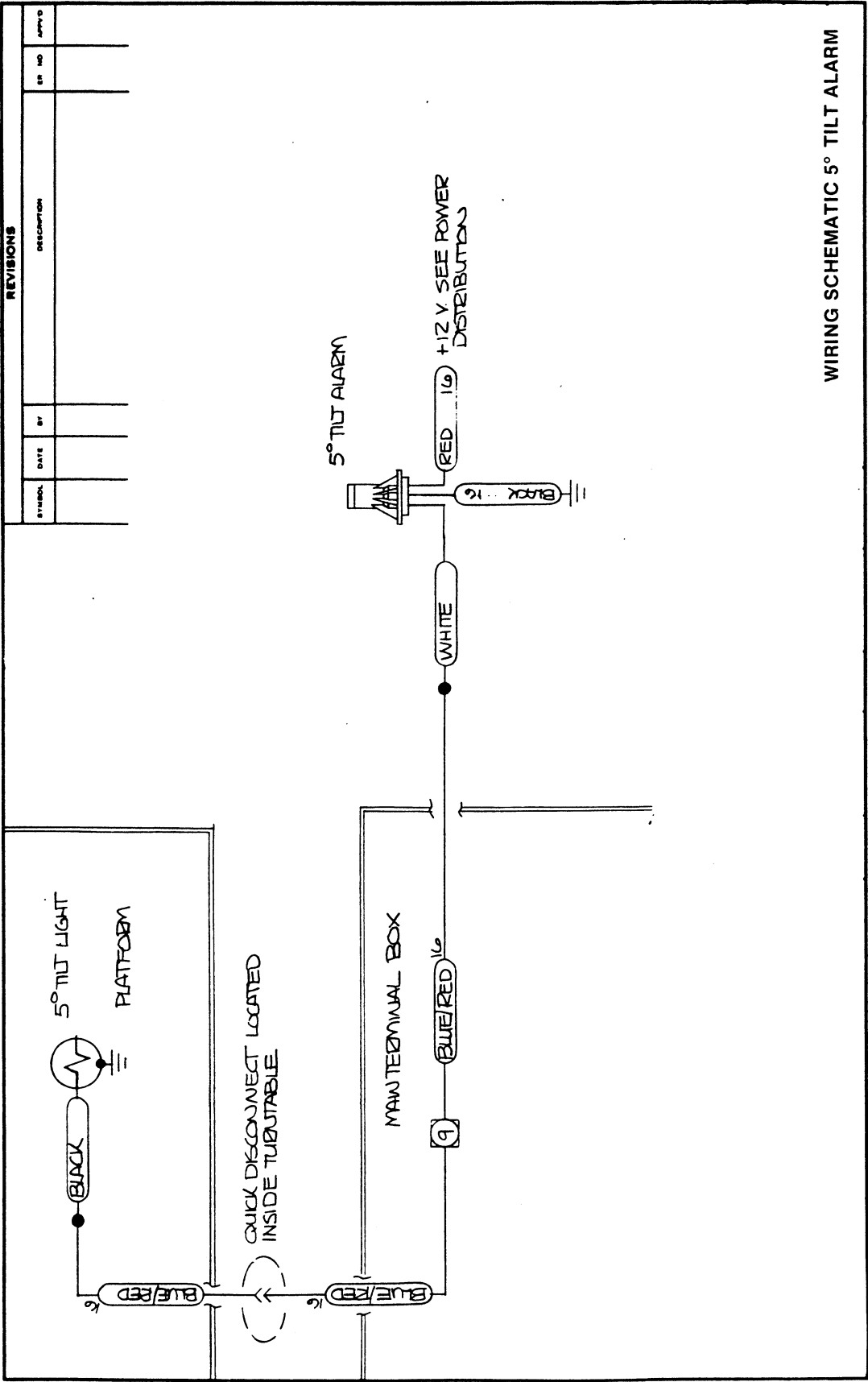
SECTION 3 — TROUBLESHOOTING



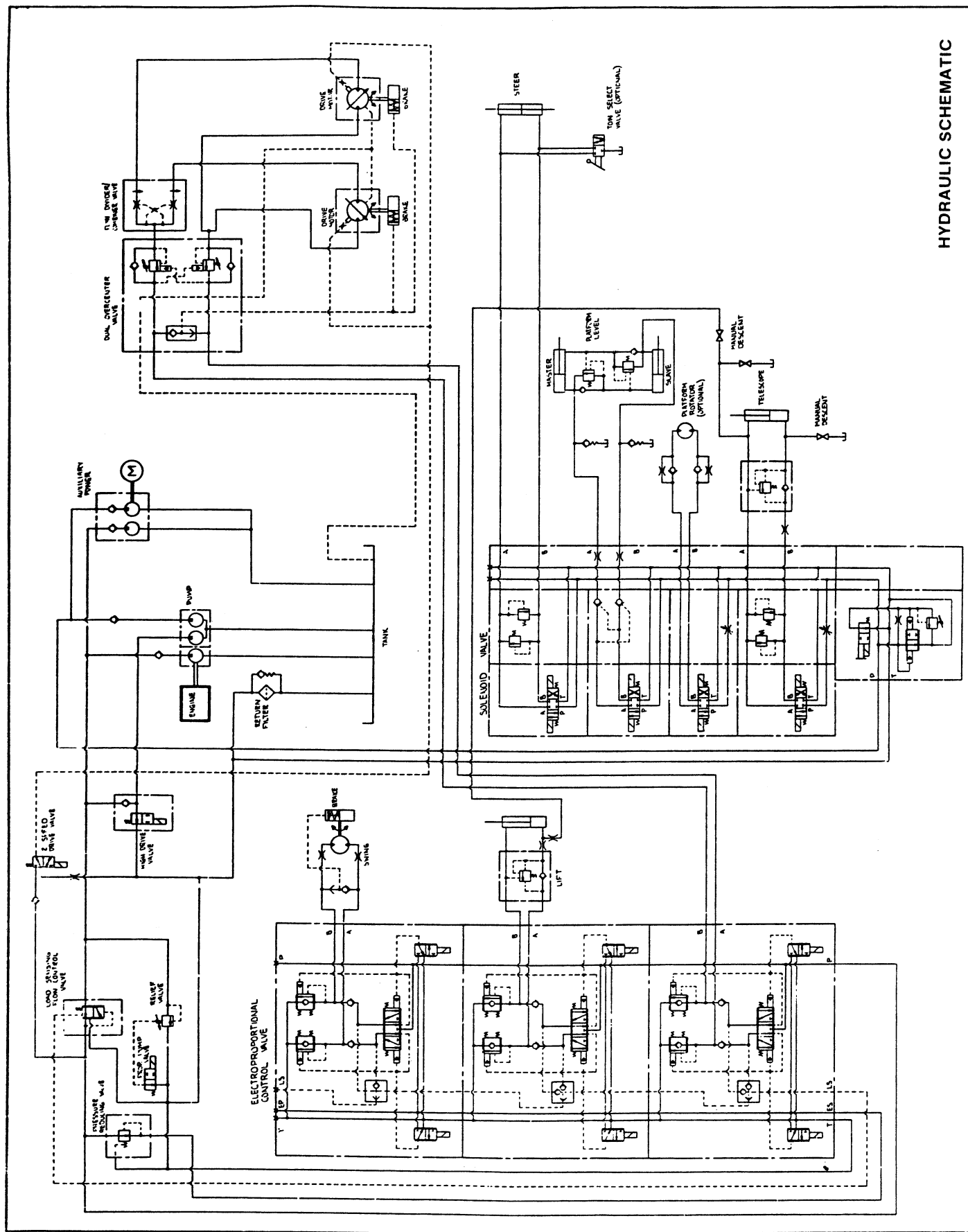
WIRING SCHEMATIC AUXILIARY POWER



SECTION 3 — TROUBLESHOOTING



WIRING SCHEMATIC 5° TILT ALARM



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