Operation & Maintenance Instructions

Model	Serial No.
21 SCR	**001 and UP**

MM#	Date:
82	**8/12/85**

HIGH LIFT TRUCK: A self-loading truck equipped with an elevating mechanism designed to permit tiering.

HORIZONTAL TRANSPORTATION: A category of industrial trucks designed to effectively transport material in the horizontal direction. ELECTOTE® and the 10-TOW are two Raymond Corporation products in this category.

HY-DRIVE® REACH: A combination Order Picker and REACH-FORK truck.

L: Low-Lift Truck.

LC: Load Center.

LH: Lowered Height.

LLC: Lost Load Center.

LVCB: Low Voltage Circuit Breaker.

LENGTH - of a Fork Truck: The dimension that is measured in the direction of fork length. As an industry standard the Length direction for Forks and pallets coincide.

LIFT SPEED: The average velocity in FPM when raising the load carriage throughout its operating range, specified for empty and loaded conditions.

LINE DRIVER: The signal source used to energize the RAY-GUIDE guidewire.

LOAD BACKREST: That portion of the carriage and forks which support the load when it is tilted rearward or upward.

LOAD BACKREST EXTENSION: A device extending vertically from the fork carriage frame (load backrest).

LOAD CENTER (LC): The horizontal distance from the intersection of the fork face and fork heel (or equivalent load positioning structure) to the center of gravity of the load.

LOADED: The condition when the truck is handling the equivalent of a symmetrical maximum capacity load.

LOST LOAD CENTER (LLC): The amount of horizontal distance, measured from the carriage forward, that is lost from the standard 24" load center when an attachment is added.

LOW LIFT PLATFORM TRUCK (L,P): A self-loading truck equipped with a load platform intended primarily for transporting corporate skids.

LOW LIFT TRUCK (L): A self-loading truck equipped with an elevating mechanism designed to raise the load only enough to permit horizontal movement.

LOWERED HEIGHT (LH): The vertical dimension to the top surface of the forks when the carriage is at its lowest position.

LOWERING SPEED: The average velocity in FPM when lowering the load carriage throughout its operating range, specified for empty and loaded conditions.

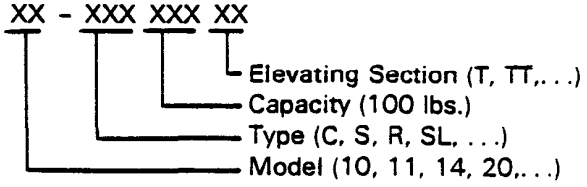
M: MOBILITY® systems and truck designators, as M1000 System and M1021 Order Picker Truck; and M2000 System and M2021 Order Picker Truck.

MPH: Miles Per Hour, a measure of truck speed.

MAST: The support member that provides a structure to permit vertical movement of the carriage. It is usually constructed in the form of channels or similar sections providing the supporting pathway for the carriage rollers.

MAST, TELESCOPING: (See Telescoping Mast).

MODEL DESIGNATOR: of Raymond Trucks.



Eg., 80- CSR40TT = Mod 80 Counterbalanced Swing-Reach, 4000 lb. capacity, 3-stage mast.

NARROW AISLE TRUCK: A self-loading truck primarily intended for stacking in aisles narrower than those normally required by counterbalanced trucks of the same capacity.

MECHANICAL SECTION

Chassis

Introduction

The Model 21 SCR chassis consists of the following parts (See Figure 1.4):

Chassis Parts Description

Truck Frame — The truck frame is constructed of 1/4 inch formed plate and sheet steel welded into a sturdy unit.

Bumper — Both sides and the rear of the truck are protected by a 1/2 inch thick wrap-around bumper.

Front — The front of the truck is constructed of 3/4 inch steel plate.

Door — A hinged door fabricated of 3/16 inch steel plate is located on the left side of the operator's compartment. Opening this door exposes the drive unit, brake, steering, lift pump and motor, and hydraulic components.

Covers — Two covers on top of the tractor can be removed to expose the auxiliary pump and motor, master switch assembly, lift and auxiliary valves and hydraulic components. Another cover, located on the right side of the operator's compartment can be removed to expose the electrical components.

Operator's Compartment — Has been designed for both the protection and comfort of the operator (Figure 1.3). The floor is covered with a 3/4 inch thick sponge rubber pad. A foam rubber hip pad is located in the upper right side of the operator's compartment. The truck's side panel extends toward the front, forming a knuckle guard which protects the operator's hand when holding the directional/speed control assembly handle.

Battery Compartment — The battery compartment is 38 inches long by 31 inches high by 14-1/2 inches wide. The battery compartment is only 7 inches off the floor. This contributes to the truck's exceptional stability. The bottom of the compartment incorporates rollers to aid in battery installation and removal. Battery gates on both sides of the truck permit the battery to be installed from either side.

Lift/Lower Parts Description (Cont'd.)	Manifold Assembly (Cont'd)	Low Pressure Adjustable Relief Valve	Low pressure adjustable relief valve holds the lift circuit pressure to a minimum level, and is designed to prevent the lift cylinder from drifting down separately from the fork carriage if forks hang up in the racks.
		Check Valve	The cartridge check valve used in the manifold allows oil to flow from the lift pump to the travel lift solenoid and the lift/lower control valve, but prevents oil from flowing into the reservoir when the load is elevated and the pump is turned OFF.
		Disc Valve	Disc valve allows oil flow from the lift pump to the lift cylinder during a travel lift operation. The valve stops oil from running the pump backwards during a lowering operation.
		Flow Control Valves	The manifold contains two pressure compensated flow control valves, one for travel/remote lift and one for travel/remote lower. They keep the slow lift and lower speeds from varying with different loads.
	Travel Lift/ Lower Switch	Travel lift/lower is controlled by a three position switch located on top of the directional/speed control handle.	
	Main Flow Control	The main flow control is located at the base of the lift cylinder. The control's purpose is to prevent the truck carriage from abruptly falling if a hydraulic line ruptures or breaks. The flow control limits the maximum lowering speed to approximately 70 feet per minute.	
	Lift Cylinder	The lift cylinder incorporates U cup type packings and is chrome plated for long service life.	
	Oil Filter	The oil filter is a pressure by-pass type with a replaceable cartridge. The 10 micron rated filter is located in the hydraulic return line adjacent to the reservoir. The filter traps foreign particles that enter the system. Oil is allowed to by-pass the filter cartridge when oil pressure reaches 15 PSI. This would occur if the filter becomes too dirty.	

Parts Description (Cont'd.)	Fail Safe Protective (Cont'd)	Overload (cont'd)	• employ an automatic/manual switch which provides either automatic or manual reset: - in manual reset, the overload kickout deactivates the travel circuit. The key-switch must be turned to OFF, then to ON to reset the circuit. - automatic reset, an overload kick-out will kick-out and cycle once, kick-out and cycle three times, or kick-out and stay. If after resetting the overload control by moving the control handle back to neutral, the directional contactors again cycle, a malfunction exists. If the overload control does not kick out again, it may have false fired. A malfunction should be repaired before continuing operation. • deactivate, by means of the M blank overload circuit, the fail safe monitoring circuit from the SCRs when the truck goes into M speed. The M blank overload is activated when the M time delay circuit is activated.
		Weld Detect	Prevents electrical "plugging", if the M contacts weld or the main SCR is shorted, in the following manner: The F and R time delay would be deactivated after the directional/speed control handle is turned thru neutral by plugging. The weld detector circuit would sense the welding of the M contacts or shorted main SCR, preventing the truck from going into either forward or reverse direction. The truck will not start after being stopped if the weld detector circuit is activated.
		M Lockout	Will not allow the M contactor to energize if there is a failure in the SCR speed range. If SCR range does not turn ON, there will be no M speed range.

REACH LEVER

Description The reach lever is located at the front of the operator's compartment, just left of the lift/lower lever.

Function Moving the lever allows the operator to extend or retract the forks at a variable speed.

Activation

1. Step into the operator's compartment.
2. Turn keyswitch to ON position.
3. Move lever forward to extend reach.
4. Move lever back to retract reach.
5. The extent of lever movement controls the speed of the vehicle.

TILT LEVER

Description The tilt lever is located at the front of the operator's compartment, just left of the reach lever.

Function Moving the lever allows the operator to tilt the load up or down.

Activation

1. Step into the operator's compartment.
2. Turn keyswitch to ON position.
3. Move lever back to raise tilt.
4. Move lever forward to lower tilt.
5. The extent of lever movement controls the speed of the tilt.

TRUCK TRAVEL

Braking Procedure

1 Return the directional/speed control handle to the neutral position.

2 Gradually let up on the deadman pedal.

⚠ WARNING AVOID SUDDEN CHANGES IN DIRECTION WHICH COULD CAUSE THE TRUCK TO TIP OR THE LOAD TO SHIFT.

Plugging

Introduction

Plugging is the process of slowing or changing direction of truck travel entirely through the use of the directional/speed control handle.

Procedure

1 Rotate the directional/speed control handle back through neutral to the direction opposite of truck travel.

2 The truck will slow down, come to a stop, then start traveling in the opposite direction.

3 The farther past neutral the handle is moved, the greater the plugging force.

4 To slow or change truck direction in a short distance, move the handle all the way in the opposite direction.

5 To slow or change truck direction gradually, move the handle to slow speed in the opposite direction.

SET UP

Procedure

Visually inspect the truck upon arrival for damage:

- load and drive wheel for chips and cracks
- hydraulic lines for dents and bulges
- electrical wiring for damaged insulation or loose connections
- operating controls for visible damage

Remove the solid rubber gasket from under the cover of the brake master cylinder. This gasket prevents the loss of fluid during shipping. Check to see that the proper level of brake fluid is present.

Remove the rubber gasket from beneath the reservoir cap and check the oil level. The drive unit, which was drained prior to shipping, will require filling with approximately 5 pints of oil (refer to Chapter 5) before the truck can be operated.

Perform the following procedure for the battery:

- Install the battery charger in accordance with manufacturer's recommendations. Be sure the operation of the charger is thoroughly understood before attempting to re-charge a battery. Battery life can be considerably shortened by improper recharging procedures.

- Clean the battery connectors and lubricate them with a thin coat of petroleum jelly.

- Connect the battery cables to the battery terminals if they have not already been installed. Be sure to observe the proper polarity.

- Before placing the truck in operation, recheck to make sure the battery is the correct size and weight indicated on the truck capacity plate.

- Give the battery an adequate charge.

- Install the battery from either side of the truck. Carefully slide the battery into the truck and reinstall the battery gate.

TRAVEL LIFT/LOWER

Travel Lower Process (Refer to Figures 4.1 and 4.5)

Pressing the thumb switch forward closes the travel lift/lower switch S5 to the lower position.

Normally closed travel lower solenoid SOL2, contained in the manifold assembly, is energized and opens.

Oil flows from lift cylinder (10), thru flow control (9) to the manifold assembly and travel lower solenoid SOL2 (4), flow control (20), relief valve (18), filter (17) and back to the reservoir. Travel lower speed is limited to 40 feet per minute.

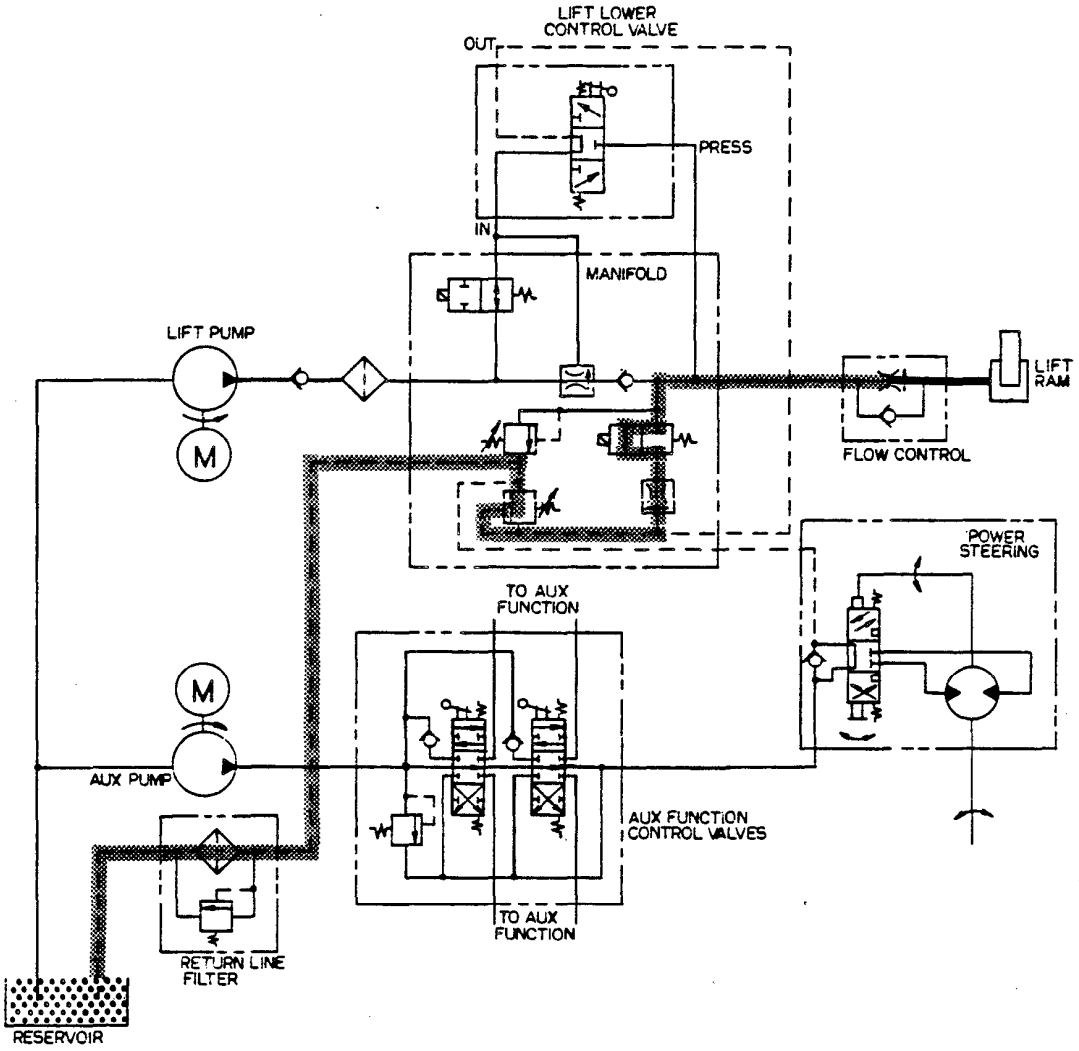


Figure 4.5 Model 21 Travel Lower

SCR - Speed Control Theory

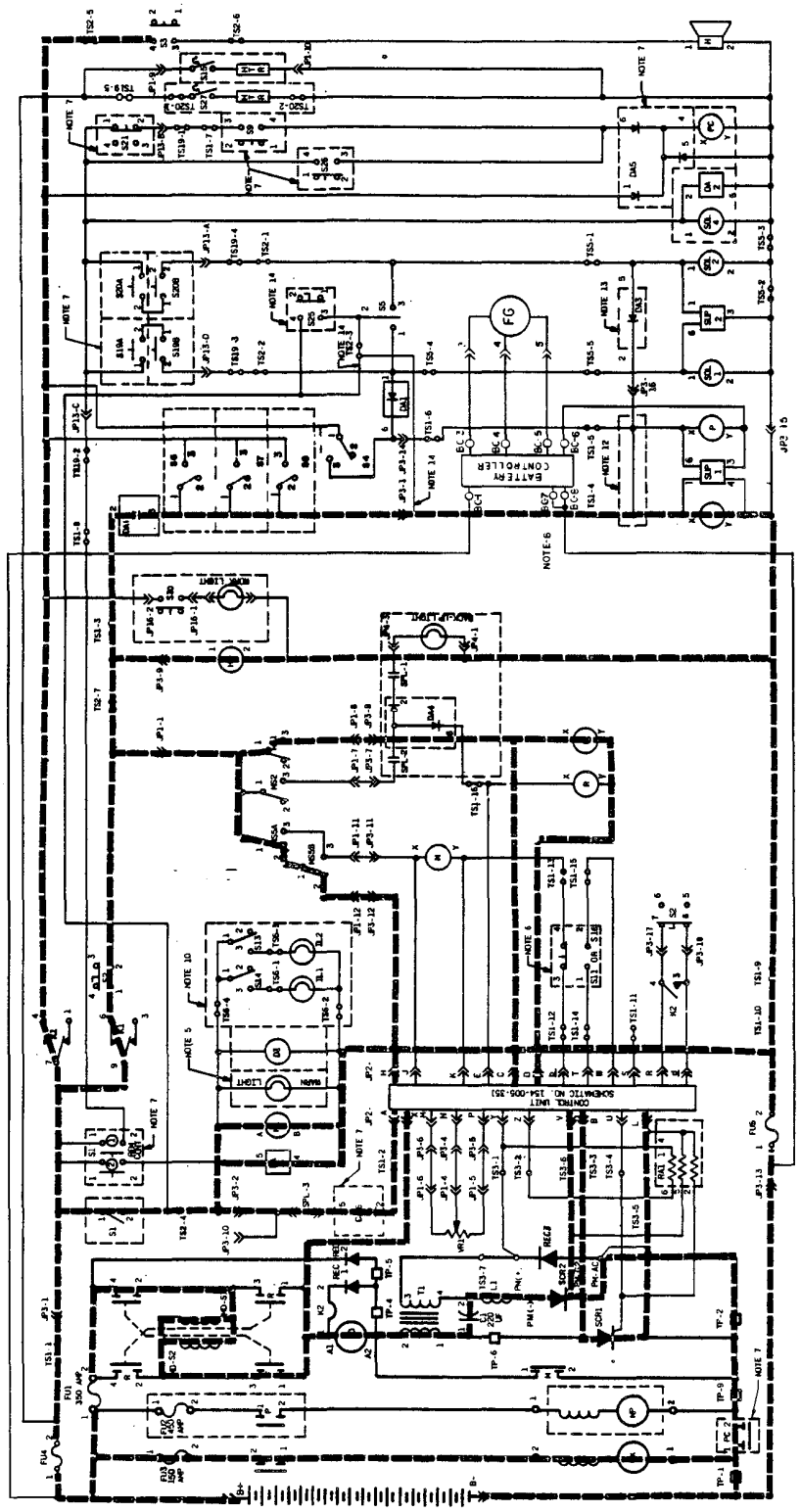
Figure 4.13 represents a simplified schematic of a mechanical speed control switch between the motor and battery. If this rotary switch is closed and opened at predetermined intervals the speed of the motor will be controlled. Thus the rate of switch operation will determine the motor speed.

To demonstrate the effect refer to Figure 4.14, showing a battery and voltmeter circuit. With the negative lead from the meter connected to the negative battery terminals and the positive lead from the meter as a probe, quickly tap the positive battery terminal. The quickness of the person making and braking the contact between the probe and battery terminal will determine the voltage readings on the meter. The longer the contact the higher the voltage or visa-versa. Example: If in a one second time interval the voltmeter is connected three times with respective readings of 4, 8 and 12 volts, the average voltage for that one second would be 8 volts. Likewise if readings were 8, 10 and 12 volts, the average would be 10 volts.

This example shows how voltage of a circuit could be controlled with a mechanical switch. Since speed of a motor depends directly on voltage, it is easy to see how the speed of the motor is varied. However, the drawback to this method is that a mechanicalswitch cannot withstand the arcing which occurs each time the switch is opened. Also the switch actuation could not function fast enough to obtain smooth motor speeds.

In Figure 4.15 an SCR is shown replacing the mechanical speed switch. The SCR can be turned ON (conducting) and OFF (non-conducting) at a much faster rate than the mechanical switch. In addition, the turning ON and OFF of an SCR can be accurately controlled by means of electronics to enable a continuous selection of smooth motor speeds.

OPERATION OF THE TRAVEL SYSTEM



NOTE:

Refer to Chapter 7 for current schematics and legends.

Figure 4.21 Turning OFF the Main SCR1

SCHEDULED MAINTENANCE

Monthly or every 175 operating hours, whichever occurs first

Item	Checklist	Maintenance
Drive Unit Swivel 5M	• Lubricate the two pressure fittings	• Use Lube E. Refer to page 5.7. Lubricate until the lubricant is forced out between the swivel assembly. Turn the drive unit while greasing.
Tractor Swivel Caster Bearing 6M	• Lubricate the pressure fittings	• Use Lube E. Refer to page 5.7.
Spring Rod Pivots 7M	• Lubricate the two pressure fittings.	• Use Lube E. Refer to page 5.7.
Caster Wheel Bearings 8M	• Lubricate	• Use Lube E. Refer to page 5.7.
Felt Washers 9M	• Lubricate each felt washer	• Use Lube C. Refer to page 5.7.
Steering Gear Box 10M	• Lubricate one pressure fitting	• Use Lube E. Refer to page 5.7.
Steering Chain 11M	• Clean and lubricate the chain	• Use Lube C. Refer to page 5.7.
Brake Master Cylinder 12M	• Fluid level should be 1/2" from the top.	• Use Lube G. Refer to page 5.7.
Motors (Drive, Lift, and Auxiliary) 13M	• Correct brush length • Correct spring tension. • Armature commutator wear. • Cleaning	• See Figure 5.23, page 5.66, for proper brush length and replace brushes as necessary. • See page 5.65 to clean the motors. • See Figure 5.23, page 5.66, for proper spring tension and replace springs as necessary. • Replace the motor if necessary.

DRIVE MOTOR

1. Drive Motor
2. Steering Plate
3. Screw
4. Lockwasher
5. Motor Mounting Plate
6. Screw
7. Lockwasher
8. Screw
9. Lockwasher
10. Screw
11. Lockwasher
12. Drive Wheel
13. Screw
14. Lockwasher
15. Shield
16. Screw
17. Lockwasher
18. Gear Housing
19. Filler Plug
20. Screw
21. Lockwasher
22. Grease Fitting
23. Pin
24. Ball Bearing (75 req.)
25. Pivot Ring
26. Thrust Ring Set
27. Outer Radial Ring
28. Inner Radial Ring

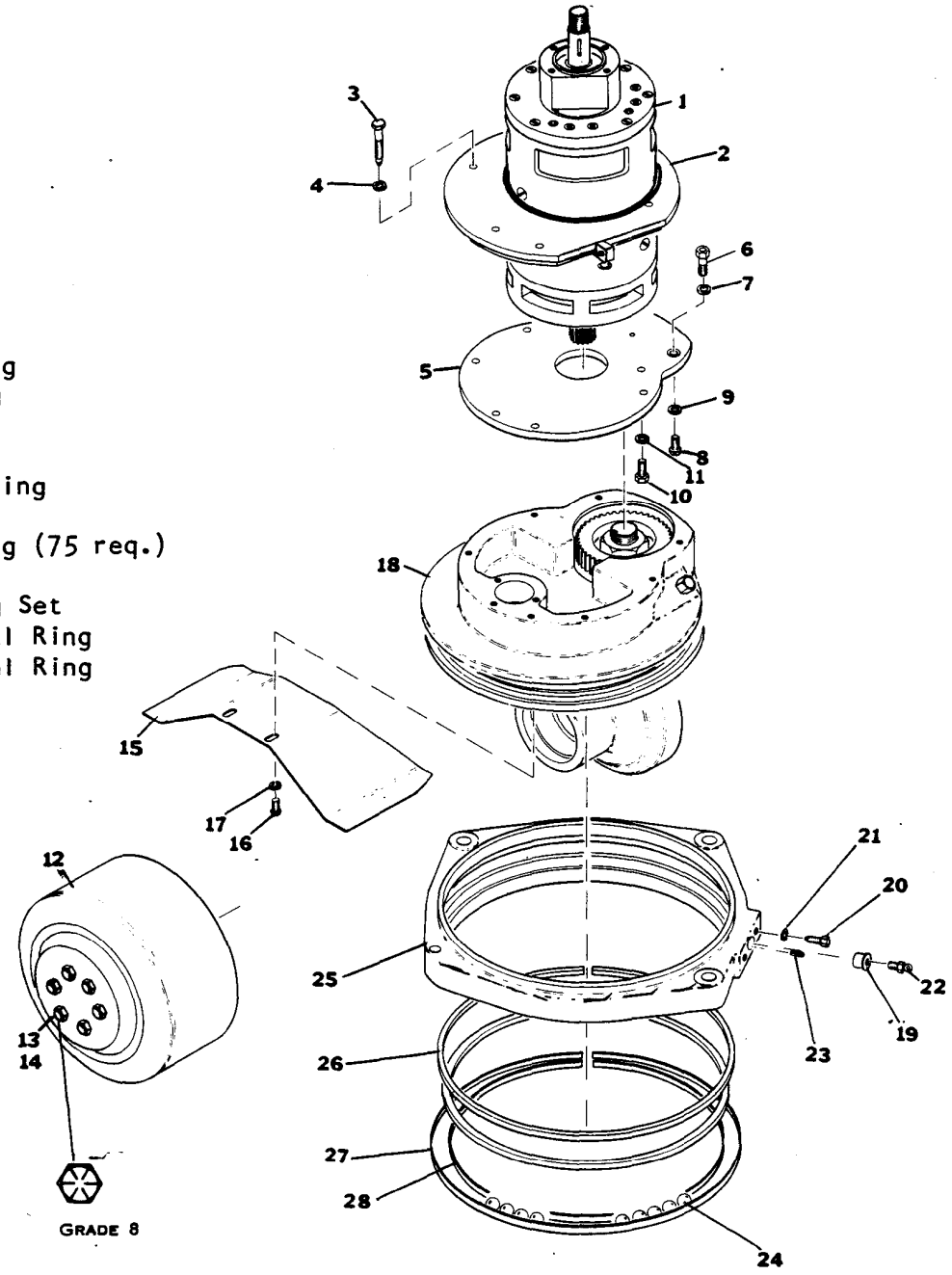


Figure 5.6 Drive Unit

1. Lock Nut
2. Brake Drum
3. Brake Drum Spacer
4. Screw
5. Washer
6. Support Plate
7. Shoe to Shoe Spring
8. Brake Shoe Assembly
9. Brake Actuating Cam Shaft
10. Washer
11. Brake Control Lever
12. Nut
13. Bolt
14. Screw
15. Washer
16. Screw
17. Washer
18. Mounting Plate
19. Switch Bracket
20. Screw
21. Lockwasher
22. Spring
23. Slave Cylinder
24. Push Rod
25. Brake Clevis
26. Pin
27. Cotter Pin
28. Set Screw
29. Brake Adjustment Screw
30. Spring
31. Woodruff Key
32. Motor Shaft

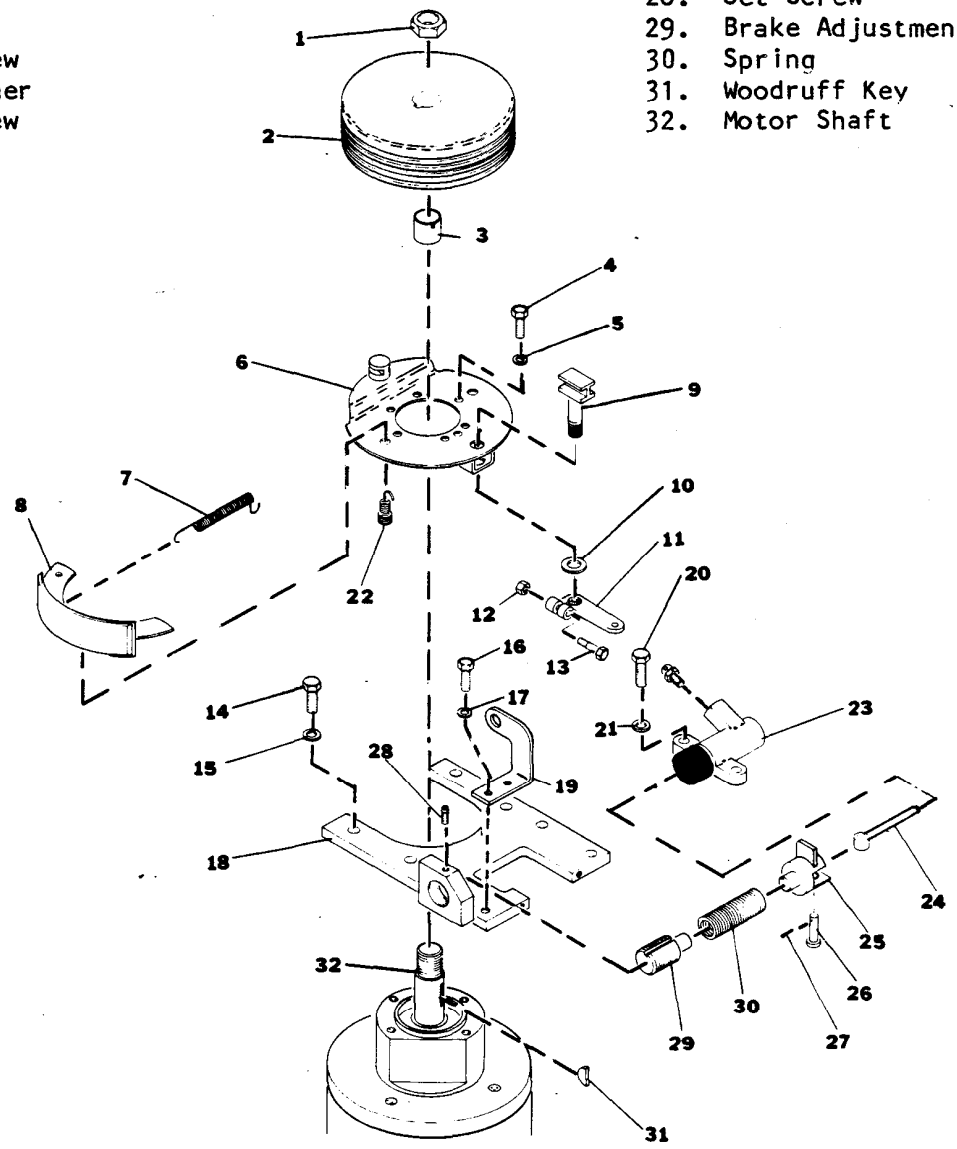


Figure 5.12 Exploded View of Brake Assembly

SWIVEL CASTER

Swivel Caster Checklist

Procedure		
	Lubrication	See Scheduled Maintenance, page 5.6.
	Weakness or Breakage	Visually inspect. Repair or replace as necessary. See page 5.30 for disassembly.
	Wheel	Check for wear, cracks or chips. Repair or replace as necessary. See page 5.31.
	Bearings	Check for wear or damage. Replace if necessary per page 5.31.

Swivel Caster Disassembly/Assembly (See Figure 5.17)

Procedure

Remove cotter pins (22), washer (17) and felt washers (18) from both ends of the axle shaft (21).

Disassemble nuts (16), sleeves (15) and bearings (14) from the caster bolts (13).

Remove nuts (7), washers (8), sleeves (9), springs (10) and washer (11).

Disassemble the caster arm (25), caster bolt (13), axle shaft (21), bearings (19) and felt washers (20).

Remove nuts (33), washers (32), wheel bearings and wheels (29) from the caster arms (25).

Reassemble in the reverse order of disassembly, remembering the additional important procedures contained in this checklist:

Checklist	
Felt Washers	Soak felt washers (18 and 20) in SAE No. 10 oil before assembly.
Wheel Bearing and Wheel Cavity	Pack the wheel bering and wheel cavity with lube "E". Refer to page 5.7.
Nuts	Torque nuts (33) to 60 foot pounds. Then loosen 1/4 turn.
Casters	Adjust the caster following the instructions of pages 5.34and 5.35.

Lift and Auxiliary Pump

⚠CAUTION WHEN REPLACING THE LIFT PUMP, FILL THE CASE OF THE NEW PUMP WITH OIL TO THE PROPER LEVEL.

NOTE: WHEN ASSEMBLING THE LIFT PUMP TO THE MOTOR, LUBRICATE THE SPLINE WITH A THIN COAT OF MOLYKOTE TYPE G LUBRICANT.

Introduction

The lift and auxiliary pumps require no periodic maintenance or adjustments. A thorough scheduled maintenance program which includes regular inspection of oil for contamination, line checks for leakage, and replacement of oil, will aid in extending pump life.

If pump operation is noisy, problems may be developing. A noisy pump can be caused by an air leak, a clogged pump intake line, a plugged reservoir air vent, air trapped in the pump or by internal failure of the pump. If the pump fails to perform, replace it.

If the pump operates noisily, leaks, or fails to perform properly, kits are available for repairing the pump. Refer to the parts catalog for repair parts available. If the pump requires major repair, it is recommended that the pump be returned to the manufacturer for re-building.

Lift Pump Replacement Procedure

Disconnect the battery.

Disconnect the inlet and outlet lines from the pump. Provide clean containers to catch the oil which drains from the lines.

Loosen two screws securing the pump; then, while holding the pump, remove the screws and washers and lift out the pump and coupling.

Apply Molycoat type G lubricant to the coupling. Assemble the coupling and new pump to the motor, securing it with the two screws and washers.

Connect inlet and outlet lines to the pump. Refill the reservoir with clean oil. Refer to Lubrication Equivalency chart, page 5.7 for recommended oil.

Prior to running the pump, make sure that the system is full with hydraulic oil. Connect the battery.

When first starting the pump, it may be necessary to bleed air from the pump outlet line. To permit bleeding loosen the outlet connection. Operate the pump until a solid stream of oil flows from the port, then tighten the connection.

ELECTRICAL MAINTENANCE

NOTE: IT IS SUGGESTED THAT ACCURATE RECORDS BE KEPT OF ALL ELECTRICAL INSPECTIONS AND WORK PERFORMED ON THE TRUCK. BY DOING THIS, IT IS EASY TO KEEP TRACK OF RECURRENT PROBLEMS.

⚠ WARNING CAPACITOR C1 IS POTENTIALLY DANGEROUS. AVOID CONTACT (EITHER DIRECTLY OR THROUGH UNINSULATED TOOLS) WITH CAPACITOR TERMINALS OR WIRING UNTIL THE CAPACITOR HAS BEEN FULLY DISCHARGED. TO DISCHARGE THE CAPACITOR, CAREFULLY HOLD THE INSULATED HANDLE OF A SCREWDRIVER AND PLACE THE METAL BLADE ACROSS THE BUSS BARS ON THE CAPACITOR. EACH TIME WORK IS TO BE DONE ON THE CIRCUIT, THE CAPACITOR MUST BE DISCHARGED IF THE CIRCUIT HAS BEEN ENERGIZED SINCE LAST DISCHARGING.

BATTERY CONTROLLER ADJUSTMENTS

Discharge Potentiometer Adjustment

Turning the potentiometer from N towards K will cause the battery to be more deeply discharged at lockout.

Turning the potentiometer from N towards P will cause the battery to be less deeply discharged at lockout.

Reset and Discharge Setting Values

Figure 5.24 list the potentiometer settings and associated voltages per cell. The N setting for the Model 21 SCR vehicle is (12 cells x 1.73 volts).

Discharge		Reset	
P	1.82 VPC	E	2.18 VPC
O	1.78	D	2.15
N (Factory set)	1.73	C	2.12
M	1.68	B (Factory set)	2.09
L	1.63	A	2.06
K	1.57	Beyond A	2.00
Beyond K	1.56		

Figure 5.24 Table of Pot Settings and Associated Voltages per Cell

General

Two potentiometers on the battery controller are available for adjustment.

⚠CAUTION ADJUSTMENTS SHOULD BE DONE BY AUTHORIZED PERSONNEL ONLY.

CONTACTORS

Procedure (Cont'd)

Use a "C" clamp or hand arbor press and two 3/4" I.D. nuts which encircle the core bottom for protection.

NOTE: REMOVE THE BASE BUSS BAR ASSEMBLY FROM MULTIDECK UNITS SO THAT CLAMPING PRESSURE IS APPLIED DIRECTLY TO THE PLATE AND TIE ROD ASSEMBLY. APPLY PRESSURE UNTIL THE CORE BOTTOMS OUT AND THERE IS NO FURTHER MOVEMENT.

Press the end frame and core assembly (1) into position and tighten the four frame side screws (9) that secure the frame and core assembly (1) to the sideplate (2,3).

REPLACEMENT OF CONTACTOR TIPS, INSULATION AND/OR CORE AND ROD ASSEMBLY

Introduction

Replacement of these components is very similar for all contactors on the Model 21. Refer to the specific Figure for each contactor pages 5.75 through 5.79 and follow the general disassembly and reassembly procedure.

NOTE:

LEAVE ALL SHIMS IN PLACE WHEN REPLACING CONTACT TIPS AS THEY ARE NECESSARY FOR PROPER CONTACT GAP AND OVERTRAVEL.

General Disassembly/ Reassembly Procedure

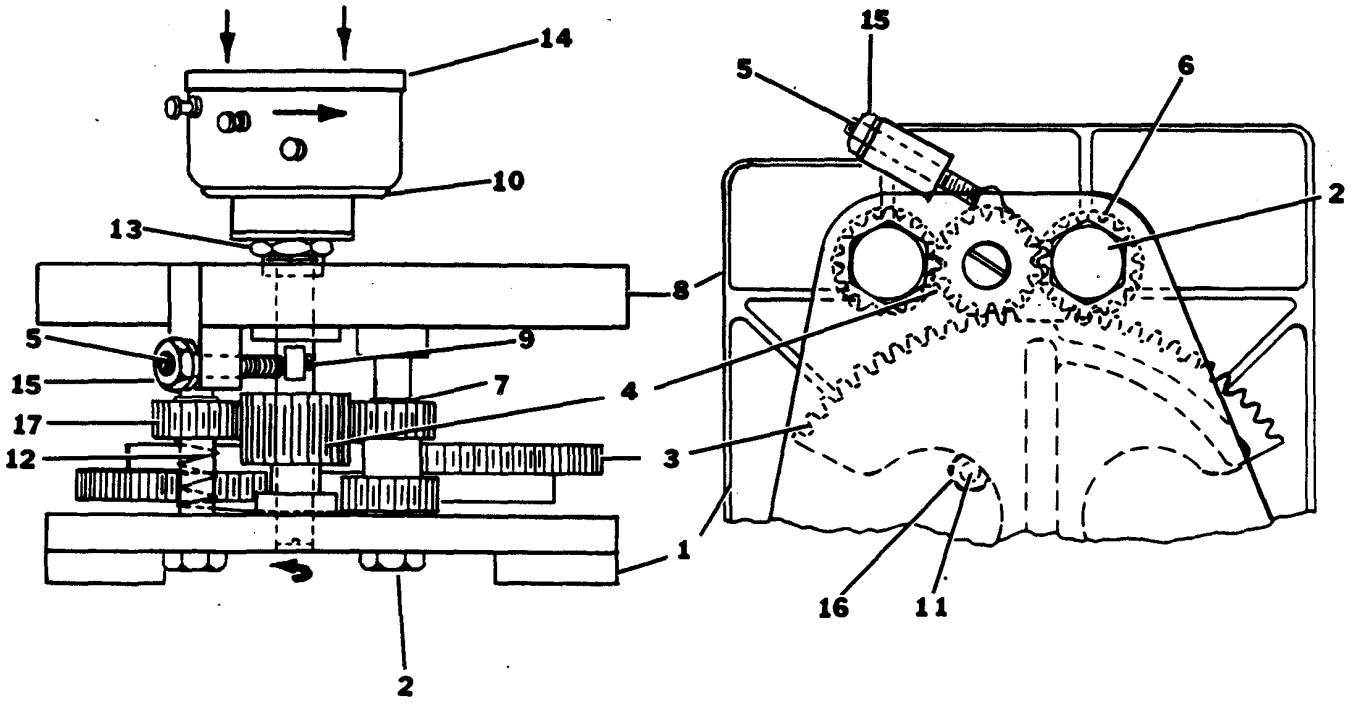
Remove any external buss bars (36,37,38) if present.

Remove nut (33) and its associated hardware.

Lift off, as applicable, consulting the Figure for order, the:

- non-metallic washer (32)
- bushing (31)
- insulation (21), if present
- buss bars (35), if present
- contact spring (30) and movable contact bar (29)
- bushing (28)
- non-metallic spacer (34), if present
- washer (27), if present
- bushing (28), if present
- second set of comparable components, if present.

POTENTIOMETER



View I View II

Key:

1. Support
2. Gear Shaft
3. Dual Segment Gear
4. Potentiometer Gear
5. Socket Head Set Screw
6. Idler Gear
7. Snap Ring
8. Switch Bracket
9. Socket Head Set Screw
10. Potentiometer Key
11. Binding Head Screw
12. Torsion Spring
13. Locknut
14. Potentiometer
15. Nut
16. Nut
17. Return Gear

Figure 5.36 Directional/Speed Control Assembly

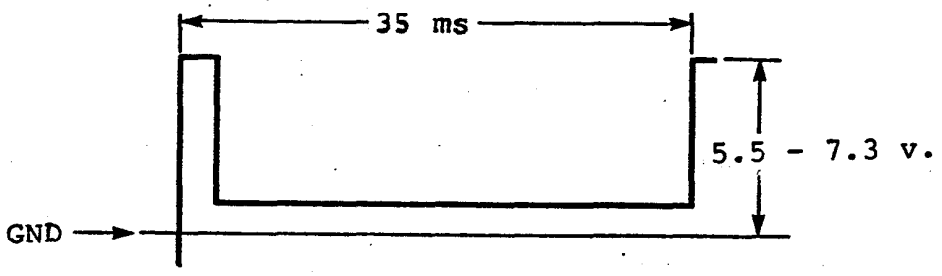


Figure 5.41 Plugging Adjustment

1/2 Speed Test Procedure (VPG Card)

⚠ WARNING CARE MUST BE TAKEN WHEN JACKING OR BLOCKING THE TRUCK SO IT DOES NOT FALL OVER. NEVER BLOCK THE TRUCK BETWEEN THE TELESCOPIC AND THE FLOOR. USE A SUITABLE HOIST TO STABILIZE THE MAST.

Jack up and block the truck.

Put the truck in a half speed situation. See page 4.34.

Connect the oscilloscope probe to TP-4 and ground to TP-2.

Set the time/div. to 2 ms. and the volt/div. to 0.2 volts (10 x probe).

Turn on the keyswitch and activate the deadman.

Move the directional/speed control handle to full forward or reverse. The scope should approximate the figure below. If it does not approximate it, replace the VPG card.

Return the directional/speed control handle to the neutral position.

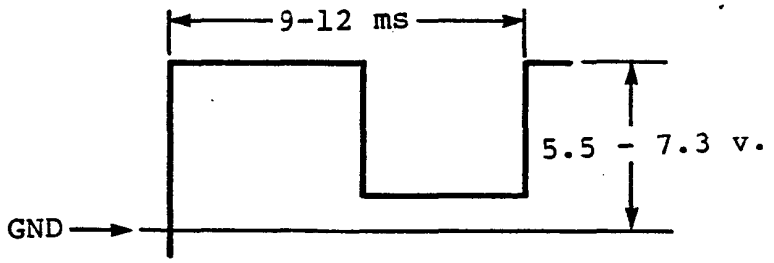


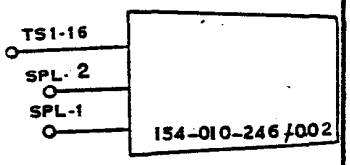
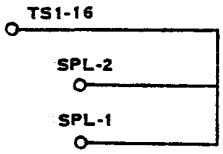
Figure 5.42 1/2 Speed Adjustment

DIODE ASSEMBLIES

DA2 and DA3 (Cont'd.)

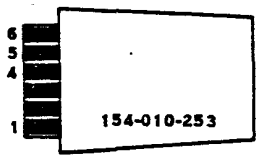
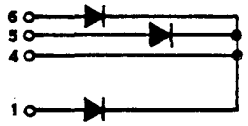
Ohmmeter Lead Connections		Ohmmeter Setting	Passing Meter Reading
+ to pin	- to pin	RX	Ohms
5	2	1	10 to 15
2	5	1	open
Replace any module failing any of these tests.			

DA4

Location	Appearance	Symbol
DA4 is located next to terminal strip TS1 in the contactor panel assembly. It is used only with the back-up light. (optional)		

Ohmmeter Lead Connections		Ohmmeter Setting	Passing Meter Reading
+ to terminal	- to terminal	RX	Ohms
TS5-1	TS5-2	1	open
TS5-4	TS5-2	1	open
TS5-2	TS5-1	1	10 to 15
TS5-4	TS5-1	1	10 to 15
Replace any modules failing any of these tests.			

DA5

Location	Appearance	Symbol
DA5 is located in front of the PC Contactor (used with remote lift EE ONLY).		

SHORTS TO FRAME

⚠CAUTION DISCONNECT THE BATTERIES WHEN CHECKING ELECTRICAL CIRCUITS WITH AN OHMMETER. BATTERY CURRENT CAN DAMAGE THE METER.

Frame - Short Test Procedure

Unplug the battery.

Use an ohmmeter set on the R x 10,000 scale.

Connect one lead to the truck frame and the other to different points in the electrical system - ie. terminal strips, contactors, wire connections, etc.

Reverse the leads and repeat Step 3.

If there is a short, the meter needle will noticeably move. The meter should register no less than one megohm.

If the ohmmeter registers less, the short within the particular circuit must be located.

BATTERY ELECTRICAL LEAKAGE TO FRAME TEST

Procedure

Set the voltmeter scale to 50 volts.

Attach the negative meter lead to the frame of the truck and the positive lead to the battery positive.

The voltmeter should show no voltage or at most a 2 to 3 volt reading.

Attach the positive meter lead to the frame and the negative lead to the battery negative.

The voltmeter should show no voltage or at most a 2 to 3 volt reading.

If there is more than a 2 to 3 volt reading in Steps 3 and 5, clean the battery.

NOTE: LEAKAGE ON THE POSITIVE SIDE OF THE BATTERY IS NOT AS CRITICAL AS LEAKAGE ON THE NEGATIVE SIDE.

Alternate Method

A meghommeter may also be used to check for shorts to frame.

⚠CAUTION ISOLATE ANY COMPONENT FROM THE REMAINDER OF THE CIRCUIT WHEN USING A MEGOHMMETER.

OVERVIEW

Procedure (Cont'd.)

Use the Troubleshooting Flow Diagrams by:

- consulting the List of Truck Problems.
- If a Flow Diagram is applicable, then follow the particular diagram from the beginning to where the probable cause is isolated.

Identify the cause of the problem by:

- checking for improper truck usage.
- bringing the problem to the service manager's attention to avoid repetition of the cause.

Correct the problem by:

- repairing or replacing defective components following instructions in the Maintenance section of this manual.
- complying with appropriate safety procedures.

⚠ WARNING WHEN THE TRUCK MUST BE JACKED UP AND BLOCKED SO THE DRIVE WHEEL IS OFF THE FLOOR, CARE MUST BE TAKEN SO THE TRUCK DOES NOT TIP OVER. USE AN OVERHEAD HOIST TO STABILIZE THE MAST.

⚠CAUTION DISCONNECT THE BATTERY WHEN CHECKING ELECTRICAL CIRCUITS WITH AN OHMMETER. BATTERY CURRENT CAN DAMAGE THE OHMMETER.

NOTE USE THE ELECTRICAL SCHEMATIC, THE HYDRAULIC SCHEMATIC, AND THE WIRING DIAGRAM WHEN TROUBLESHOOTING. SEE THE LIST OF ILLUSTRATIONS FOR THE APPROPRIATE PAGE NUMBER.

NOTE CHECK ALL TRUCK FAILSAFE AND OVERLOAD CIRCUITS:

- before attempting any troubleshooting procedure
- after making any repairs or adjustments before returning the truck to operation.

THERE IS NO REACH, TILT, SIDESHIFT OR POWER STEERING

⚠ WARNING WHENEVER TROUBLESHOOTING PROCEDURE REQUIRES CLOSING KEYSWITCH S1, THE TRUCK MUST BE BLOCKED. THIS WILL AVOID ACCIDENTS CAUSED BY UNEXPECTED TRUCK TRAVEL.

After the truck is jacked up and blocked, turn keyswitch S1 to the ON position and manually close X contactor. Does the pump motor start?

NO → Go to F, page 6.13.

YES ↓

Is there continuity between K1-4 and K1-7?

NO → Replace any faulty relay.

YES ↓

Close auxiliary switches S6, S7 and S8 (if used) separately. Do any fuses blow?

YES → Replace any faulty switch.

NO ↓

Check for voltage drop between X contactor tips. Should be 0 volts. Test coil of X contactor refer to page 5.105.

NOT OK → Repair tips or replace coil as necessary.

OK ↓

With an ohmmeter check the power circut wiring for shorts and grounds.

NOT OK → Repair or replace as necessary.

THE TRUCK RUNS AT APPROXIMATELY HALF SPEED IN THE SCR RANGE

Check limit switches S11 and S16 (if available) for proper operation.

NOT OK → Replace switches as necessary.

OK ↓

Test the current limit setting, refer to page 5.98.

NOT OK → Replace the control unit or the VPG circuit card.

OK ↓

Check the VPG card in the control unit for frequency and width, using test procedures on page 5.91.

NOT OK → Replace any faulty card.

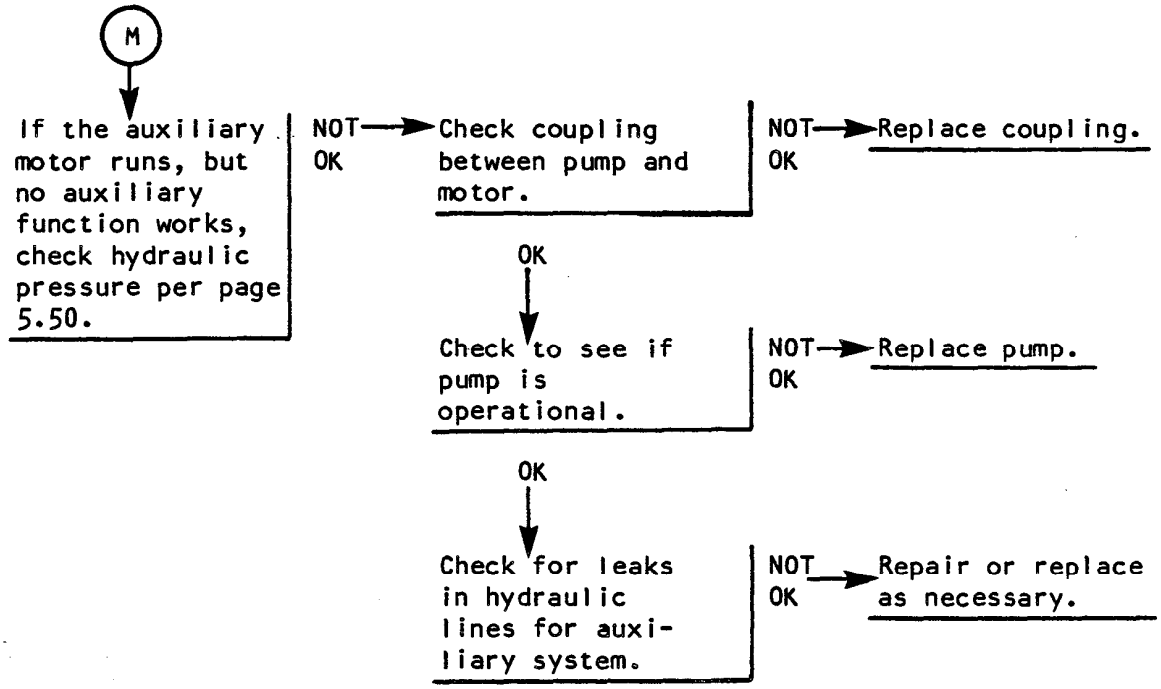
OK ↓

Test the potentiometer, refer to page 5.82 for test procedure.

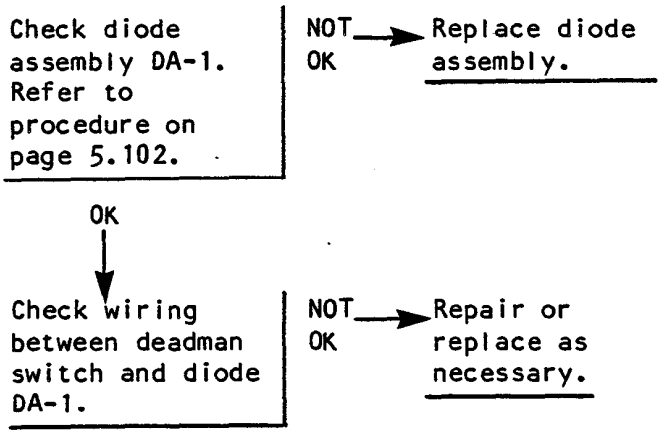
NOT OK → Replace faulty potentiometer.

AUXILIARY SYSTEM PROBLEMS

- If the auxiliary system is totally inoperative, travel and lift systems are OK (Cont'd.)



- If power steering does not work when the deadman pedal is depressed but works when an auxiliary valve is closed.



WIRING DIAGRAM

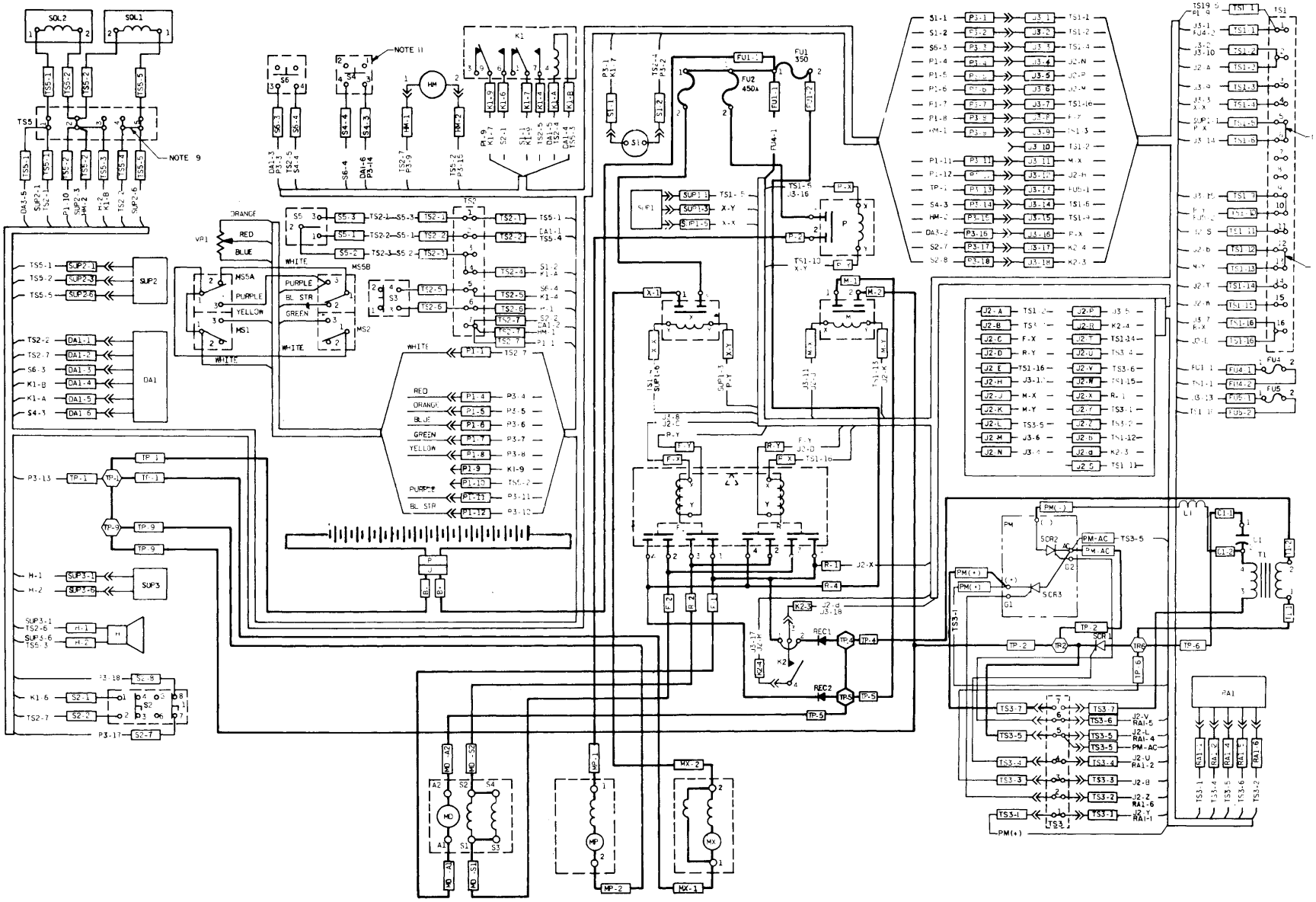


Figure 7.2 Wiring Diagram
(Early Models)