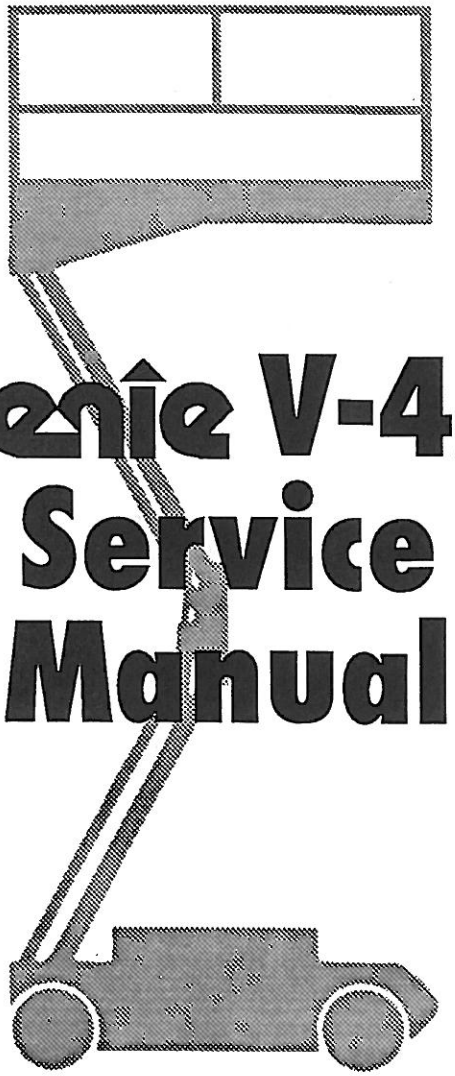




# Genie V-4M Service Manual

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Genie Industries

Part No. 27169

# Theory of Operation

## Power Source.

The Genie V-4M is powered by four 6V DC batteries connected in series to provide 24V DC power. Each battery is rated at 250AH at a 20 hour rate. The batteries are recharged after each day's use by a 24V, 32A line compensated battery charger. The charger utilizes an electronic current limiting system which automatically sets the charge rate depending on battery condition, and tapers the charge rate off as the batteries approach full charge. The charger also incorporates a function shut-off relay which prevents machine operation when the charger is plugged in.

## Hydraulic System.

All machine functions are performed by the hydraulic system. To power these functions, the hydraulic system uses a power unit incorporating a 24V DC electric motor and a two-stage gear pump. When activated, the power unit supplies hydraulic oil to the hydraulic control manifold where all valves are located. Each pump stage is independently protected from over-pressurization by its own relief valve. The secondary pump stage is regulated by the unloader valve and is only brought into use for DRIVE function.

The ELEVATE Up and Down functions utilize two lifting cylinders. The ELEVATE Up function is accomplished by actuating the ELEVATE Up directional control valve and the proportional valve. The directional control valve creates the flow path to the cylinders, and the proportional valve controls the speed of the function by regulating the flow in direct relation to the valve's input voltage. The ELEVATE Down function is accomplished by actuating the down directional control valve creating a flow path for hydraulic oil to exit the cylinders. The manual lowering valve bypasses the down directional control valve in the event of an electrical system failure. A pressure compensated flow control valve controls the rate the cylinders retract. A series of check valves maintain cylinder pressure and prevent free descent in the event of a hydraulic failure. The lift hydraulic circuit also incorporates a pressure switch which issues an over-pressure signal when platform load exceeds platform capacity.

The STEER Left and Right functions utilize one dual-acting cylinder. The steering functions are accomplished by actuating the steering directional control valve which directs oil to the steering cylinde

The DRIVE Forward and Reverse functions use two rotary drive motors. DRIVE functions are accomplished by actuating the Forward or Reverse directional control valve and the proportional valve. The pump unloader valve is simultaneously activate to provide two-stage combined output from the pum The DRIVE functions also use two counterbalance valves and a series/parallel directional valve. The counterbalance valves prevent the machine from exceeding the maximum drive speed and provide hydrostatic braking. The series/parallel directional valve provides drive functions in a Low speed, high torque (parallel flow path) mode or in a High speed, low torque (series flow path) mode.

The Parking Brake utilizes a spring-applied, hydraulically released positive engagement brake cylinder. The brake shuttle valve taps the drive hydraulic circuit to release the brake during drive functions. The Parking Brake can also be released manually with the handle provided on the cylinder.

## Electrical System.

The electrical system uses stored electrical energy t control and power all machine functions. The electrical system can be divided into two categories the **control circuit** and the **power circuit**.

The **control circuit** incorporates the components a circuitry required to turn the machine On and Off, or control other electrical devices. Small diameter wire and multi-wire control cables are used to connect th control circuit components.

The **power circuit** incorporates the components which convert stored electrical energy into a mechanical force to provide movement. Since the power circuit must be able to conduct full operating current, heavy battery cables are used to connect th power circuit components.

Before any machine functions can be operated, the key switch must be turned to the appropriate Platfor or Ground position, the red POWER On/Off buttons must be pulled up and the load in the platform must not be in excess of the rated load.

**Note**: If overloaded, the elevate pressure switch will energize a relay and break the circuit between the POWER On/Off button and the keyswitch, disabling all functions. This load limit feature also incorporates another relay to bypass the load limit circuitry during the operation of any machine function, thereby avoiding unintended shut-off. The travel alarm will sound continuously if the platform is overloaded.

# Electrical Operation.

All machine functions can be operated from the ground control station or the platform control station by actuating the appropriate toggle switch or joystick proportional controller.

The ELEVATE Up function is operated at a fixed speed from the ground control station with a toggle switch and at variable speeds, with a joystick, from the platform control station.

When the ground control toggle switch is actuated, a 24V circuit is completed from the toggle switch to the motor start relay, the proportional valve and the ELEVATE Up valve. The motor start relay completes a 24V power circuit to the hydraulic power unit.

When the platform control joystick is actuated, a 24V circuit is completed from the joystick to the motor start relay and the ELEVATE Up valve. The proportional valve is supplied with a variable voltage corresponding to the degree of deflection of the joystick handle. The motor start relay completes the power circuit to the power unit.

The ELEVATE Down function is not a powered function and does not supply 24V to the motor start relay or the proportional valve. Actuating the ELEVATE Down toggle switch or joystick completes a 24V circuit to the ELEVATE Down valve.

The STEER Left/Right functions are operated by actuating the toggle switch from the ground control station or the thumb rocker switch (on the top of the drive joystick) from the platform control station. When actuated, either switch completes a circuit to the motor start relay and to the STEER Left or Right valve. The motor start relay completes the power circuit to the power unit.

The DRIVE Forward/Reverse functions are operated at a fixed speed from the ground control station with a toggle switch and at variable speeds, with a joystick, from the platform control station.

When the ground control toggle switch is actuated, a 24V circuit is completed from the toggle switch to the motor start relay, the pump unloader valve, the proportional valve and the DRIVE Forward/Reverse valve. The motor start relay completes the power circuit to the hydraulic power unit.

When the platform control joystick is actuated, a 24V circuit is completed from the joystick to the motor start relay, the pump unloader valve, the DRIVE Forward/Reverse directional control valve and the High/Low toggle switch. The proportional valve is supplied with a variable voltage corresponding to the degree of deflection of the joystick handle. The motor start relay completes the power circuit to the power unit. The High/Low toggle switch, when in High position completes a circuit to the series/parallel directional valve. Also incorporated in the High/Low circuit is the drive limit switch. When in the raised position, the limit switch breaks the circuit to the series/parallel valve allowing travel only in the Low or parallel mode.

# Battery Charger Operation

## Dangers And Warnings:

- Do not connect the charger AC line without verifying the voltage switch is correctly set for the measured line voltage or the charger may be damaged.
- Operating the charger with the incorrect mode switch setting could cause the batteries to rupture or explode.
- Connect charger only to properly grounded AC power outlet. Keep dry; do not expose to rain, power wash spray or detergents. Replace damaged cords immediately.
- DC output leads polarity identification: Negative lead is labeled "-" or is Black; Positive lead is labeled "+" or is Red. Charger will not operate with reversed polarity connection and DC fuse may blow.
- Do not use charger near flammable materials or vapors. Keep sparks, flame and smoking material away from batteries. Battery gases are explosive; use in well ventilated areas.
- Do not leave charger connected while unattended for more than two consecutive days. In the unlikely event the charger does not turn off or turns back on, the batteries could be damaged.

## Setup.

- This model charger can be adjusted to operate on two different line voltage ranges. Verify the intended voltage and set the voltage switch accordingly before connecting charger to AC power. Remove the cover to verify or set the switch to match the intended voltage (this charger automatically adjusts for 50 or 60 Hz line voltage frequency).
- This model charger can be adjusted to recharge either conventional replaceable electrolyte or sealed, maintenance-free, deep cycle batteries. Remove the left panel to verify or change the mode switch setting for the specific battery type.
- Refer to charger nameplate to determine input power requirements and verify circuit breaker or fuse protection is correct for the specific requirements.

## Operation.

- Read the instructions on the charger prior to every use.

1. Connect the AC line to a properly grounded AC outlet. Charger will start in one to three seconds if AC and DC line connections are complete. Ammeter indicates charger operation and output.
2. Correct initial charge rate should be about 30A until the battery voltage increases to approximately 70% recharge. The charge rate then gradually decreases to a reading determined by the mode selector switch setting.
3. A. In the sealed maintenance-free battery position, the charge current gradually decreases toward zero and remains there until the charger turns off.

   B. In conventional (replaceable electrolyte), deep cycle battery position, the charging current gradually decreases to around 12A and remains there until the charger turns off.
4. The charger turns off automatically when the batteries reach full charge. Under normal conditions, recharge time will not exceed 14 hours.
5. Disconnect AC line after charger turns off.

**Note**: When the equipment is not in use, charge the batteries once each week.

# Maintenance Inspection Checklist

**Note:**

- ☑ The following inspection should be performed every 150 hours or 3 months, which- ever comes first, or if the machine has been out of service for three months or more.
- ☑ Maintenance inspections must be conducted by a maintenance person trained on this machine.
- ☑ Remove from service any machine found to have defects and always repair any defects before operating.

Make copies of this checklist to use for each inspection. Date:

| Inspector's Initials | Inspection |
|---|---|
| ☐ | Inspect entire machine for physical damage, structural cracks or missing parts: platform rails and decking, platform and pround control boxes, elevate linkage and cylinders, chassis and chassis-mounted components, tires, wheels and other missing parts. |
| ☐ | Inspect all welds: platform assembly, elevate linkage, elevate cylinders and attachment points, chassis assembly. |
| ☐ | Inspect for corrosion damage: All painted and non-painted surfaces, all fasteners, all elevate linkage pivot pins. |
| ☐ | Inspect for hydraulic leaks: elevate cylinders, steer cylinder, parking brake release cylinder, drive motors, all hoses, hydraulic manifold, hydraulic reservoir and filter. |
| ☐ | Check battery condition: electrolyte level, specific gravity, load test and recharge. |
| ☐ | Check hydraulic reservoir oil level. Replenish with Shell Tellus T-68 or equivalent 20 weight hydraulic oil. |
| ☐ | Check wheel lug nut torque: 35-45 foot-pounds (81Nm). |

| Inspector's Initials | Inspection |
|---|---|
| ☐ | Check parking brake operation: automatic application and release with drive function, manual release (chock wheels to prevent machine from rolling). |
| ☐ | Check all machine functions from the platform and ground control stations. |
| ☐ | Inspect front steering linkage for excessive wear, damaged or missing parts. |
| ☐ | Inspect rear axle bearings for proper adjustment and lubrication. |
| ☐ | Inspect decals and placards for damage and legibility. |
| ☐ | Check auxiliary lowering function. |
| ☐ | Check tilt sensor and alarm for proper operation. (Manually deflect tilt sensor—alarm should sound after short delay.) |
| ☐ | Check load limit function for proper operation. (Machine should not be able to lift more than rated load and if overloaded when raised, all functions are disabled and travel alarm sounds continuously.) |
| ☐ | Check charging function shut-off operation. (With charger plugged in, all functions should be disabled.) |

# Daily Decal Inspection Checklist

**Note:** ☑ Use this checklist to verify that all decals and placards are in place and clearly legible. This inspection should be performed by a qualified person on a daily basis. ☑ Correct any defects before operating.

Make copies of this checklist to use for each inspection. Date:

O = Good Condition/Legible X = Damaged/Illegible **Must Be Replaced Immediately**

| Part No. | Chassis Decals - Description and Location* | O | X |
|---|---|---|---|
| 25914J | Maintenance Instructions | | |
| 18684J | Ground Control Pre-Start | | |
| 25917J | Electric Diagram | | |
| 25918J | Hydraulic Schematic | | |
| 916237J | Hydraulic Oil Only | | |
| 12515J | 120V AC 15A | | |
| 25919J | Charge After Each Shift | | |
| 916245J | Proper Tire Usage Warning (Right Side) | | |
| 916245J | Proper Tire Usage Warning (Left Side) | | |
| 916251J | Manual Lowering Valve Instructions | | |
| 25921J | Secure As Shown For Transport | | |
| 24973J | Machine Will Not Operate With Charger Plugged In | | |
| 24916J | Ground Control Panel | | |
| 24917J | Brake Release Instructions | | |
| 25922J | Pinch Point (Right Side) | | |
| 25922J | Pinch Point (Left Side) | | |
| 45228 | Serial Number Plate | | |
| 25913J | Manual Lower Valve Location | | |

| Part No. | Platform Decals - Description and Location* | O | X |
|---|---|---|---|
| 24939J | Maximum Height (Right Toeboard) | | |
| 24939J | Maximum Height (Left Toeboard) | | |
| 24935J | Maximum Capacity (Right Toeboard) | | |
| 24935J | Maximum Capacity (Left Toeboard) | | |
| 25915J | Operating Instructions | | |
| 916260 | Safety Belt Anchor (Right Side) | | |
| 916260 | Safety Belt Anchor (Left Side) | | |
| 25920J | Load Capacity And Distribution (Platform Entrance) | | |
| 25920J | Load Capacity And Distribution (Instruction Panel) | | |
| 916300J | Warning Before Operating | | |
| 24974J | Platform Control Panel | | |
| 24971J | Range Of Motion | | |

* See *Genie V-4M Parts Reference Guide* for precise locations of each decal.

# Specifications Chart

| MODEL | | V-4M |
|---|---|---|
| Height-working max. | U.S. - ft | 19 |
| | Metric - m | 5.8 |
| Height-platform max. | U.S. - ft | 13 |
| | Metric - m | 4 |
| Height-stowed | U.S. - ft | 6' 2" |
| | Metric - m | 1.87 |
| Width-drive chassis | U.S. - in | 35 |
| | Metric - m | 0.89 |
| Length-stowed | U.S. - ft | 6' 8" |
| | Metric - m | 2.25 |
| Lift capacity (evenly distributed) | U.S. - lbs | 440 |
| | Metric - kg | 200 |
| Wheelbase | U.S. - in | 59 |
| | Metric - m | 1.49 |
| Turning radius (outside) | U.S. - ft | 7' 5" |
| | Metric - m | 2.26 |
| Turning radius (inside) | U.S. - ft | 4' 6" |
| | Metric - m | 1.37 |
| Power source | | 24V DC |
| Batteries (included) | | (4) 6V Deep cycle |
| Travel speed-stowed | U.S. - mph | 0-1.6 |
| | Metric - km/h | 0-2.5 |
| Travel speed-raised | U.S. - mph | 0-1.1 |
| | Metric - km/h | 0-1.8 |
| Controls | | Proportional |
| Platform dimensions (length x width) | U.S. - in | 79 x 32 |
| | Metric - cm | 200 x 81 |
| AC outlet in platform | | Standard |
| Hydraulic pressure max. | U.S. - PSI | 2000 |
| | Metric - bar | 138 |
| Tires | | 16 x 4 x 8 Solid rubber |
| Gradeability-stowed position only | | 15% |
| Ground clearance | U.S. - in | 3 ½ |
| | Metric - cm | 9 |
| Hydraulic reservoir capacity | U.S. - gallon | 4.5 |
| | Metric - liter | 17 |
| Weight | U.S. - lbs | 2194 |
| | Metric - kg | 995 |

# Consumable Materials

- **Hydraulic oil** - SHELL Tellus T-68 or equivalent 20 weight hydraulic oil.
- **Electrolyte (battery acid)** - Sulfuric acid, 1.224 specific gravity.
- **Bearing Grease** - SHELL Alvania EP or equivalent Multi-Purpose Grease.
- **Paint** - Rudd 91-869 Blue and Rudd 91-841 Grey.

# Torque Specifications

| Fastener | Recommended Torque |
|---|---|
| Lug Nuts (front) | 60 foot-pounds |
| | 81 Newton meters |
| Lug Nuts (rear) | 60 foot-pounds |
| | 81 Newton meters |
| Screw-HHC, M6 x 8.8 | 88 inch-pounds |
| | 10 Newton meters |
| Screw-HHC, M8 x 8.8 | 17 foot-pounds |
| | 24 Newton meters |
| Screw-HHC, M10 x 8.8 | 35 foot-pounds |
| | 48 Newton meters |
| Screw-HHC, 3/8-16 grade 8 | 37 foot-pounds |
| | 50 Newton meters |
| Screw-HHC, 5/8-11 grade 8 | 170 foot-pounds |
| | 230 Newton meters |
| #2 Hydraulic Plug | 50 inch-pounds |
| | 6 Newton meters |
| #4 Hydraulic Plug | 13 foot-pounds |
| | 18 Newton meters |
| #6 Hydraulic Plug | 18 foot-pounds |
| | 24 Newton meters |
| #8 Hydraulic Plug | 50 foot-pounds |
| | 68 Newton meters |

# Wheel Motor Repair

**Note:**

- All repairs must be performed by a maintenance person trained on this machine.
- All numbers in parenthesis are references to items detailed on the *Wheel Motor Legend*, page 18.
- Prior to motor disassembly, plug the open ports and clean all dirt from the outside of the motor.
- Prior to assembly, lightly oil all seals, rollers and threaded bolt ends.

## Main Shaft Seal and/or Shaft Replacement.

If the shaft seal or the shaft is damaged or if it is necessary to inspect the motor for internal contamination damage, follow the procedure below.

A. Disassembly of Shaft and Front Seal Assembly.

- Place the motor on a clean, flat surface with shaft facing up. Clean the front end of the motor to avoid contaminating the lubricating system during the procedure.
- Remove the key (15) from the shaft.
- Remove the snap ring (1) using snap ring pliers.
- Pull the shaft (16) out vertically.

  **Caution**: When pulling the shaft vertically, do not rotate the shaft or move the motor as this may alter internal timing.
- With the seal retainer assembly and shaft assembly removed, remove all the parts from the shaft and inspect the various parts of the seal assembly (2), (3), (4), shaft (16) and thrust bearing assembly (10), (11) and (12). Replace any worn or damaged parts. Always replace the seal retainer assembly (19). The shaft should have smooth polished surfaces in the bearing and seal areas. If the shaft is lightly scratched in these areas, polish with fine emery paper in a circumferential direction. However, if the shaft has any pitting or deep scratches, the entire motor should be disassembled for inspection.

B. Assembly of Shaft and Front Seal Assembly.

- Assemble the thrust washers (11) and thrust bearing (12) on the shaft using the snap ring (10). The snap ring sharp edges must face away from the thrust washers with the thrust bearing (12) between the washers.
- Slowly lower the spline end of the shaft (16) assembly into the motor body using caution not to rotate the internal parts once the shaft spline starts to engage.
- Place the lightly oiled O-ring Seal (13) into the groove in the body bore.
- Gently slide the oiled seal retainer assembly (19) (items 2, 3 and 4) over the shaft, chamfered side first, and press into the body bore. When fully in place, the body snap ring groove will be visible.
- Install the snap ring (1) into its body groove with the snap ring's sharp edges facing outward and the retainer pin between the snap ring lugs. Be sure the snap ring is completely seated in the groove.

## Motor Disassembly.

A. Disassembly of Cover Section of Motor.

- Remove the key (15) from the shaft.
- Mount the motor in a vise or other holding device with the shaft facing down.
- Remove the eight bolts (9). If the current motor has bolt washers, remove and discard them.
- Remove the cover/bearing assembly (18) and the square ring seal (8).
- Remove the IGR assembly components (14) in the following order: Outer locating ring, rollers, outer rollers, inner rotor and valve plate (5). If any of these components are damaged the entire IGR assembly must be replaced.
- Remove the two check valve balls (6).

  **Note:** Check valve balls frequently fall into the body tapped holes or into the body valve ports during disassembly. Be sure that the check valve balls are removed.

B. Disassembly of Shaft Section of Motor.

- See *Main Shaft Seal and/or Shaft Replacement*, Instruction A.

# Motor Assembly.

A. Assembly of Complete Motor.

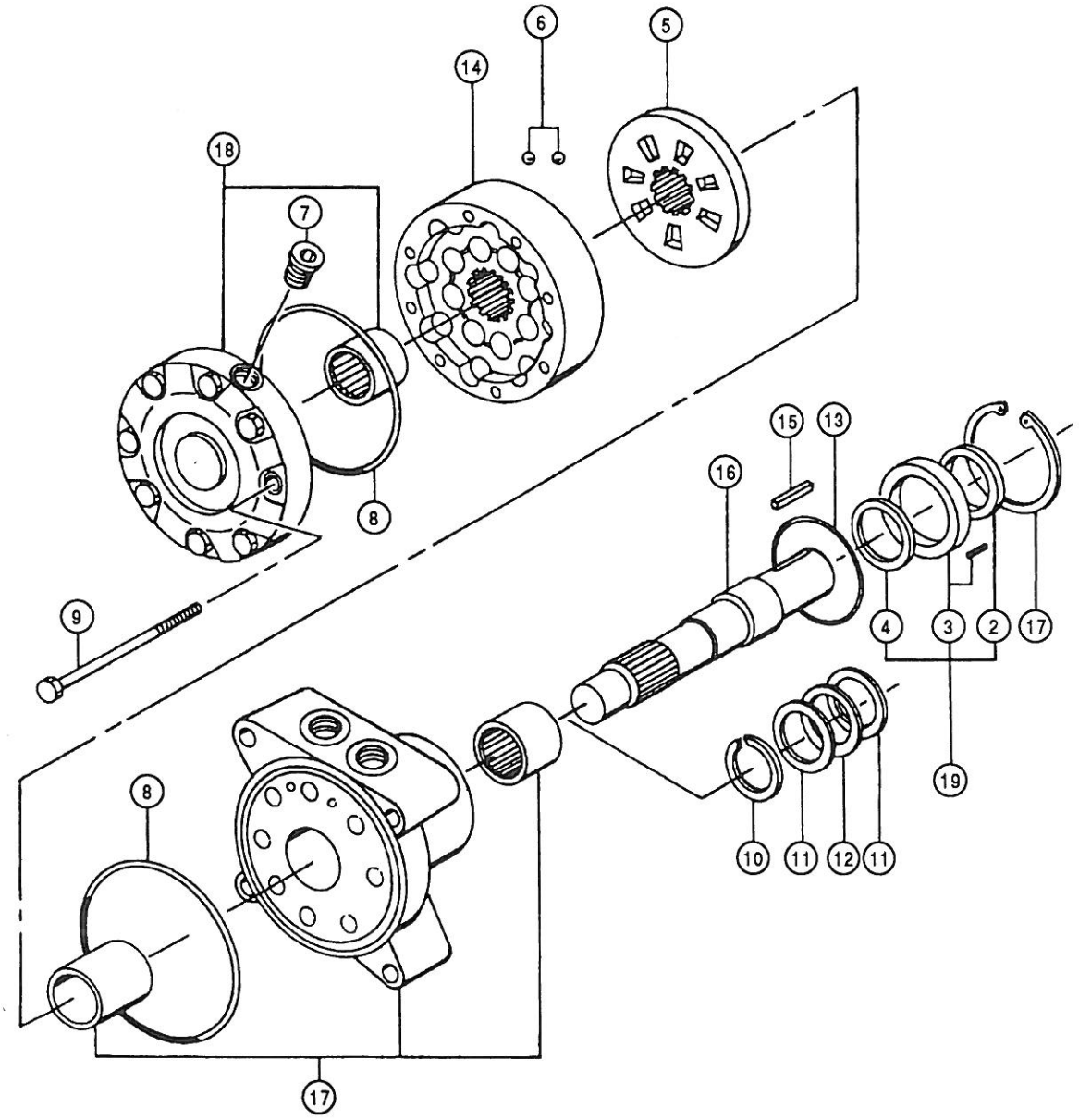
- Prior to assembly, all parts must be cleaned with a suitable solvent and free of nicks and burrs.
- Mount the body with the pilot and bearing facing up in a vise or other holding mechanism.
- Insert shaft (16) and install seals and thrust bearings as per *Main Shaft Seal and/or Shaft Replacement*, Instruction B.
- Mount the body with the pilot and bearing facing down in a vise or other holding fixture.
- Place the valve plate (5) on the shaft spline with the "T" shaped slots on first.
- Put the IGR inner member on the shaft spline with the semi-circular roll pockets between the rotary valve ports.
- Place the contour member of the IGR over the inner member and insert seven rolls into the inner pockets (large diameter rolls).
- Lightly oil the square ring seal (8) and place in the body groove.
- Place the check valve balls (6) over the two 1/8" diameter holes in the body. Be sure the check valve balls do not fall into the body tapped holes.
- Place the locating ring section (4.5 inch diameter) of the IGR (14) onto the body with the check valve ball holes facing downward over the balls. Align the eight bolt holes in the locating ring with the eight holes in the body. The holes align in only one position.

**Note**: Be sure not to dislodge the body square ring seal while moving the locating ring.

- Install the eight locating ring rollers (small diameter rolls) into their pockets and oil lightly.
- Place the other lightly oiled square ring seal (8) into the groove in the cover. Place the cover assembly (18) over the shaft end and align the bolt holes.
- Install the eight bolts (9) with the lightly oiled thread ends into the bolt holes and tighten diagonally to 30 foot-pounds (41Nm). (If current motor had bolt washers, install bolts with new washers.) The motor is now ready for installation.
- Shaft may not turn freely after assembly. A short running period may be required.

**Note**: On tapered shafts, torque castle nut to 80-90 foot-pounds (108-122Nm), then continue tightening nut until the cotter pin slot lines up with the shaft cross-hole.

# Wheel Motor Legend




| Index No. | Description | Quantity |
|---|---|---|
| 1* | Snap Ring 1.25 | 1 |
| 2* | Dust Seal 1.312 | 1 |
| 3* | Retainer With Pin | 1 |
| 4* | Lip Seal 1.312 | 1 |
| 5 | Valve Plate | 1 |
| 6 | Check Valve Ball | 2 |
| 7 | Plug Hollow Hex 7/16-20 | 1 |
| 8* | Square Ring Seal | 2 |
| 9 | Bolts 5/16-24 | 8 |
| 10 | Snap Ring HD 1.25 | 1 |
| 11 | Thrust Washer TRC-2031 | 2 |

| Index No. | Description | Quantity |
|---|---|---|
| 12 | Thrust Bearing NTA-2031 | 1 |
| 13 | O-ring Seal 2.033 | 1 |
| 14 | IGR Assembly 7110 16.4 cubic inch/revolution | 1 |
| 15 | Key 0.312 X 1.0 | 1 |
| 16 | Shaft 1-1/4 Inch Taper | 1 |
| 17 | Body 4 Bolt With Tapped Holes | 1 |
| 18 | Cover Assembly With Bearing | 1 |
| 19 | Seal/Retainer Assembly | 1 |

* Seal Kit, Genie Part No. 19543, Contains Parts Indexes 1, 2, 3, 4 and 8 (Quantity: 2).

# Joystick Controller Adjustments

Adjustments are provided to set Threshold current and Maximum Output current. By setting the following adjustments correctly, you can obtain fully proportional valve control over the entire handle deflection.

Note: Adjust Threshold voltage prior to adjusting Maximum Output voltage.

## Threshold Adjustment.

This adjusts threshold voltage as the controller first turns on. Move the handle so the controller just turns on. Turn the Threshold trimpot screw clockwise until the function starts to respond, then turn the screw counterclockwise one turn. This provides minimum dead band. If the function starts to move too soon when the handle is moved, turn the Threshold adjustment further counterclockwise.

## Max-Out Adjustment.

This adjusts the Maximum Output voltage when the controller handle is fully deflected. To adjust, deflect the handle fully in either direction. Turn the Max-Out trimpot counterclockwise until the function begins to slow down. Now turn the trimpot one to two turns clockwise. If slower maximum function speed is desired, turn the Max-Out adjustment counter-clockwise until the desired maximum function speed is obtained.

**Notes:**

- The specified maximum speed of the V-4M lift is 1.8 km/h (5 meters in 10 seconds).
- The trimpots require 15 turns to travel from end to end. It may be necessary to turn the adjusting screw a number of turns (five or more) before a change in the output is noticeable. A clutch mechanism in the trimpot prevents damage due to over-rotation.

# General Troubleshooting

To use this section a maintenance person should be trained in the operation of the machine and have the use of the following tools and test equipment:

- Volt/ohm meter (multimeter)
- 0-3000 psi (0-207bar) pressure gauge
- A full complement of standard and metric hand tools.

**Note**: Various degrees of a particular function loss may occur. For example, "ELEVATE Up Function Inoperative". This should mean "Elevate cylinders will not extend with the same speed or power of a properly functioning machine."

## Before Performing Machine Tests:

- ☑ Read, understand and obey the safety rules and operating instructions in the *Genie V-4M Operating Instruction Manual.*
- ☑ Make certain the machine is on a firm, level surface.
- ☑ Read and understand the *Theory Of Operation,* pages 2 and 3.
- ☑ Some components mentioned in this section carry schematic legend references that can be found on pages 19 through 25.
- ☑ When testing the drive system, jack drive wheels off ground and chock rear wheels to secure machine from rolling.

| Symptom. | Cause. | Remedy. |
|---|---|---|
| 1.<br>- All functions inoperative<br>- Motor does not run | A. Charging function shut-off feature. | A. Be sure charger is not plugged into AC outlet. |
| | B. Circuit breaker (CB1) tripped. | B. Reset circuit breaker (CB1); check for shorts or defects. |
| | C. 200A fuse (F1) blown or defective. | C. Check fuse (F1) for open circuit or defects; repair or replace. |
| | D. Ground control power button (P1) in off position or defective. | D. Pull power button up, check for proper continuity; repair or replace. |
| | E. Load limit feature is opening circuit to keyswitch. | E. Check for overloaded platform or defective load limit relay (C6). |
| | F. Keyswitch in Off position or defective. | F. Be sure keyswitch is in Ground or Platform position and check for proper continuity; repair or replace. |
| | G. Charging function shut-off relay (C4) failure. | G. Check relay (C4) for proper continuity; repair or replace. |
| | H. Batteries have insufficient charge. | H. Check battery condition, specific gravity, load test; recharge or replace. |
| | I. Charger not properly charging batteries. | I. Plug charger into AC outlet, check amp gauge and voltage. See *Battery Charger Operation* and *Troubleshooting*, pages 4 and 17. |
| | J. Motor start relay (C1) defective. | J. Check for proper continuity; repair or replace. |
| | K. Power unit electric motor (M1) defective. | K. Check for voltage and ground potential; repair or replace. |

| Symptom. | Cause. | Remedy. |
|---|---|---|
| **2.**<br>- All functions inoperative<br>- Motor runs | A. Hydraulic oil level low. | A. Check oil level; replenish if necessary. |
| | B. Relief valve (item B) in P1 hydraulic circuit failed. | B. Check for proper adjustment and/or defects; repair or replace. |
| | C. All directional valves not functioning. | C. Check manifold valves ground ("-") wiring harness for proper continuity to battery negative. |
| | D. Inadequate pump output. | D. Check flow and pressure of both P1 and P2 pump stages; repair or replace.<br>Check electric motor to pump coupling. |
| **3.**<br>- STEER function works<br>- All other functions inoperative<br>- Motor runs | A. Proportional valve (item I) not opening. | A. Check proportional valve (item I) for proper voltage and/or defects; clean, repair or replace. |
| | B. Differential sensing valve (item H) is allowing flow to return to tank. | B. Check differential sensing valve (item H) for defects; clean, repair or replace. |
| | C. Inadequate pump output. | C. Check flow and pressure of both P1 and P2 pump stages; repair or replace. |
| **4.**<br>- DRIVE functions inoperative<br>- Motor runs | A. Freewheel valve open or defective. | A. Close free wheel valve or check for defects. |
| | B. Forward (item O) or Reverse (item P) directional valve not receiving proper voltage. | B. Check for proper input and output voltage at DRIVE toggle switch and/or joystick controller; repair circuit or replace defective component. |
| | C. Proportional valve (item I) not receiving proper voltage. | C. Check for proper input and output voltage at DRIVE toggle switch and/or joystick controller; repair circuit or replace defective component. |
| | D. Proportional valve (item I) defective. | D. Check for proper voltage supply and coil resistance (defective if reading is zero or infinity); repair or replace. |
| | E. Parking brake not releasing. | E. Check for proper hydraulic pressure and parking brake operation. |
| | F. Cushion cylinder bypassing internally. | F. Check for internal bypassing of cushion cylinder piston. |

| Symptom. | Cause. | Remedy. |
|---|---|---|
| **4.** Continued<br>- DRIVE functions inoperative<br>- Motor runs | G. One of the two drive motors bypassing internally. | G. Check DRIVE in both High and Low range. If High range operation works, jack up machine; wheel which does not turn is possibly defective. |
| | H. Either of two counterbalance valves (items S and T) could be defective. | H. Inspect counterbalance valves (items S and T); clean or replace. |
| | I. Inadequate pump output. | I. Check flow and pressure of both P1 and P2 pump stages; repair or replace. |
| **5.**<br>- DRIVE functions inoperative<br>- Motor does not run<br>- Symptoms affect ground controls only | A. Defective DRIVE toggle switch. | A. Check DRIVE toggle switch input and output voltage to terminal T31; repair circuit or replace switch. |
| | B. Open diode between terminals T31 and T45. | B. Check for input voltage to diode and open diode; repair circuit or replace diode. |
| **6.**<br>- DRIVE functions inoperative<br>- Motor does not run<br>- Symptoms affect platform controls only | A. Defective joystick controller. | A. Check for input voltage to joystick and output voltage to pump unload relay (C3); repair circuit, repair or replace joystick. |
| | B. Defective pump unload relay (C3). | B. Check pump unload relay (C3) output voltage at terminal T47 and inspect relay (C3) for defects; repair or replace. |
| | C. Open diode between terminals T29 and T45. | C. Check for input voltage to diode and open diode; repair circuit or replace diode. |
| **7.**<br>- STEER function inoperative<br>- Motor runs | A. Steering directional valve (Item E) defective. | A. Check for proper input and output voltage and coil resistance (defective if reading is zero or infinity); repair circuit, clean or replace valve. |
| **8.**<br>- STEER function inoperative<br>- Motor does not run | A. STEER toggle switch and/or joystick rocker switch defective. | A. Check for proper input and output voltage of STEER toggle switch and/or joystick rocker switch; repair circuit or replace defective component. |
| | B. Open diode between terminals T23 and T39 (STEER Right). | B. Check for input voltage at terminal T23 and open diode; repair circuit or replace diode. |
| | C. Open diode between terminals T27 and T43 (STEER Left). | C. Check for input voltage at terminal T27 and open diode; repair circuit or replace diode. |

| Symptom. | Cause. | Remedy. |
|---|---|---|
| **9.**<br>- ELEVATE Up function inoperative<br>- Motor runs | A. Manual descent valve (item V) open or defective. | A. Close valve (item V) or inspect for defects; repair or replace. |
| | B. ELEVATE Up directional control valve (item J) not receiving proper voltage. | B. Check for proper input and output voltage at ELEVATE toggle switch and/or joystick controller; repair circuit or replace defective component. |
| | C. ELEVATE Up directional control valve (item J) defective. | C. Check for proper input voltage and coil resistance (defective if reading is zero or infinity); clean valve or replace defective component. |
| | D. Proportional valve (item I) not receiving proper voltage. | D. Check for proper input and output voltage at ELEVATE toggle switch and/or joystick controller; repair circuit or replace defective component. |
| | E. Maximum elevate limit switch (LS2) defective. | E. Check if limit switch (LS2) is being depressed prior to maximum elevation—check for defects; repair or replace. |
| | F. Lift relief valve (item W) not properly adjusted or defective. | F. Check lift relief pressure adjustment (item W); clean or replace. |
| | G. Check valve (items L and/or M) defective. | G. Inspect check valves (items L and M); clean or replace. |
| | H. One of the two elevate cylinders bypassing internally. | H. Isolate each cylinder individually and test function; repair or replace. |
| **10.**<br>- ELEVATE Up function inoperative<br>- Motor does not run | A. ELEVATE toggle switch and/or joystick controller defective. | A. Check for proper input and output voltage at ELEVATE toggle switch and/or joystick controller; repair circuit or replace defective component. |
| | B. Open diode between terminals T25 and T41. | B. Check for proper input voltage and open diode; repair open circuit or replace diode. |

| Symptom. | Cause. | Remedy. |
|---|---|---|
| **11.**<br>- ELEVATE Down function inoperative | A. ELEVATE toggle switch and/or joystick controller defective; auxiliary lower will work. | A. Check for proper input and output voltage at ELEVATE toggle switch and/or joystick controller; repair circuit or replace defective component. |
| | B. ELEVATE Down directional valve (item F) defective; auxiliary lower will work. | B. Check for proper input voltage, coil resistance (defective if reading is zero or infinity) and proper valve operation; clean, repair or replace. |
| | C. Flow control valve (item G) clogged or defective; auxiliary lower will not work. | C. Clean or replace flow control valve (item G). |
| **12.**<br>- Load limit malfunction<br>- Does not shut-off all functions when weight in platform exceeds rated capacity | A. Pressure switch defective or improperly adjusted. | A. Check that pressure switch contacts close at 1475 psi (102bar); repair or replace. |
| | B. Load limit relay (C6) defective. | B. Check for proper input voltage when pressure switch closes and proper relay function; repair circuit or replace relay. |
| | C. Load limit bypass relay (C5) defective. | C. Check for proper voltage inputs and proper relay function; repair circuit or replace relay. |
| **13.**<br>- Load limit malfunction<br>- All functions shut-off when weight in platform is less than rated capacity | A. Pressure switch defective or improperly adjusted. | A. Check that pressure switch contacts close at 1475 psi (102bar); repair or replace. |
| | B. Diode on load limit relay (C6) shorted. | B. Check for proper input voltage when pressure switch closes and proper relay function; repair circuit or replace relay. |
| | C. Load limit relay (C6) defective. | C. Check for proper voltage inputs and proper relay function; repair circuit or replace relay. |
| **14.**<br>- Battery Charger malfunction | | See *Battery Charger Troubleshooting* on the next page. |

# Battery Charger Troubleshooting

## Before Performing Tests:

- ☑ Disconnect both the AC and DC lines.
- ☑ Remove the screws on each side of the charger and lift the cover off.
- ☑ Make sure that all the charger internal connections are secure and tight.
- ☑ Refer to the battery charger electrical schematic and compare the charger being tested to locate the described test points.

## Test for correct AC voltage available at transformer.

- Connect the AC line to a live outlet.
- **110V Setting:**

  Verify AC line voltage (110-127V AC) by measuring across terminals 5-6 and 7-8 on the transformer.
- **230V Setting:**

  Verify AC line voltage (215-245V AC) by measuring across terminals 5-8 on the transformer.
- Repair or replace AC line with plug, AC fuse and/or AC fuse holder or power switch assembly as necessary.

## Test for correct AC voltage at transformer auxiliary coil.

- Verify that approximately 26-30V AC is measured across terminals 9-12 on the transformer.
- Unplug the electronic timer assembly and verify this same voltage across the control cable assembly electronic timer edge connector contacts 4-6.
- One-half of this measured voltage should appear across transformer terminals 9-10 and 11-12.
- With the electronic timer assembly unplugged the same reading should also appear across plug contacts 3-4, 3-6, 7-4, 7-6, 9-4 and 9-6.

## Test for correct AC voltage at transformer secondary.

- Verify that approximately 58-64V AC is measured across transformer secondary terminals 1-4.
- One-half of this measured AC voltage should also appear across the transformer coil center tap and each end, transformer terminals 1-2 and 3-4.
- Transformer failure is indicated when the measured AC voltages are significantly lower than specified.

## Test for complete circuit from charger to batteries.

- Connect charger DC line to batteries.
- Verify that approximately 24-26V is measured across all four batteries.
- Make sure this same battery pack voltage (about 24V) is measured across where the red wire connects to the shunt ("+", positive), and transformer terminals 2 and 3 ("-", negative).
- If the correct battery voltage does not appear inside the charger, test the following circuits until the open is identified and repair or replace:
  - Charger DC line
  - Charger DC fuse and/or fuse holder
  - Charger control cable assembly with shunt resistor
  - Charger ammeter

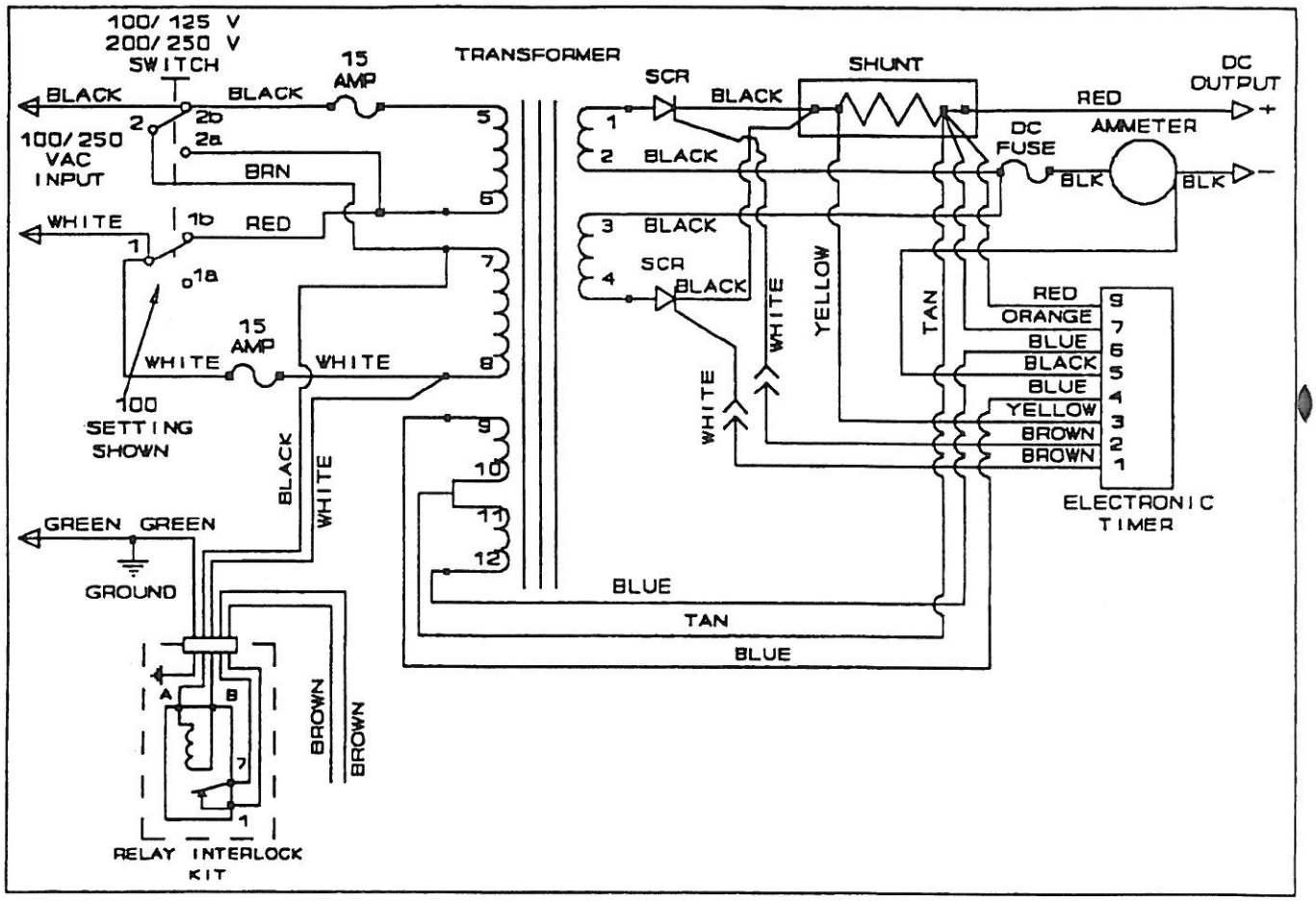
## Check electronic timer connections.

- Unplug the connector from the electronic timer assembly. Inspect the plug contacts for distortion, corrosion or other conditions that would prevent electrical contact with the pads on the electronic timer assembly. Test all of the leads of the control cable assembly for an open circuit.
- If all of the above test in good condition and the charger still has no output, the only two components remaining are the SCR assemblies and the electronic timer assembly.
- The complexity of the electronic timer assembly prohibits field service. Replacement with a known good timer for test purposes is the only alternative. For this reason, it is essential to have a spare timer assembly on hand when troubleshooting.

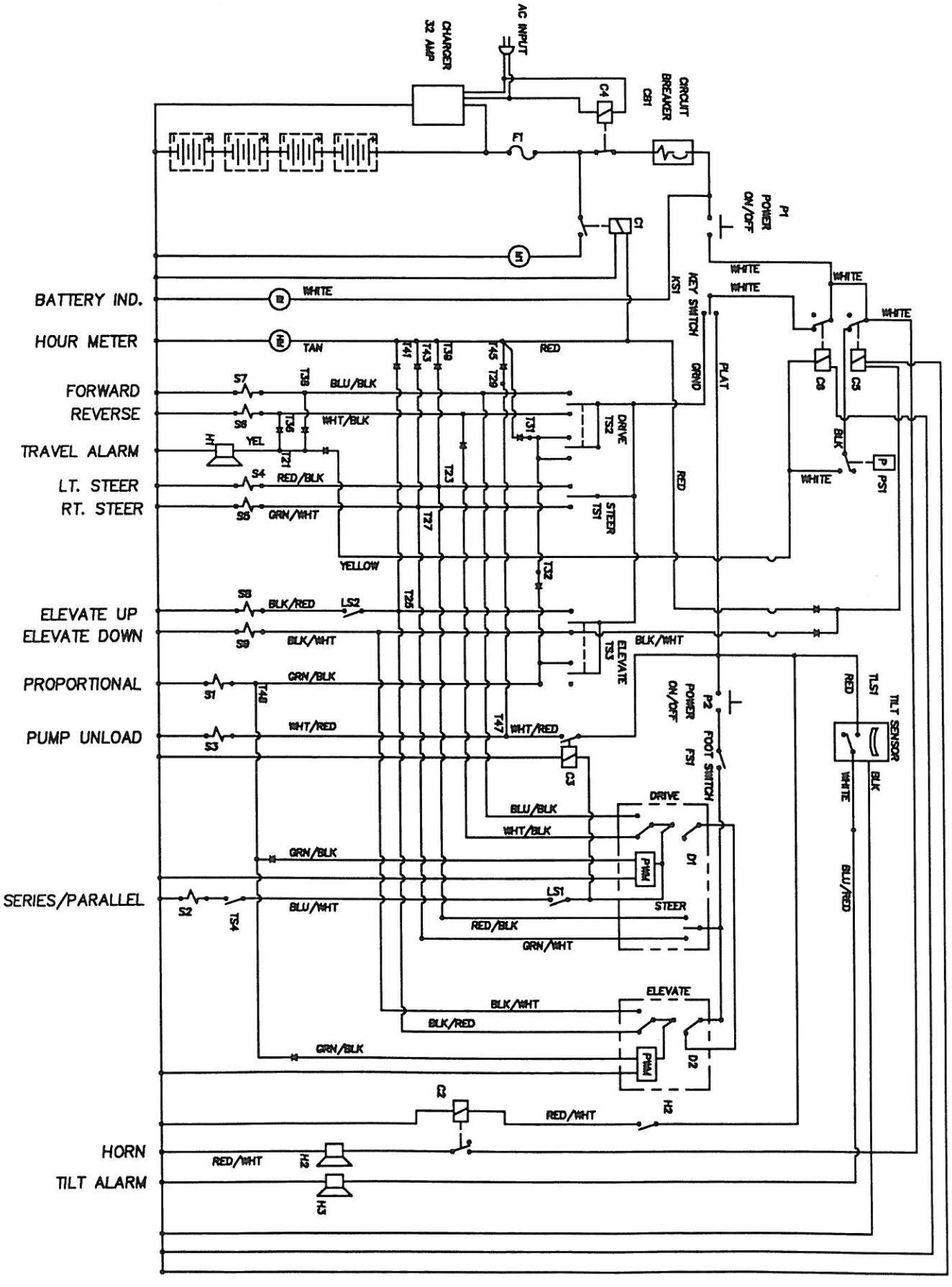
# Check SCR Operation.

- The feedback control design of the charger makes it possible for one of the SCRs in the SCR assembly to not function and the charger to still have some output. This condition can be detected by checking the temperature of the separate SCRs and replacing the complete assembly if one of the SCRs feels cold and the other hot. This condition may also suggest its presence by continual melting of the DC fuse.

# Battery Charger Electrical Schematic.

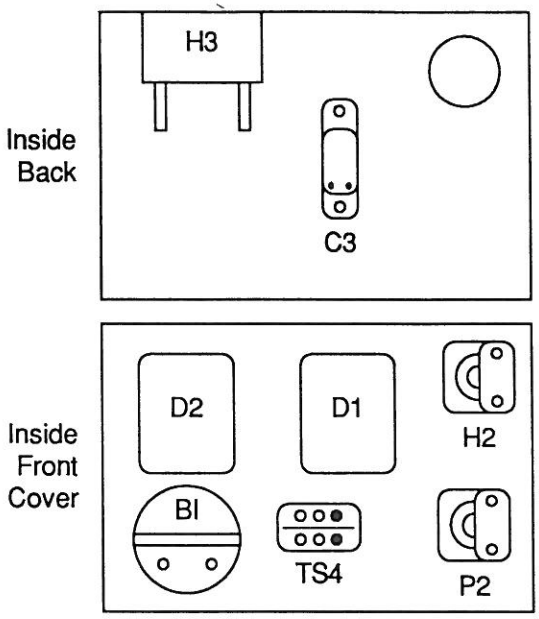


# Electrical Schematics

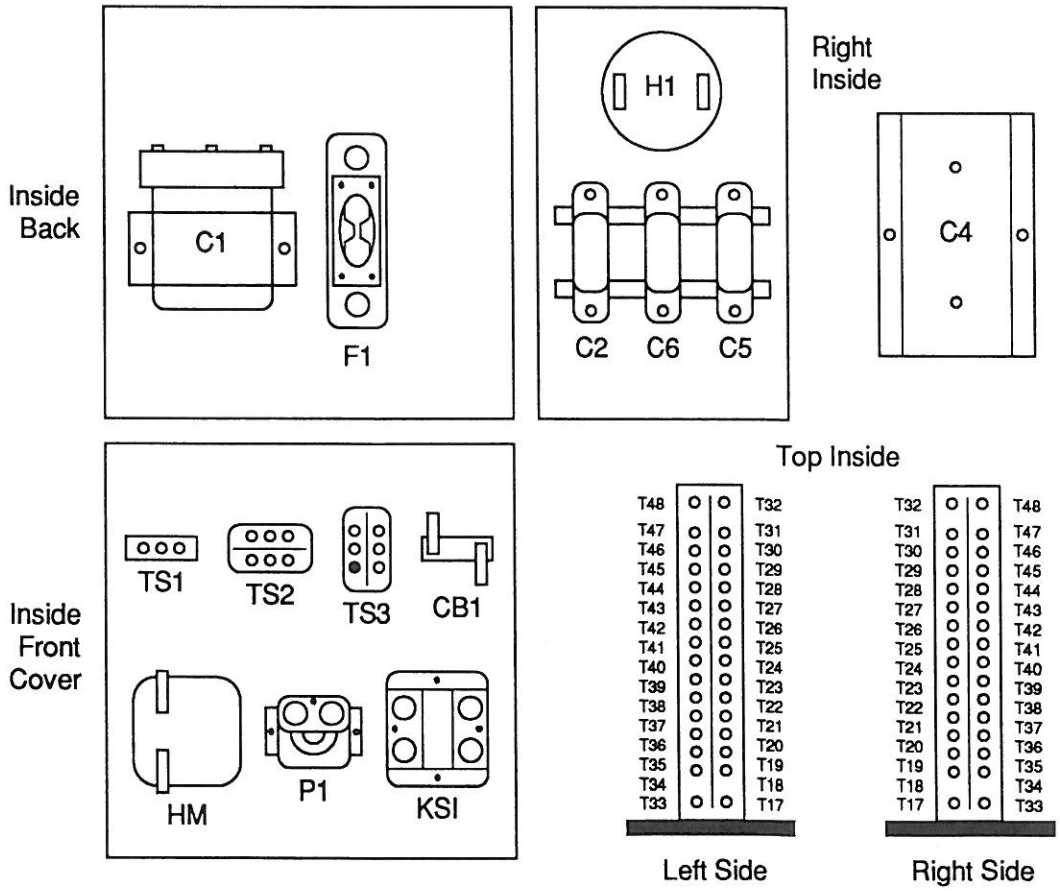


# Electrical Schematic Legend

## Platform Control Panel



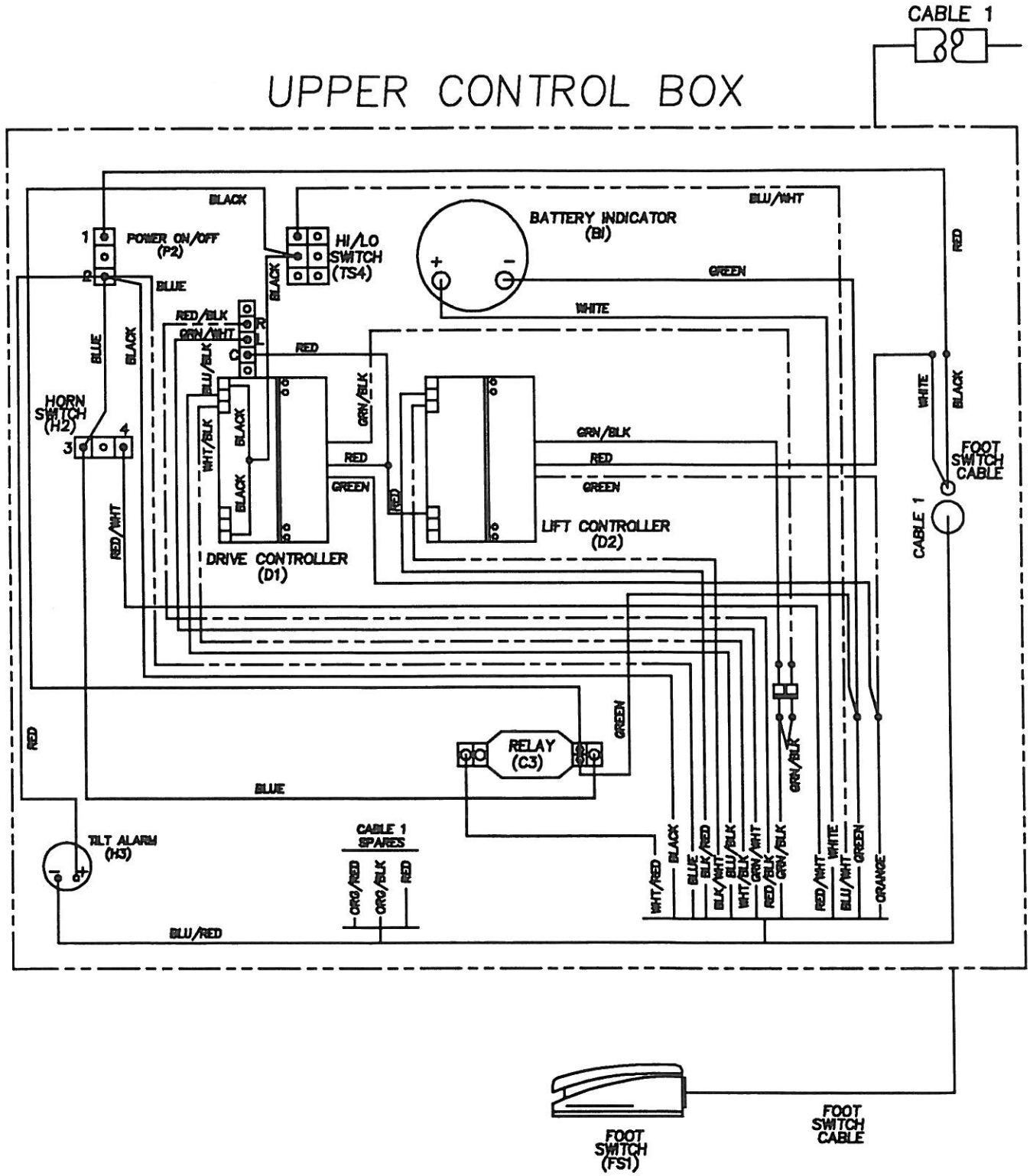

## Ground Control Panel

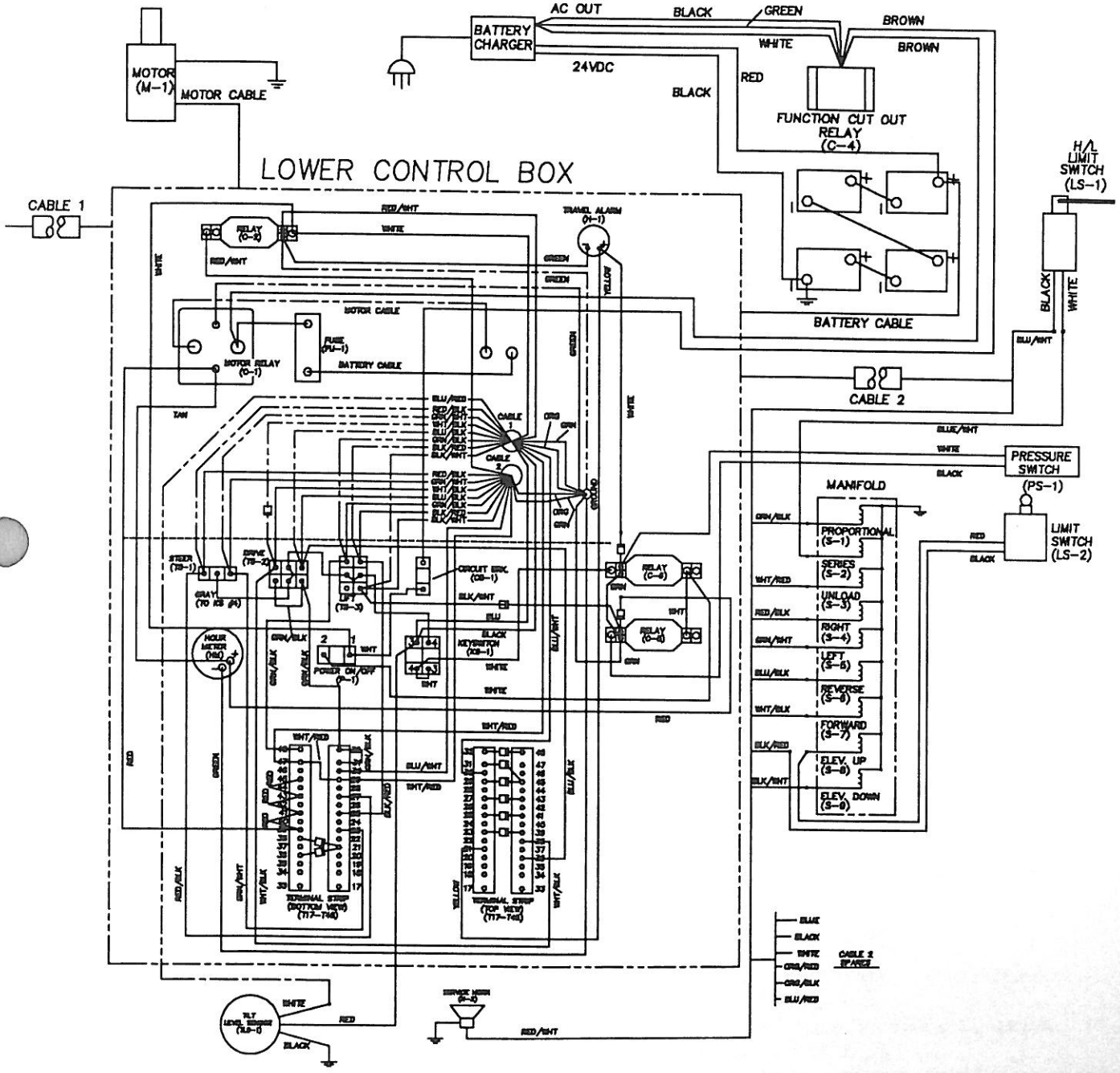


# Electrical Schematic Legend

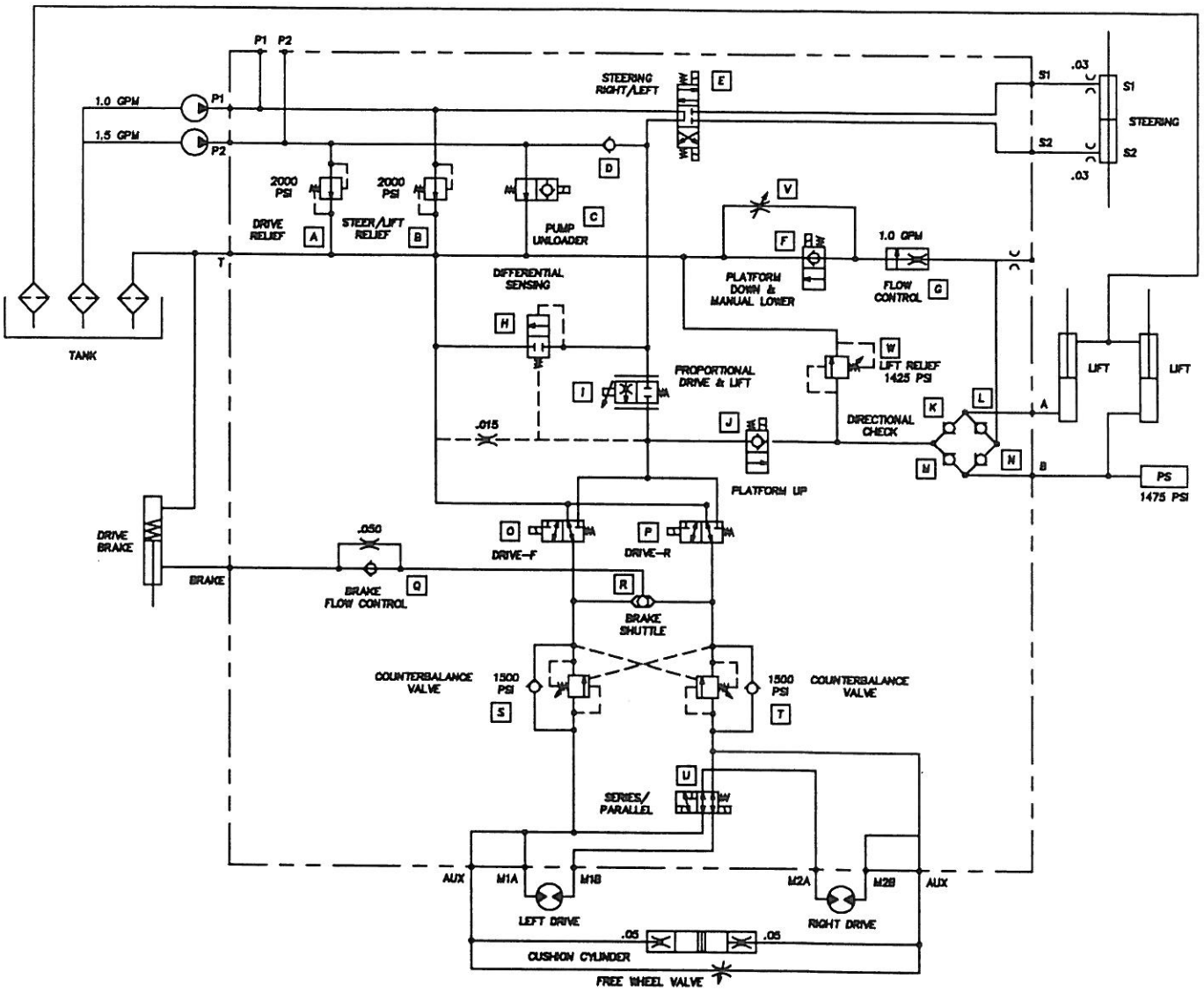
| | | |
|---|---|---|
| BI | Battery Charge Indicator | Platform Control Panel |
| CB1 | Control Circuit 10A Circuit Breaker | Ground Control Panel |
| C1 | Motor Start Relay, 24V | Ground Control Box |
| C2 | Service Horn Relay, 24V | Ground Control Box |
| C3 | Pump Unload Relay, 24V | Platform Control Box |
| C4 | Charging Function Shut-off Relay, 110V | Ground Control Box |
| C5 | Load Limit Bypass Relay, 24V | Ground Control Box |
| C6 | Load Limit Relay, 24V | Ground Control Box |
| D1 | DRIVE Forward/Reverse Proportional Control Joystick with STEER Left/Right Thumb Rocker Switch | Platform Control Panel |
| D2 | ELEVATE Up/Down Proportional Control Joystick | Platform Control Panel |
| F1 | Power Circuit Fuse, 200A | Ground Control Box |
| FS1 | Foot Switch | Platform |
| H1 | Travel And Load Limit Alarm | Ground Control Box |
| H2 | Service Horn Button | Platform Control Panel |
| H2 | Service Horn | Chassis |
| H3 | Tilt Alarm | Platform Control Box |
| HM | Hour Meter | Ground Control Panel |
| KS1 | Keyswitch - Select Ground or Platform Controls | Ground Control Panel |
| LS1 | DRIVE Speed Limit Switch (shown with Platform up) | Chassis |
| LS2 | ELEVATE Limit Switch (shown at Maximum Elevate) | Midpoint of Elevate Linkage |
| M1 | Hydraulic Power Unit Motor | Chassis |
| P1 | POWER On/Off Button | Ground Control Panel |
| P2 | POWER On/Off Button | Platform Control Panel |
| PS1 | Load Limit Pressure Switch | Hydraulic Manifold |
| PWM | Joystick Variable Voltage Output | Platform Control Box |
| S1 | Proportional Control Solenoid | Hydraulic Manifold |
| S2 | DRIVE Speed High/Low Control Solenoid | Hydraulic Manifold |
| S3 | Pump Unload Control Solenoid | Hydraulic Manifold |
| S4 | STEER Right Directional Control Solenoid | Hydraulic Manifold |
| S5 | STEER Left Directional Control Solenoid | Hydraulic Manifold |
| S6 | DRIVE Reverse Directional Control Solenoid | Hydraulic Manifold |
| S7 | DRIVE Forward Directional Control Solenoid | Hydraulic Manifold |
| S8 | ELEVATE Up Directional Control Solenoid | Hydraulic Manifold |
| S9 | ELEVATE Down Directional Control Solenoid | Hydraulic Manifold |
| T17-T48 | Wiring Connection Terminals | Ground Control Box |
| TLS1 | Tilt Level Sensor | Chassis |
| TS1 | STEER Left/Right Toggle Switch | Ground Control Panel |
| TS2 | DRIVE Forward/Reverse Toggle Switch | Ground Control Panel |
| TS3 | ELEVATE Up/Down Toggle Switch | Ground Control Panel |
| TS4 | DRIVE Speed High/Low Toggle Switch | Platform Control Panel |

# Electrical Diagrams

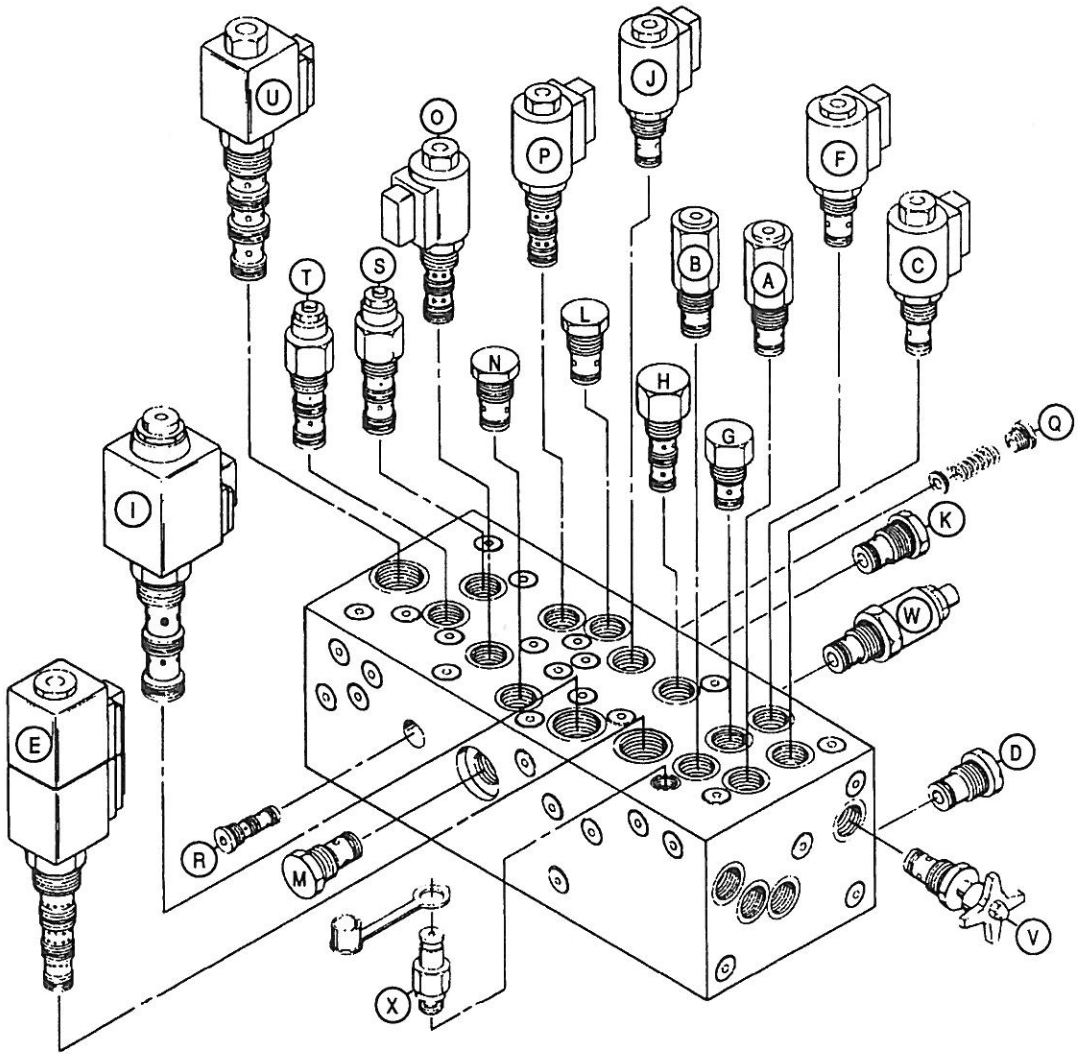



LOWER CONTROL BOX
MOTOR (M-1)
MOTOR CABLE
BATTERY CHARGER
AC OUT
BLACK
GREEN
BROWN
WHITE
BROWN
24VDC
RED
BLACK
FUNCTION CUT OUT RELAY (C-4)
H/L LIMIT SWITCH (LS-1)
CABLE 1
BATTERY CABLE
CABLE 2
PRESSURE SWITCH (PS-1)
MANIFOLD
LIMIT SWITCH (LS-2)
PROPORTIONAL (S-1)
SERIES (S-2)
UNLOAD (S-3)
RIGHT (S-4)
LEFT (S-5)
REVERSE (S-6)
FORWARD (S-7)
ELEV. UP (S-8)
ELEV. DOWN (S-9)
MOTOR RELAY (C-1)
FUSE (FU-1)
BATTERY CABLE
CIRCUIT BRK. (CB-1)
KEYSWITCH (KS-1)
POWER ON/OFF (P-1)
HOUR METER (HM)
TRAVEL ALARM (H-1)
RELAY (C-2)
RELAY (C-3)
RELAY (C-5)
TERMINAL STRIP (BOTTOM VIEW) (TB7-TB8)
TERMINAL STRIP (TOP VIEW) (TB7-TB8)
TILT LEVEL SENSOR (MS-1)
CABLE 2 (PARTIAL)

# Hydraulic Schematic



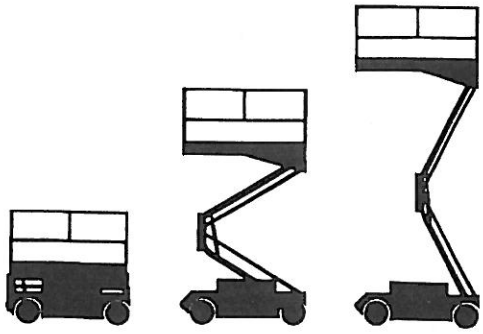
# Hydraulic Schematic Legend




| Index No. | Description | Function |
|---|---|---|
| A | Relief Valve 2000 psi (138bar) ..... | Maximum pressure valve for DRIVE |
| B | Relief Valve 2000 psi (138bar) ..... | Maximum pressure valve for ELEVATE and STEER |
| C | Solenoid Valve 2 Pos. 2 Way ..... | Closes combining pump stage P2 with P1 for DRIVE |
| D | Check Valve ..... | Isolates unloader valve from pump stage P1 |
| E | Solenoid Valve 3 Pos. 4 Way ..... | Directional valve for STEER functions |
| F | Solenoid Valve 2 Pos. 2 Way ..... | Directional valve for ELEVATE Down |
| G | Flow Control Valve ..... | Pressure compensated 1 gpm flow rate for descent |
| H | Differential Sensing Valve ..... | Allows excessive oil back to tank |
| I | Solenoid Valve Proportional ..... | Controls flow to DRIVE circuit and ELEVATE circuit |
| J | Solenoid Valve 2 Pos. 2 Way ..... | Directional valve for ELEVATE Up |
| K, L, M & N | Check Valve (4) ..... | ELEVATE cylinder pressure holding and cylinder isolation |
| O | Solenoid Valve 2 Pos. 3 Way ..... | Directional valve for DRIVE Forward |
| P | Solenoid Valve 2 Pos. 3 Way ..... | Directional valve for DRIVE Reverse |
| Q | Check Orifice ..... | Provides delay before Parking Brake applies |
| R | Mini Shuttle Valve ..... | Provides pressure to release Parking Brake |
| S & T | Relief Valves 1500 psi (103bar) ..... | Counterbalance valves for hydrostatic braking |
| U | Solenoid Valve 2 Pos. 4 Way ..... | Directional valve for High/Low (series/parallel) |
| V | Needle Valve ..... | Emergency manual ELEVATE Down |
| W | Relief Valve 1425 psi (98bar) ..... | Maximum pressure For ELEVATE Up |
| X | Pressure Gauge Quick-disconnect .... | P1 circuit pressure check (not shown on schematic) |

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