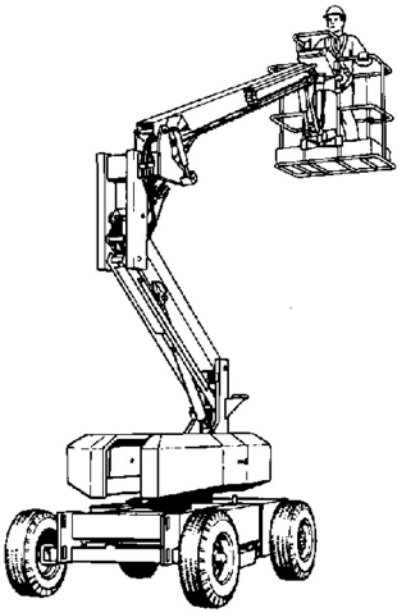
Genie Industries

Technical Publications

Genie® Z-30/20 HD™

Operating and Maintenance Manual



(from serial number 3084-101 to 3090-2213)

Second Edition, First Printing
Part No. 139381 (Rev A)
June 2008

Genie BOOM Z-30/20
Operating and Maintenance Manual

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RECORD OF CHANGES

CHANGE NUMBER	DATE	TITLE OR BRIEF DESCRIPTION OF CHANGE	UNIT SERIAL NO.	ENTERED BY

1.1 PURPOSE

This manual provides instructions for the operation and maintenance of the Genie Boom Z-30/20. After reading this manual, be sure to keep it as a ready reference. Please contact our Service Department at 18340 N.E. 76th Street, Redmond, Washington 98052, or call toll free 1-800-426-8089 for any further information. We are happy to help you and can answer any questions you may have about your Genie Boom.

All information, illustrations, and product description contained in this manual are valid at the time of publication.

Genie Industries reserves the right to make changes in design or to make additions to or improvements in its products without imposing any obligations upon itself to install them on its products previously manufactured.

1.2 SCOPE

This manual contains the information required to allow proper use, the correct maintenance intervals, and procedures to maintain the unit in a safe operating condition. The functions cover scheduled maintenance, troubleshooting, repair/replacement, and adjustment.

1.3 ITEM DESCRIPTION

The Genie Boom Z-30/20 is a one-man self-propelled integral-frame boom-supported elevating work platform which articulates, rotates, and telescopes above and beyond the base dimensions to position personnel, along with their tools and materials, at the work location. It has a maximum platform height of 30 feet and a maximum horizontal reach of 20 feet from a vertical elevation of 14 feet. Boom travel is from -4 to +79 degrees from horizontal, unrestricted. The unit can be driven through a 6' X 6’8" doorway.

Power for all functions is provided by stored electrical energy. Lift mode and steering functions are operated by a hydraulic pump which is powered by an electric motor to deliver fluid power to hydraulic actuators.

Drive speed and direction of travel are electrically powered by a separate electric motor through which voltage is controlled by use of a silicon controlled rectifier (SCR). The unit has infinitely variable drive speed from 0 to 4 miles per hour and has 25% gradeability with platform fully lowered. Drive speed and torque with platform elevated is decreased to comply with ANSI A92.5, 1980. Effective ground clearance is seven inches, and forklift sockets are provided. Ground controls are located on the turntable for operating all boom and turntable functions in case of emergency. A hand pump is also provided to operate all boom, turntable and steering functions in the event of total power loss.

LEADING PARTICULARS

GENIE BOOM SPECIFICATIONS

MODEL		Z-30-20	Z-30-20 HD
Height-working. max.	U.S. - ft.	37	38
	Metric-m	11.28	11.58
Height-platform. max.	U.S. - ft.	30	31
	Metric-m	9.14	9.45
Height-stowed	U.S. - ft.	6' 7"	6' 7"
	Metric-m	2.01	2.01
Horizontal reach - max.	U.S. - ft.	20	20
	Metric-m	6.10	6.10
Width	U.S. - ft.	5' 11"	5' 11"
	Metric-m	1.80	1.80
Length - stowed	U.S. - ft.	13' 6"	16' 6"
	Metric-m	4.11	5.03
Lift capacity (unrestricted)	U.S. - ft.	300	500
	Metric-kg.	136	226
Wheelbase	U.S. - ft.	6	6
	Metric-m	1.83	1.83
Turning radius (outside)	U.S. - ft.	14	14
	Metric-m	4.26	4.26
Turning radius (outside)	U.S. - ft.	7	7
	Metric-m	2.13	2.13
Turret rotation	Degrees	360°	360°
Turret tailswing		Zero	Zero
Power source		36V DC	36V DC
Batteries		Six 6V 220 Ah	Six 6V 220 Ah
Travel speed - stowed	U.S. - mph	0 - .4	0 - .4
	Metric - km/h	0 - 6.5	0 - 6.5
Travel speed - raised	U.S. - mph	0 - .6	0 - .6
	Metric - km/h	0 - 1	0 - 1
Controls		SCR	SCR
Platform dimensions (length x width)	U.S.- in.	30" x 24"	30" x 24"
	Metric - m	.76 x .60	.76 x 1.60
Platform leveling		Gravity	Self - leveling
Platform rotation	Degrees	n/a	150°
AC outlet in platform		standard	standard
Hydraulic operating pressure	U.S. - PSI	2000	2000
	Metric - kPa	13800	13800
Tires		7: 00 x 15LT	11L- 15
Gradeability		25%	20%
Ground clearance	U.S. - in	5 1/2"	5 1/2"
	Metric - m	.14	.14
Hydraulic reservoir capacity	U.S. - gal	2.5	2.5
	Metric - l	9.5	9.5
Weight. gross	U.S. - lb	5500	8500
	Metric - kg	2495	3855

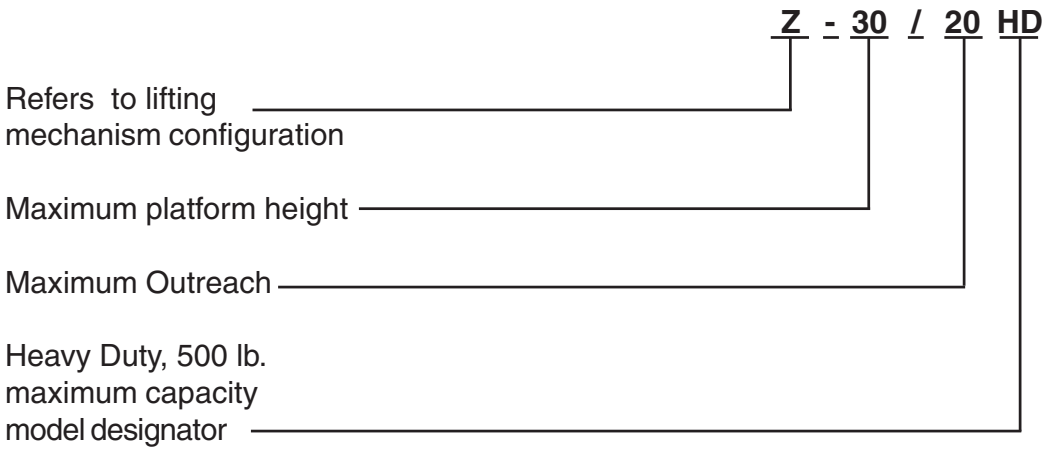
CONSUMABLE MATERIALS

LOCATION	MATERIAL	DESCRIPTION
Hydraulic Reservoir	Hydraulic Fluid	Shell Tellus 46
Differential	Gear Oil	SAE 90 multipurpose Gear Lubricant, API Service classification GL-5
Fasteners	Thread Adhesive	Loctite Removable Thread Locker 242
Painted Surfaces	Finish	Rudd 91- 869, Blue Rudd 91- 841, Grey
SCR Mounting	Heat Transfer Grease	Dow Corning 340
Front Wheel Hubs	Wheel Bearing Grease	Texaco Marfax (or equivalent multipurpose lithium grease)

1.4 IDENTIFICATION

The Genie Boom Identification Plate is attached to the turntable riser (refer to Figure # 6 6-32 for location). The following information was stamped into each plate at the time of manufacture :

MODEL NO. -



SERIAL NO. -

This number identifies a particular machine with reference to the original owner. This number should always be referred to when requesting information or ordering service parts for the machine

MAX. LOAD. -

This is the maximum platform capacity. It designates the maximum safe load which can be placed on the platform at any time.

PLATFORM HT. -

This is the maximum attainable platform height and is measured from level ground surface to the platform.

VOLTS -

A number stamped into the appropriate box designates the voltage at which the unit operates.

AMPS -

This designation does not apply to DC powered units, as operating amperage is affected by battery voltage

1.5 OPERATION

The Genie Boom 2-30/20 is controlled from the platform by means of a control console which consists of a forward and reverse driving lever and various toggle switches which control the other machine functions. The operator enters the caged platform and drives the unit to the work location. The platform is elevated to the work and the chassis may be repositioned, while the platform is elevated. Platform leveling is gravity self-leveling. In the event of an emergency, the lower central may be used to override the upper controls to operate all turntable and boom functions. In the evert of a power loss the turntable, boom, and steering functions may be operated by means of a manual pump. At the end of each day's use, the integral battery charger must be connected to the appropriate AC source.

2.1 THEORY OF OPERATION

ENERGY SOURCE:

The Genie Boom Z-30/20 is powered by six 6 volt batteries connected in series to provide 36 volt DC power. Each battery is rated at 220 ampere hours at a 20 hour rate.

CHARGING SYSTEM:

A 36 volt 25 amp line compensating battery charger is used to recharge the battery pack after each day's use. The charger utilizes an electronic timing system which automatically sets the timer based on the battery pack state of charge each time the charger is plugged in. The charger also incorporates a resonant transformer which causes the charge rate to taper off as the batteries approach full charge.

HYDRAULIC SYSTEM:

The Genie Boom utilizes fluid power to operate all lift, lower, extend, retract, rotation, and steering functions. Fluid power is provided by a 36 volt DC hydraulic power unit with a 1 gpm pump mounted on the turntable. Any time the electric motor is electrically energized, hydraulic oil flows to the directional control valves also located on the turntable. When electrically energized, the directional control valves direct fluid to the actuators (lift, extension, or steering cylinders and turntable rotation motor) and cause lifting, lowering, extension, retraction, or rotation of the boom assembly and steering left or right. The main system relief valve located at the hydraulic power unit is set at 2000 psi.

Attached to the port end of each boom lifting and extension cylinder is a counterbalance valve. The counterbalance valve is designed to prevent the cylinder from retracting unless hydraulic flow from the pump is directed to the valve assembly applying pressure and causing it to open and allow fluid to evacuate the cylinder. The counterbalance valve will cause the hydraulic cylinders to maintain pressure and prevent free descent in the event a hydraulic line fails. Relief valves set at 1000 psi are installed in the upper boom and lower boom lift cylinder circuits to prevent over pressurization of the lift cylinders during boom descent. These valves are located at the hydraulic valve bank between the directional control valves and the hydraulic manifold. The turntable rotation circuit is protected from over pressurization by a dual cross-over relief valve also located at the hydraulic valve bank between the directional control valve and the hydraulic manifold.

An emergency hand pump located on the turntable allows operation of all hydraulic functions in the event a power loss condition occurs. In order to activate any of the hydraulic functions, the appropriate hydraulic directional control valve spool is depressed and held while pumping the hand pump. A ten micron return line filter located on the turntable removes any particulate contaminants. The filter incorporates "built in" bypass to allow full flow in the event the element becomes clogged.

ELECTRICAL SYSTEM:

The Genie Boom utilizes stored electrical energy and power the hydraulic functions (boom lift, extension, and steering) as well as the drive (speed control forward and reverse) . The electrical system may be divided into two basic operating modes, lift and drive. Each mode consists of a control circuit and a power circuit. The control circuit consists of the components and circuitry required to turn on and off or control other electrical devices. It includes the toggle switches, limit switches, diodes, solenoids, etc., and, because it typically conducts very low current, the small diameter (12 - 16 AWG) wire and multi-wire control cables. The control circuit is depicted on the electrical schematic by thin lines which represent the small diameter control wires connecting the graphic -symbols which represent the control circuit components. The power circuit consists of those items which actually convert stored electrical energy into a mechanical force. It includes the batteries, electric motors, contactors, rectifiers, and, because it must be able to conduct full operating current, the heavy (#2 - #4 welding cable) battery cables. The power circuit is depicted on the electrical schematic by heavy black lines connecting the power circuit components to the batteries.

DRIVE MODE:

The Genie Boom is driven by a 3.5 hp 36 volt DC electric motor. Drive speed and direction of travel (forward or reverse) is controlled by using the accelerator lever located at the platform control station. The accelerator switch assembly consists of a forward and a reverse switch and a potentiometer. The forward and reverse switches control a set of contactors. These contactors, when energized, determine the direction current flows through the field coils of the motor and the direction the motor shaft turns. The motor shaft is coupled directly to an electrically released, spring applied parking brake. The brake must be electrically released for the unit to drive.

The accelerator potentiometer, which is also actuated by the accelerator lever, is the input to the Silicon Controlled Rectifier (SCR). The SCR is used to control the motor speed by controlling the motor voltage. The SCR is a fast acting switch capable of turning on and off hundreds of times a second, has no moving parts, and is able to conduct full load amperage. The SCR conducting, or “on” time, is fixed, and the “off” time decreases as the accelerator lever is moved from its center or neutral position. The further the lever is pushed in either the forward or reverse direction, the shorter the “off” time for the SCR. This pulsing, which occurs too quickly to notice, causes the machine to accelerate to desired drive speed gradually. As the unit approaches full speed, pulsing is no longer required and contactor IA is energized, which bypasses the SCR circuit and connects the electric motor directly to the batteries.

The SCR pulsing is also used to bring the unit to a stop and reverse direction by applying battery current to the motor fields in the opposite direction the armature is turning. This is called plugging and is accomplished by reversing the accelerator lever in the opposite direction the machine is traveling.

Steering is accomplished by actuating the steering toggle switch located at the platform controls. Depressing the steering toggle switch while the Power On switch is energized and the Mode Selector switch is in Drive completes a circuit from a 24 volt tap off the 36 volt battery pack through the steering toggle switch to the printed circuit board located on the turntable. From the circuit board current is split to activate a 24 volt motor starter relay located in the SCR/charger module and a 24 volt hydraulic valve solenoid located at the hydraulic valve bank on the turntable. The starter relay energizes the 36 volt DC hydraulic power unit, and the hydraulic valve directs hydraulic fluid to the steering cylinder which causes the wheels to turn.

LIFT MODE:

The Genie Boom Lift Mode functions include: (1) Primary (upper) boom lifting and lowering, (2) Secondary (lower) boom lifting and lowering, (3) Extension boom extension and retraction, and (4) Turntable rotation, clockwise and counterclockwise. Controls for these functions are located both at the platform control station and the lower turntable control station. In order to perform any of these functions, the appropriate toggle switch must be actuated. When operating the unit from the upper controls, the “Power On” switch must be energized and the Mode selector switch must be in “Lift Mode.” If operating the unit from the lower controls, the “Pump On” toggle switch must be energized and held while actuating the appropriate toggle switch function. The lower controls override the upper controls and will function regardless of upper control inputs. Depressing the toggle switch which controls the desired function (under the previously mentioned conditions) completes a circuit from a 24 volt tap off the 36 volt battery pack through the toggle switch to the printed circuit board located on the turntable. From the circuit board, current is split to energize a 24 volt motor starter relay located in the SCR/charger module at the rear of the chassis and a 24 volt hydraulic valve solenoid coil located at the hydraulic valve solenoid coil located at the hydraulic valve bank on the turntable. The 24 volt relay coil energizes a set of 36 volt contacts which, when closed, completes a circuit from the 36 volt battery pack to the DC hydraulic power unit electric motor. The hydraulic valve solenoid coil, when energized, causes a valve spool to shift in the directional control valve ana allows hydraulic fluid to flow to and from the actuator (lift or extend cylinder or rotation motor). The DC motor starter for the hydraulic power unit must be activated each time any lift, rotation, extension, or steering function is operated. Diodes soldered into the printed circuit board allow the motor starter relay to be energized each time anyone hydraulic valve solenoid is energized but blocks current and prevents any other solenoid from being energized.

3.1 SCHEDULED INSPECTIONS, CHECKS, AND SERVICES

INTERVAL	COMPONENT / LOCATION	INSPECTION / CHECK / SERVICE
Daily	Batteries / Battery Compartment	Check battery electrolyte level. Check battery lead connections. Wipe battery surfaces.
Daily	Battery Charger / SCR, Charger Module	Charge batteries. Check DC fuse links. Check charger amperage output (25 amps).
Daily	Hydraulic Power Unit / Turntable	Check hydraulic fluid level. Check for leaks at power unit and valve bank. Check hose connections.
Daily	Tires and Wheels / Chassis	Check lug nuts for tightness. Check tire pressure (45 psi). Inspect tires and wheel for damage.
Daily	Ground Control Back-up System / Turntable	Check all boom and turntable functions from ground station.
Daily	Boom Z-30 / 20	Visually inspect machine for any damaged or missing parts.
Weekly	Batteries / Battery Compartment Module	Check specific gravity of all cell. Clean battery posts.
Weekly	Rotation Limit Switches / Turntable	Check limit switches and stop relationship. Check hoses and tubes for proper routing through turntable rotation.

INTERVAL	COMPONENT / LOCATION	INSPECTION / CHECK / SERVICE
Monthly	Front Axle MechanisM	Lube front axle linkage.
Monthly	Cylinder / Various	Check rod for damage. Check Seal leakage. Check hoses and fittings. Check mounting.
Monthly	Slide Bearings / Upper Boom Extension Section	Inspect high density polyurethane slide bearings for wear.
6 Months	Hydraulic Oil Filter / Turntable	Replace oil Filter
6 Months	Drive Train / Chassis	Check rear wheel hubs for leaks. Check universal joints.
6 Months	Steering Linkage / Chassis	Check steering wheels for end play and toe in. Inspect steering mechanism for damage.
6 Months	Boom Linkage Pivot Points	Check for wear. Inspect all welds.
2 Years	Hydraulic Power Unit / Turntable	Replace hydraulic fluid.
2 Years	Electric Motors / Turntable Chassis	Check motor brushes.
2 Years	Front Axle / Chassis	Repack front axle bearings.
2 Years	Speed Reducer / Chassis Drive Train	Replace gear oil.
2 Years	Differential/Chassis	Replace gear oil.

3.2 ADJUSTMENTS AND REPAIR

This section contains the procedures and precautions required for adjusting and repairing certain Genie Boom components.

SECTION	DESCRIPTION	PAGE
3.2.1	Front Axle & Steering Mechanism	14
3.2.2	Parking Brak	16
3.2.3	Spice Model 44 Differential	17
3.2.4	Extension Cylinder	18

3.2.1 FRONT AXLE AND STEERING LINKAGE (Figure 6-9)

Do not check or adjust the front wheel alignment without first making the following inspection for front end maladjustments, damage, or wear.

1. Raise the front end off the floor making certain the elevating device does not come in contact with the steering linkage.

2. Grasp each tire at the front and rear and push the wheel back and forth. If any free play is detected relative to the spindle, the wheel bearings must be adjusted.

3. If the free play is attributed to the spindle and tie rod assemblies, replace the worn bearings.

4. Grasp each tire at the top and bottom and rock the wheel while watching for movement on the spindle shaft. If the movement exceeds 1/16", rebush the spindle.

5. Rotate each front tire slowly. Observe the lateral or side runout. If the wheel runout exceeds 1/8", replace the wheel or install that wheel on the rear.

FRONT END ALIGNMENT:

1. Raise the front end off the ground.

2. Position the steering cylinder at mid-stroke using the lower control. This will ensure that the turning radius is identical for both left and right turns.

3. Mark both tires on the centerline at the height of the axle. Record the distance measured from the centerline of one tire to the centerline of the other tire. Rotate both tires 180 degrees and remeasure using the same marks. The two measurements should be the same, plus or minus 1/16". To correct misalignment, remove the tie rod pins at the spindles and loosen the tie rod locking nut.

4. Position both wheels parallel to the chassis and adjust the tie rod clevis to allow installation of the tie rod pin.

5. Repeat Step 3. To adjust toe-in alignment, remove the tie rod clevis pin and turn the tie rod clevis clockwise to toe out, counterclockwise to toe in.

WHEEL BEARING ADJUSTMENT:

If it has been determined, after completing the front end pre-adjustment test, that the wheel bearings require adjustment, complete the following procedure before continuing any further.

1. Remove the dust cap.

2. Wipe off all excess grease and remove the spindle nut cotter pin.

3. While rotating the wheel, torque the spindle nut to 40 ft. lbs. in order to seat the bearings.

4. Stop rotation and back off the adjusting nut to reduce and pre-load.

5. Finger tighten the spindle nut and position the nut with one pair of slots in line with the cotter pin hole.

6. Check front wheel rotation. If the wheel rotates freely with no noticeable end play, install the cotter pin and dust cap. If the wheel is still loose or rotates roughly, the bearing cup and bearing must either be cleaned and repacked or replaced.

BEARING REPACKING:

If bearing adjustment will not eliminate looseness or rough operation, the bearing cone and bearing should be cleaned, inspected, and repacked with wheel grease. If the bearing or cone appear scarred or pitted, they must be replaced.

1. Raise the front end and remove the wheel from the hub.

2. Remove the dust cap, cotter pin, and spindle nut from the spindle. Remove the outer bearing. Pull the hub off the spindle.

3. Remove the grease seal in the hub and the inside bearing and clean all traces of old lubricant from the bearings, cone, and spindle.

4. Inspect the bearing cones inside the hub for imperfections. If cups are worn or damaged, remove them with a drift pin. Clean the inner and outer bearings with solvent and dry thoroughly. (Do not spin bearings dry with compressed air.)

5. Inspect the bearings and cones for cracks, nicks, brinelling, or seized rollers.

6. Install the inner and outer bearing cups in the hub. Be sure to seat the cups properly in the hub. The cups will be properly seated when they are fully bottomed. Pack the inside of the hub with bearing grease. Fill the hub until the grease is flush with the inside diameters of both bearing cups. Pack the bearing cones and rollers with wheel bearing grease. Use a bearing packer for this operation. If a packer is not available, work as much lubricant as possible between the rollers and cages. Lubricate the cone surfaces with grease.

7. Place the inner bearing cone and roller in the inner cup and install the grease seal. Be sure the retainer is fully bottomed. Install the hub on the wheel spindle. Keep the wheel centered on the spindle to prevent damage to the grease retainer or the spindle thread.

8. Install the outer bearing and flat washer on the spindle and tighten the spindle nut. Refer to wheel bearing adjustment for spindle nut installation.

3.2.2 PARKING BRAKE (Figure 6.8, Item 25)

The spring applied electrically released parking brake is designed to hold the unit on any hill it is capable of climbing. Whenever DC voltage is applied to the *coil,* the magnetic field causes the flapper plate to compress four springs which releases the clamping force on the rotor. The rotor is coupled directly to the electric motor output shaft. When voltage is removed from the coil, the springs compress the flapper, which causes a braking effect between the rotor and the friction discs. The parking brake is failsafe and will cause the machine to stop in the event of a power failure.

PERIODIC MAINTENANCE:

Depending on the cycle rate and inertia load, spring set brakes require gap adjustments, since the gap will increase with wear. Adjusting a gap is critical to proper operation and long life. It can be accomplished while on the machine.

AIR GAP ADJUSTING PROCEDURE:

1. Ensure the unit is resting on a smooth, level surface and the wheels are chocked.

2. Insert four pieces of .008 shim stock evenly spaced between the coil and the flapper plate.

3. Adjust the lower adjusting lock nuts clockwise until the coil rests evenly on the four shim inserts.

4. Carefully, without excessive force, adjust the four upper lock nuts down evenly until they meet the coil assembly plate. Make sure the coil has evenly bottomed out on four shims.

5. Adjust the four lower lock nuts evenly in a ·counterclockwise direction and tighten securely against the assembly.

6. All four shims can now be removed. If they have to be removed with force, repeat Steps 2 through 6.

7. Test the unit before shorting the machine by applying the proper voltage. Make sure all four corners of the flapper move when the coil is energized and also that the rotor rotates or moves freely when the coil is energized. If excessive wear of rotor and/or friction discs exists, replace all items at the same time.

8. Improper operation could· be the result of any combination of the following:

    a. Burned out coil
    b. Improper adjustment
    c. Improper voltage applied
    d. Excessively worn friction material
    e. Obstructions jammed between the gap
    f. Improper installation

3.2.3 REAR AXLE (Figure 6-8, Item 6)

The Genie Boom Z-30/20 utilizes a Spicer Model 44 rear axle. The manufacturer's part number at the time .of this printing is 604044-26. Commencing on the following page is the Spicer Axle Maintenance Manual for the Model 44. Please refer to this manual for maintenance instructions.

3.2.4 BOOM EXTENSION CYLINDER (Figure 6-21, Item 48)

REMOVAL:

1. Separate the battery pack quick disconnect connectors located on the chassis side tube on the front end of the unit.
2. Remove the platform assembly. Refer to Figure 6-25.
3. Disconnect the main control cable from the printed circuit board located on the turntable.
4. Disconnect all wires from the platform control station.
5. Disconnect the hydraulic hoses from the extension cylinder.
6. Pull the control cable through the secondary boom and leave loose at the end of the primary (upper) boom tube.
7. Disconnect cylinder mount (Figure 6-21, Item 2) located at the rear of the primary boom tube.
8. Remove the slide block retainers (Figure 6-21, Items 19, 20, and 21) and the slide blocks (Figure 6-21, Items 22 and 23) from the front end of the primary boom tube.
9. Slide the aluminum extension tube forward and out of the front end of the primary boom tube.
10. Remove the eight (8) flathead machine screws (Figure 6-21, Item 35) from the boom tube.
11. Slide the cylinder assembly out of the rear of the extension tube.

BOOM EXTENSION CYLINDER SEAL REPLACEMENT: (Figure 6-22, Item 1)

1. Remove the extension cylinder from the primary boom assembly.
2. Ensure that the chrome finish on the rod is protected at all times.
3. Insert a spanner wrench *in* the drilled holes of the gland nut and rotate 360 degrees.
4. Remove the lock wire, Item 6, by placing a sharp object such as a screw driver under the lock wire to start it out of the cylinder. After the end of the lock wire is exposed, rotate the gland nut using a spanner wrench to remove the lock wire completely from the cylinder.
   NOTE: Direction of rotation for lock wire removal depends on prior installation. Check lock wire position for correct rotation.

5. Pull on the rod to remove the pistons and gland nut.

6. Remove the nut from the end of the rod which holds the piston assembly onto the rod.

7. Check the rod and cylinder bore for nicks, burrs, scratches, or rust. Slight defects may be removed with fine sandpaper. All parts removed from the cylinder that are to be reused should be thoroughly cleaned. Be sure to carefully clean all cavities and grooves prior to replacing parts.

8. Apply clean oil liberally to the new cylinder seals, static a-ring, piston rod, and the inside of the cylinder. Install all seals included in seal kit no. 13013-1. Do not overstretch seals to facilitate installation. Make sure all seals are not twisted or distorted in the grooves.

9. Reassemble the gland nut and piston on the rod. Install the lock nut and torque to 54 - 66 ft.lbs. To reinstall the lock wire, locate the drilled hole in the gland nut through the milled slot in the cylinder barrel and insert lock wire. With the lock wire in place, rotate the gland nut 360 degrees.

3.3 TROUBLESHOOTING

INTRODUCTION:

The following section is designed to aid in the diagnoses of problems which may occur on the Genie Boom. The systematic format is used to diagnose problems ranging from defective solenoids to the need for pump replacement. It assumes that the user is equipped with basic hand tools and test equipment (voltmeter, ohmmeter, pressure gauges, and flow meters). Before performing any of the procedures recommended to repair or isolate the various malfunctions covered *in* the 19 subsections, observe the following safety precautions:

1. Read and follow all safety instructions as recommended in this manual. Follow all instructions as indicated by decals on the Genie Boom and any others which may be required to comply with safety regulations.

2. When troubleshooting, make certain the machine is resting on a firm, smooth, level surface.

3. Perform all tests with the platform completely lowered.

4. Disconnect the main battery connector located on the side of the chassis next to the battery box compartment.

5. In order to conduct any of the voltage tests, the lose function must be properly activated while the test leads are connected to the various test connections.

This Troubleshooting section deals primarily with malfunctions or defective components. Therefore, make certain all correct operating procedures are performed prior to conducting any of the recommended tests.

When troubleshooting the hydraulic functions, it *is* important to note the following:

All malfunctions in which fluid power is used to, perform a function may be subdivided into three categories:

1. The electric motor on the power unit located on the turntable does not start.

2. The power unit motor starts but -hydraulic oil bypasses back to the tank along some path other than the intended one.

3. Oil is restricted from following the intended path.

For the first category, the problem is exclusively electrical.

For the second category, pressure in the hydraulic system *is* always lower than normal working pressure for a particular function. This lower system is characterized by higher than normal electric motor rpm and a corresponding higher pitched sound from the motor. This condition can be simulated by activating the pump ON switch located at the lower control with the hydraulic hand pump bypass valve in the open position. To open the hand pump bypass valve, reposition the roll pin located at the back of the pump to the lower position. Remember to reposition the roll pin to the upper position when test is complete.

For the third category, output pressure from the pump is always higher than normal working pressure for a particular function. This higher system pressure *is* characterized by lower than normal electric motor rpm and a corresponding lower pitched sound from the electric motor. This condition can be simulated in a properly functioning machine by activating only the Pump On switch and none of the other switches on the lower control.

It should be noted that either condition, bypass or restriction, may exist in varying degrees short of a complete loss of a particular function. For example, Primary Boom Cylinder will not extend. This should be read to mean, Primary Boom Cylinder will not extend with the same speed or power of a properly functioning machine. Also, proper diagnosis of problems can only be done with batteries which are fully charged, as discharged batteries will cause sluggish operation. It is important to be able to distinguish between low pressure bypass and high pressure restriction in the hydraulic system, since the possible remedies of the two types of problems are entirely different.

The following list contains the problems which are likely to occur due to component malfunctions. Refer to the section which most accurately describes your problem. In multiple-problem cases, solve one problem at a time beginning with the lowest number.

Throughout the Troubleshooting procedures, references are made to terminal numbers. Refer to the wiring diagram for the exact location of these terminal points.

SECTION	DEFECTIVE CONDITION	PAGE
1	Machine will not lift, lower, extend, retract, rotate, drive, or steer. All powered functions lost.	22
2	Machine will not lift, lower, extend, retract, rotate, or steer. Drive Forward and Reverse is functional. Hydraulic power unit motor (located on turntable) will not start.	23
3	Machine will not lift, lower, extend, retract, rotate, or steer. Drive Forward and Reverse is functional. Hydraulic power unit motor starts and runs.	25
4	Primary Boom Cylinder will not extend.	26
5	Primary Boom Cylinder will not retract.	27
6	Secondary Boom Cylinder will not extend.	28
7	Secondary Boom Cylinder will not retract.	29
8	Boom Extension Cylinder will not extend.	30
9	Boom Extension Cylinder will not retract.	31
10	Turntable will not rotate clockwise.	32
11	Turntable will not rotate counterclockwise.	34
12	Machine will not steer left.	36
13	Machine will not steer right.	38
14	Machine will not drive forward or reverse.	39
15	Machine will not drive forward.	40
16	Machine will not drive reverse.	41
17	Machine will not drive full speed.	41
18	Machine drives at full speed with platform elevated.	42
19	Brake will not release.	43

SYMPTOM	PROBABLE CAUSE	PROCEDURE TO REPAIR ISOLATE MALFUNCTION
1 Machine will not lift, lower, retract, rotate, drive, or steer. All powered functions lost.	1.1 Power On switch in "Off" position.	1.1 Refer to Operating extend, Instructions for proper use.
	1.2 Faulty electrical connection.	1.2 Check main battery disconnect connector. Check battery cable connectors inside battery box. Check battery cable connectors inside SCR/ charger module.
	1.3 Batteries discharged.	1.3 Check each cell with hydrometer. Reading should be 1.275 (fully charged). Recharge if low reading. Replace if reading difference between cells is 0.050.
	1.4 Blown fuse 300A (FUA) .	1.4 Locate short circuit. Replace fuse.
	1.5 Two blown control circuit fuses.	1.5 Locate short in control circuit and replace10 amp fuses.
	1.6 Emergency Stop Power On switch (Toggle Switch TS6) defective. Lower controls will be functional.	1.6 Test switch for continuity when energized. Replace if open
	1.7 Mode Selector Switch (Toggle Switch TS1) defective. Lower controls will be functional.	1.7 Test switch for continuity when energized. Replace if open.

SYMPTOM	PROBABLE CAUSE	PROCEDURE TO REPAIR ISOLATE MALFUNCTION
2 Machine will not lift, lower, extend, retract, rotate, or steer. (Drive is functional.) Electric motor will not start.	2.1 10 amp control fuse or 300 amp power fuse.	2.1 Locate short circuit and replace fuse.
	2.2 Test voltage at terminal batteries and terminal strip in SCR/charger module.	2.2 Open circuit between #102 on strip located in SCR/ charger module. If 24 volts , proceed. If 0 volts, check main battery disconnect connector and battery cable connections in battery box.
	2.3 Open condition in control circuit.	2.3 Test voltage at terminal #109 in SCR/charger module. If 24 volts, go to Step 2.13. If 0 volts, proceed.
	2.4 Open circuit between SCR/charger module and printed circuit board on turntable.	2.4 Check voltage at terminal #2 on printed circuit board. If 24 volts, proceed. If 0 volts, locate open circuit and repair.
	2.5 Defective trace on printed circuit board (PCB).	2.5 Test voltage at terminal #12 on PCB . If 24 volts proceed. If 0 volts, replace PCB.
	2.6 Pump On toggle switch (TSII) defective (turntable controls).	2.6 Test voltage at terminal #14 on PCB. If 24 volts, proceed. If 0 volts, check switch for continuity in both positions.
	2.7 Open control cable circuit.	2.7 Test voltage at terminal #6 on PCB. If 24 volts, go to Step 2.10. If 0 volts, proceed to Step 2.8.
	2.8 Power On Switch (TS6) defective.	2.8 Test switch for continuity. Replace if open.

SYMPTOM	PROBABLE CAUSE	PROCEDURE TO REPAIR ISOLATE MALFUNCTION
	2.9 Mode Selector Switch (TSI) defective.	2.9 Test switch for continuity in both positions. Replace if open in either position.
	2.10 Pump On toggle switch defective.	2.10 Test voltage at terminal #15 on PCB. If 24 volts, proceed. If 0 volts, test switch for continuity in both positions. Replace if open in either.
	2.11 Defective trace on PCB.	2.11 Test voltage at terminal #5 on PCB. If 24 volts, proceed. If 0 volts, test board for continuity. Replace if open.
	2.12 Open circuit between terminal #5 (PCB) and terminal #109 S/C module.	2.12 Test voltage at terminal #109. If 24 volts, proceed. If 0 volts, locate open circuit between terminal #5 and 1109 and repair.
	2.13 Motor starter solenoid defective.	2.13 Test solenoid coil for continuity and replace if open. If solenoid has continuity, check motor brushes motor fields for continuity.

SYMPTOM	PROBABLE CAUSE	PROCEDURE TO REPAIR ISOLATE MALFUNCTION
3. Machine will not lift, lower, extend, retract, rotate, or steer. (Drive is functional.) Hydraulic power unit motor starts and runs.	3.1 Low hydraulic fluid supply.	3.1 Check hydraulic reservoir for proper fluid level.
	3.2 Release valve on back of hand pump in open position.	3.2 Reposition roll pin pump release valve to Up position.
	3.3 Diode(s) in printed circuit board (PCB) shorted.	3.3 Located on top of each surface directional control valve is a small window which lights whenever the coil is energized. Two or more lights lit at the same time for anyone function indicate a short circuit. Remove wire from terminal #6 and check each diode for proper operation.
	3.4 Open circuit in wire connecting hydraulic power unit to terminal #10 on PCB which grounds all hydraulic valve coils.	3.4 Check for continuity between terminal #10 and negative post on hydraulic power unit motor. Reconnect if open.
	3.5 Check valve in hydraulic hand pump stuck open or leaking.	3.5 Remove and plug pressure hose to hand pump. If normal operation returns, replace hand pump.

SYMPTOM	PROBABLE CAUSE	PROCEDURE TO REPAIR ISOLATE MALFUNCTION
4. Primary Boom cylinder will not extend.	4.1 Platform overloaded.	4.1 Reduce maximum capacity to rated load.
	4.2 Hydraulic valve solenoid (PU) defective. (Hydraulic power unit motor will run.)	4.2 Located on top surface of each directional control valve is a window which lights whenever the coil is energized. Check for light or voltage at terminal #46 on printed circuit board. If light or 24 volts present, go to Step 4.4. No light and 24 volts, check solenoid for continuity. Replace if open. If 0 volts, proceed to Step 4.3.
	4.3 Platform Control Primary Boom Toggle Switch (TS2) defective. (Function operational from lower controls.)	4.3 Test voltage at terminal #27. If 24 volts, proceed. If 0 volts, test switch for continuity and replace if open.
	4.4 Diode in printed circuit board (PCB) failed open. (Power unit will not start.)	4.4 Test voltage at terminal #6. If 24 volts, proceed. If 0 volts, test diode for continuity. Replace if open.
	4.5 Primary Boom hydraulic directional control valve spool stuck.	4.5 Manually depress the hydraulic valve spool. If normal operation results, repair or replace valve.
	4.6 Primary Boom hydraulic cylinder seals leaking. (Platform will descend slowly without controller input.)	4.6 Check for signs of leakage. Repair or replace cylinder if necessary.

SYMPTOM	PROBABLE CAUSE	PROCEDURE TO REPAIR ISOLATE MALFUNCTION
5. Primary Boom cylinder will not retract.	5.1 Hydraulic valve solenoid (PD) defective. (Hydraulic power unit motor will run.)	5.1 Located on top surface of each directional control valve is a window which lights whenever the coil is energized. Check for light and voltage at terminal #47 on printed circuit board. If light or 24 volts present, go to Step 5.3. No light and 24 volts, check solenoid for continuity. Replace if open. If 0 volts, proceed to Step 5.2.
	5.2 Platform Control, Primary Boom toggle switch (TS2) defective. (Function operational from lower controls.)	5.2 Test voltage at terminal #28. If 24 volts, proceed. If 0 volts, test switch for continuity and replace if open.
	5.4 Primary Boom hydraulic directional control valve spool stuck.	5.4 Manually depress the hydraulic valve spool. If normal operation results, repair or replace valve.
	5.5 Relief Valve located beneath directional control valve defective.	5.5 Install 0-3000 psi pressure gauge in cylinder rod end. If less than 500 psi during retraction, relief valve is defective. Set to 500 psi or replace.
	5.6 Overcenter Valve located on lift cylinder defective.	5.6 Overcenter valve is part of safety system. Do not attempt any adjustment or repair.

SYMPTOM	PROBABLE CAUSE	PROCEDURE TO REPAIR ISOLATE MALFUNCTION
6. Secondary Boom cylinder will not extend.	6.1 Hydraulic valve solenoid (SU) defective. (Hydraulic power unit motor will run.)	6.1 Located on top surface of each directional control valve is a window which lights whenever the coil is energized. Check for light and voltage at terminal #44 on printed circuit board. If light or 24 volts present, go to. Step 6.3. No light and 24 volts, check solenoid for continuity. Replace if open.
	6.2 Platform Control, Secondary Boom toggle switch (TS3) defective. Function operational from lower controls.	6.2 Test voltage at terminal #25. If 24 volts, proceed to next step. If a volts, test switch for continuity and replace if open.
	6.3 Diode in printed circuit board (PCB) failed open. (Power motor will not start.)	6.3 Test voltage at terminal #6. If 24 volts, proceed to next step. If 0 volts, test diode for continuity and replace if open.
	6.4 Secondary Boom hydraulic directional control valve spool stuck.	6.4 Manually depress the hydraulic valve spool. If normal operation results, repair or replace valve.
	6.5 Secondary Boom hydraulic cylinder seals leaking. (Platform will descend slowly without controller input.)	6.5 Check cylinder for signs of leakage. Repair or replace cylinder if necessary.

SYMPTOM	PROBABLE CAUSE	PROCEDURE TO REPAIR ISOLATE MALFUNCTION
7. Secondary Boom cylinder will not retract.	7.1 Hydraulic valve solenoids (SD) defective.	7.1 Located on top surface of each directional control valve is a window which lights whenever the coil is energized. Check for light and voltage at terminal #45 on printed circuit board. If light and 24 volts present, go to Step 7.3. No light and 24 volts, check solenoid for continuity. Replace if open. If 0 volts, proceed to Step 7.2.
	7.2 Platform Control Secondary Boom toggle switch (TS3)defective. Function operational from lower controls.	7.2 Test voltage at terminal #26. If 24 volts, proceed to Step 7.3. If 0 volts, test switch for continuity and replace if open.
	7.3 Diode in printed circuit board (PCB) failed open. Power unit motor will not start.	7.3 Test voltage at terminal #6. If 24 volts, proceed to 7.4. If 0 volts, test diode for continuity and replace if open.
	7.4 Secondary Boom hydraulic directional control valve spool stuck.	7.4 Manually depress the hydraulic valve spool. If normal operation results, repair or replace valves.
	7.5 Relief valve located beneath directional control valve defective.	7.5 Install 0-3000 psi pressure gauge in the cylinder rod end and perform boom retraction function with secondary boom fully lowered. If pressure is less than 1000 psi, adjust or replace relief valve.

SYMPTOM	PROBABLE CAUSE	PROCEDURE TO REPAIR ISOLATE MALFUNCTION
	7.6 Counterbalance valve located on lift cylinder defective.	7.6 Counterbalance valve is part of safety system. Do not attempt any adjustment. Replace valve assembly.
8. Extension Body cylinder will not extend.	8.1 Platform is overloaded.	8.1 Reduce load to maximum rated capacity.
	8.2 Hydraulic valve solenoid defective.	8.2 Located on top surface of each directional control valve is a window which lights whenever the coil is energized. Check for light and voltage at terminal #49 on printed circuit board. If light and 24 volts present, go to Step 8.5. No light and 24 volts, check solenoid for continuity. Replace if open. If 0 volts, proceed to Step 8.3.
	8.3 Platform control, boom extend switch (TS4) defective. Function operates using lower controls.	8.3 Test voltage at terminal #29. If 24 volts, go to Step 8.6. If 0 volts, test switch for continuity and replace if open.
	8.4 Open circuit in control cable.	8.4 Check continuity between terminals 14 and 29 with all controls activated. Replace cable if open.
	8.5 Diode in printed circuit board (PCB) failed open. (Power unit motor will not start.)	8.5 Test voltage at terminal #6. If 24 volts, go to 8.6. If 0 volts, check diode for continuity. Replace if open.

SYMPTOM	PROBABLE CAUSE	PROCEDURE TO REPAIR ISOLATE MALFUNCTION
	8.6 Extension cylinder directional control valve spool stuck.	8.6 Manually depress the hydraulic valve spool. If normal operation results, repair or replace valve.
	8.7 External hydraulic leak in system.	8.7 Locate and repair leak.
	8.8 Extension cylinder seals defective.	8.8 Remove cylinder and replace seals.
9. Boom extension cylinder will not retract.	9.1 Hydraulic valve solenoid defective.	9.1 Located on top surface of each directional control valve is a window which lights whenever the coil is energized. Check for light and 24 volts at terminal #50 on printed circuit board. If light and 24 volts, go to Step 9.5. No light and 24 volts, test solenoid for continuity. Replace if open. If 0 volts, go to Step 9.2.
	9.2 Platform control, boom retract switch TS4 defective.	9.2 Test voltage at terminal #30. If 24 volts, go to Step 9.4. If 0 volts, test switch for continuity. Replace if open.
	9.3 Open circuit in control cable.	9.3 Check continuity between terminals 14 and 30 with all controls actuated. Replace cable if open.

SYMPTOM	PROBABLE CAUSE	PROCEDURE TO REPAIR ISOLATE MALFUNCTION
	9.4 Diode in printed circuit board (PCB) failed open. (Power unit motor will not start.)	9.4 Test voltage at terminal #6. If 24 volts, go to Step 9.5. If 0 volts, check diode for continuity. Replace if open.
	9.5 Boom extension cylinder retract directional control valve spool stuck.	9.5 Manually depress the hydraulic valve spool. If normal operation results, repair or replace valve.
	9.6 External hydraulic leak in system.	9.6 Locate and repair leak.
	9.7 Counter balance valve defective.	9.7 Counter balance valve is part of the safety system. Do not attempt any adjustment. Replace valve assembly.
10. Turntable will not rotate clockwise.	10.1 Turntable anti-rotation lock pin installed.	10.1 Check for proper removal and storage of lock pin and lanyard.
	10.2 Turntable rotated to its maximum position.	10.2 Rotate turntable counterclockwise and retest.
	10.3 Platform overloaded or chassis resting on unlevel surface.	10.3 Reduce load to maximum allowable capacity or retest on level surface.

SYMPTOM	PROBABLE CAUSE	PROCEDURE TO REPAIR ISOLATE MALFUNCTION
	10.4 Hydraulic valve solenoid defective.	10.4 Located on the top surface of each directional control valve is a window which lights whenever the coil is energized. Check for light and 24 volts terminal #39 on printed circuit board. If light and 24 volts, go to Step 10.9. No light and 24 volts, test solenoid for continuity at terminals #39 and #40. Replace coil if open. If 0 volts, go to Step 10.5.
	10.5 Platform control rotation switch (TSS) defective.	10.5 Test voltage at terminal, #21. If 24 volts, go to Step 10.7. If 0 volts, test switch for continuity. Replace if open.
	10.6 Open circuit in control cable.	10.6 Check continuity between terminals 14 and 21 with all controls activated. Replace cable if open.
	10.7 Clockwise rotation stop limit switch defective.	10.7 Test continuity between terminals 34 and 35. Open circuit indicates switch is either defective or held in open position by turntable actuator. Test switch. Replace if defective.
	10.8 Diode in printed circuit board (PCB) failed open. (Power unit motor will not start.)	10.8 Test voltage at terminal #6 while activating appropriate switches. If 24 volts, go to 10.9. If 0 volts, check diode for continuity.

SYMPTOM	PROBABLE CAUSE	PROCEDURE TO REPAIR ISOLATE MALFUNCTION
	10.9 Turntable rotation directional control valve spool stuck.	10.9 Manually depress the hydraulic valve spool. If normal operation results, repair or replace valve.
	10.10 External leak in Hydraulic System	10.10 Locate and repair leak.
	10.11 Crossover relief valve misadjusted or defective. (Located beneath directional control valve.)	10.11 Install a 0-3000 psi pressure gauge in the test port “PH on right side of aluminum valve block and lock the turntable in a fixed position. Pressure should be 1000 psi. Adjust correct relief valve or replace as required.
	10.12 Rotation drive motor coupling defective.	10.12 Inspect coupling and repair or replace as required.
	10.13 Rotation drive motor defective.	10.13 Install a flowmeter in the hydraulic. line to the rotation drive motor. If flow is approximately one gpm, repair or replace motor as required.
11. Turntable will not rotate counterclockwise.	11.1 Turntable anti-rotation lock pin installed.	11.1 Check for proper removal and storage of lock pin and lanyard.
	11.2 Turntable rotated to its maximum position.	11.2 Rotate turntable clockwise retest.
	11.3 Platform overloaded or or chassis resting on an unlevel surface.	11.3 Reduce load to the allowable capacity or retest on level surface.

SYMPTOM	PROBABLE CAUSE	PROCEDURE TO REPAIR ISOLATE MALFUNCTION
	11.4 Hydraulic valve solenoid defective.	11.4 Located on the top surface of each directional control valve is a window which lights whenever the coil is energized. Check for light and 24 volts at terminal 38 on the printed circuit board. If light and 24 volts, go to Step 11.9. No light and 24 volts, test solenoid for continuity at terminals 38 and 40. Replace coil if open. If 0 volts, go to Step 11.5.
	11.5 Platform control rotation switch defective.	11.5 Test voltage at terminal 22. If 24 volts, test switch for continuity. Replace if open.
	11.6 Open circuit in control cable.	11.6 Test continuity between terminals 14 and 22 with appropriate controls activated. Replace cable if open.
	11.7 Counterclockwise rotation stop limit switch defective.	11.7 Test continuity between terminals 36 and 37. Open circuit indicates switch is either defective or held in open position b turntable actuator. Test switch; replace if open.
	11.8 Diode in printed circuit board (PCB) failed open. (Power unit motor will not	11.8 Test voltage at terminal #6 while activating appropriate switches. If 24 volts, go to 11.9. If 0 volts, check diode for continuity. Replace if open.

SYMPTOM	PROBABLE CAUSE	PROCEDURE TO REPAIR ISOLATE MALFUNCTION
	11.9 Turntable rotation directional control valve spool stuck.	11.9 Manually depress the hydraulic valve spool. If normal operation results, repair or replace valve.
	11.10 External leak in hydraulic system.	11.10 Locate and repair leak.
	11.11 Crossover relief valve misadjusted or defective	11.11 Install a 0-3000 psi pressure gauge in the test port "P" on the right side of the aluminum valve block and lock the turntable in a fixed position. Pressure should be 1000 psi. Adjust relief valve or replace as required.
	11.12 Rotation drive motor coupling defective.	11.12 Inspect coupling and repair or replace as required.
	11.13 Rotation drive motor defective.	11.13 Install a flowmeter in defective. the hydraulic line to the rotation drive motor. If flow is approximately 1 gpm, repair or replace motor as required.
12. Machine will not steer left.	12.1 Steering linkage steer left defective.	12.1 Inspect the front end and steering linkage. Replace defective parts as required.

SYMPTOM	PROBABLE CAUSE	PROCEDURE TO REPAIR ISOLATE MALFUNCTION
	12.2 Hydraulic valve solenoid defective.	12.2 Located on top surface of directional control valve is a window which lights whenever the coil is energized. Check for light and 24 volts at terminal 42. If light and 24 volts, go to Step 12.5. No light and 24 volts, test solenoid for continuity at terminals 43 and 42. Replace coil if open. If 0 volts, go to Step 12.3.
	12.3 Platform control steering switch defective.	12.3 Test voltage at terminal 24. If 0 volts, test switch for continuity. Replace if open.
	12.4 Open circuit in control cable.	12.4 Test continuity between terminals 24 and 24 with appropriate control activated.
	12.5 Diode in printed circuit board (PCB) failed open. (Power unit motor will not start.)	12.5 Test for continuity between terminals 24 and 6. Replace diode if open.
	12.6 Steering directional control valve spool stuck.	12.6 Manually depress the hydraulic valve spool. If normal operation results, repair or replace valve.
	12.7 Steering cylinder defective.	12.7 Install a flow meter in the hydraulic line to the steering cylinder. If flow is approximately 1 gpm, repair or replace cylinder seals.

SYMPTOM	PROBABLE CAUSE	PROCEDURE TO REPAIR ISOLATE MALFUNCTION
13 Machine will not steer right.	13.1 Steering linkage defective.	13.1 Inspect the front end and steering linkage. Replace defective parts as required.
	13.2 Hydraulic valve solenoid defective.	13.2 Located on top surface of directional control valve is a window which lights whenever coil is energized. Check for light and 24 volts at terminal 41. If light and 24 volts, go to Steps 13 and 5. No light and 24 volts, test coil for continuity at terminals 41 and 43. Replace coil if open. If 0 volts, go to Step 13.3.
	13.3 Platform control steering switch defective.	13.3 Test voltage at terminal 23. If 0 volts, test switch for continuity. Replace if open.
	13.4 Open circuit in control cable.	13.4 Test continuity between terminals 14 and 23 with appropriate controls activated. Replace cable if open.
	13.5 Diode in printed circuit board (PCB failed open. (Power unit motor will not start.)	13.5 Test for continuity between terminals 23 and 6. Replace diode if open.
	13.6 Steering directional control valve spool stuck.	13.6 Manually depress the hydraulic valve spool. If normal operation results, repair or replace valve.

SYMPTOM	PROBABLE CAUSE	PROCEDURE TO REPAIR ISOLATE MALFUNCTION
	13.7 Steering cylinder defective.	13.7 Install a flow meter in the hydraulic line to the steering cylinder. If flow *is* approximately 1 gpm, repair or replace cylinder.
14. Machine will not drive, Forward or Reverse.	14.1 Foot switch not depressed.	14.1 Refer to Operating Instructions for proper use.
	14.2 300 amp fuse located in SCR/ Charger module blown.	14.2 Locate cause of short circuit and replace fuse.
	14.3 Control circuit 10 amp fuse blown.	14.3 Locate short and replace fuse.
	14.4 Parking brake not releasing.	14.4 Step on foot switch with Power On switch energized. If a distinct click is not heard from the parking brake located beneath the turntable in the center of the chassis, go to Troubleshooting Step 19 to regain proper brake functions before continuing on to the next step.
	14.5 Open circuit in controls.	14.5 Test voltage at terminal #7 with Power On switch activated and accelerator l ever pushed forward. If 36 volts, go to Step 14.8. If 0 volts, proceed. NOTE: Any voltage less than 36 volts indicates batteries installed incorrectly.

SYMPTOM	PROBABLE CAUSE	PROCEDURE TO REPAIR ISOLATE MALFUNCTION
	14.6 Mode Selector Switch defective.	14.6 Test voltage at terminal #11. If 36 volts, check Mode Selector Switch for continuity. If switch is good, check control cable wires to and from (refer to wiring diagram for color code). If 0 volts, proceed.
	14.7 Open circuit between batteries and terminal 11.	14.7 Locate open circuit and repair or replace wire assembly as required.
	14.8 SCR control defective.	14.8 Refer to The General Electric Troubleshooting Guide in the Maintenance Section.
15. Machine will not drive forward. (Reverse operates normally.)	15.1 Open circuit in controls.	15.1 Test voltage at terminal #7 with appropriate controls activated. If 36 volts, go to Step 15.4. If 0 volts, proceed.
	15.2 Open circuit in printed circuit board.	15.2 Test voltage at terminal #16. If 36 volts, replace terminal board. If 0 volts, proceed.
	15.3 Forward switch in accelerator switch assembly defective.	15.3 Test switch for continuity. Replace if open.
	15.4 SCR control defective.	15.4 Refer to the General Electric Troubleshooting Guide in the Maintenance Section.

SYMPTOM	PROBABLE CAUSE	PROCEDURE TO REPAIR ISOLATE MALFUNCTION
16. Machine will not reverse. (Forward operates proceed normally.)	16.1 Open circuit in controls.	16.1 Test voltage at terminal #8. If 36 volts, go to Step 16.4. If 0 volts, proceed.
	16.2 Open circuit in printed circuit board (PCB) .	16.2 Test voltage at terminal #17. If 36 volts, replace circuit board. If 0 volts, proceed.
	16.3 Reverse switch in accelerator switch assembly defective.	16.3 Test switch for continuity. Replace if open.
	16.4 SCR control defective.	16.4 Refer to The General Electric Troubleshooting Guide in Maintenance Section.
17. Machine will not drive full speed.	17.1 Drive attempted with platform elevated.	17.1 Lower platform completely. Refer to Operating Instructions for proper use.
	17.2 Limit switch (LSI) Located on turntable riser defective.	17.2 Test continuity between terminals 31 and 32 with limit switch wand in held position. 0 resistance indicates switch is good. If 10 K ohms resistance, check wand actuator. Replace switch if failed open.

SYMPTOM	PROBABLE CAUSE	PROCEDURE TO REPAIR ISOLATE MALFUNCTION
	17.3 Accelerator potentiometer located in accelerator switch assembly misadjusted or defective.	17.3 Measure resistance between terminals 18 and 20. Resistance should be zero when the accelerator is pushed to maximum forward or rev positions and approximately 5500 ohms in the center, or neutral, position. Readjust or replace as required.
	17.4 SCR control defective.	17.4 Refer to The General Electric Troubleshooting Guide in the Maintenance Section.
18. Machine drives at full speed with platform elevated.	DANGER: FAILURE TO CORRECT THIS CONDITION COULD LEAD TO SERIOUS BODILY INJURY TO THE MACHINE OPERATOR AND TO BYSTANDERS	
	18.1 Limit Switch (LSI) located on turntable riser misadjusted.	18.1 Inspect limit switch wand operation. Switch should be in “held” position with platform lowered.
	18.2 Limit Switch (LSI) defective.	18.2 Test continuity with switch wand in unheld position. Replace switch if continuity exists.
19. Brake will not release.	19.1 Foot switch not depressed.	19.1 Depress foot switch. Refer to Operating Instructions for proper use.
	19.2 Open circuit in controls.	19.2 Test voltage at terminal #3. If 36 volts, to go Step 18.6. If 0 volts, proceed.

SYMPTOM	PROBABLE CAUSE	PROCEDURE TO REPAIR ISOLATE MALFUNCTION
	19.3 Open circuit in printed circuit board (PCB) trace.	19.3 Test voltage at terminal #13. If 36 volts, replace printed circuit board. If 0 volts, proceed.
	19.4 Foot switch defective.	19.4 Test foot switch for continuity. Replace if open when activated.
	19.5 Open circuit in wire assembly to foot switch.	19.5 Test wire assembly for continuity. Replace if open.
	19.6 Brake coil defective.	19.6 Test coil for continuity (coil leads located on top of brake assembly coupled to electric drive motor in chassis.
	19.7 Brake misadjusted.	19.7 Readjust brake assembly. Refer to Maintenance Section.

HYDRAULIC AND ELECTRICAL SCHEMATICS AND WIRING DIAGRAMS

The following Hydraulic and Electrical Schematic and Wiring Diagrams are provided to allow a complete understanding of the function and operation of the electrical and hydraulic systems of your Genie Boom Z-30/20. These diagrams also provide an aid in troubleshooting, servicing, and repairing your machine.

The Hydraulic Schematic Diagram uses only standard graphic symbols as defined in ANSI Standard Y32.10 1967. The Electrical Schematic Diagram is accompanied by a table where the function and location of each component is described. The Wiring Diagrams are a point to point illustration depicting wire color codes, connections, and termination points.

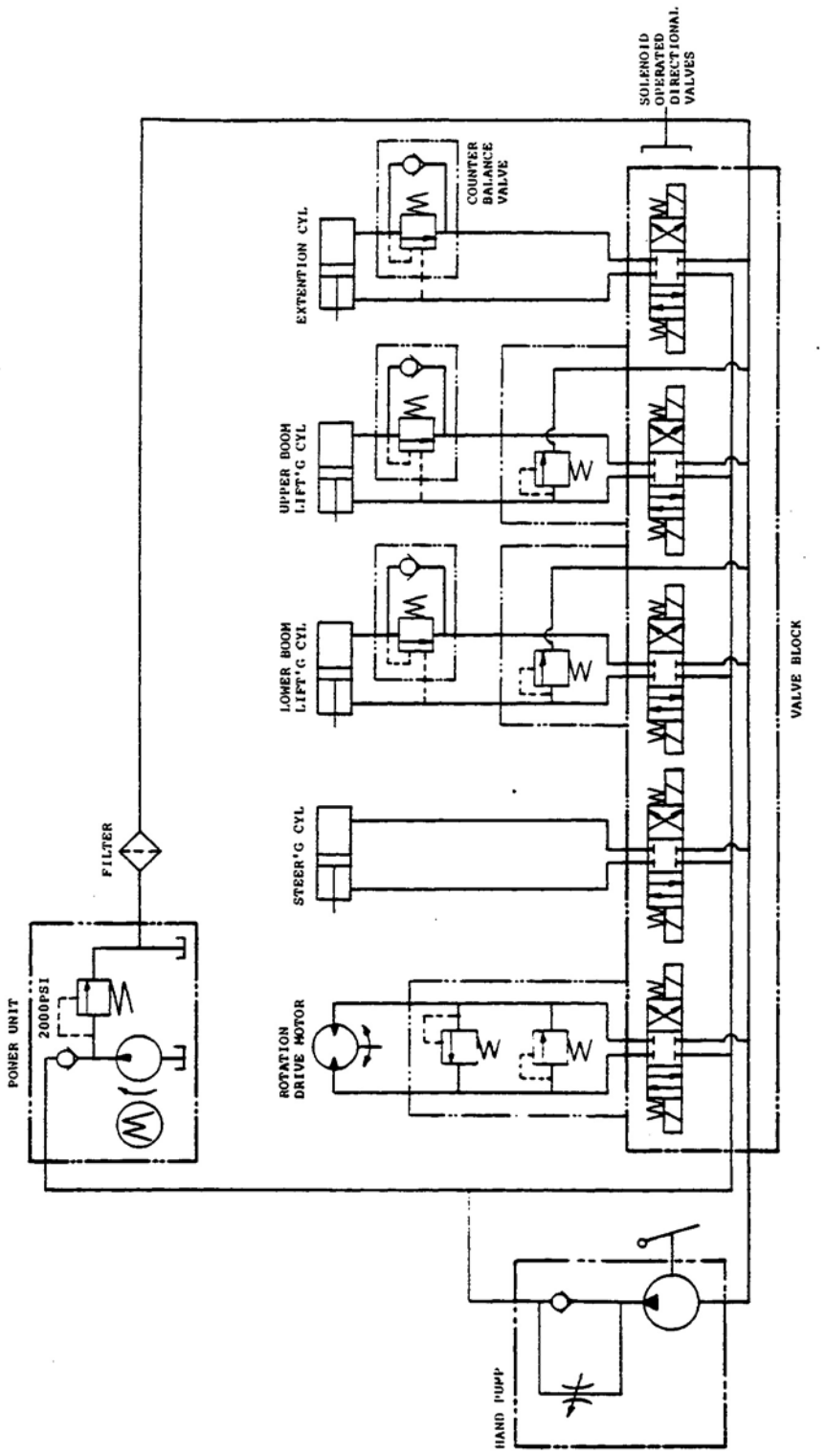


FIGURE 5-1
HYDRAULIC SCHEMATIC

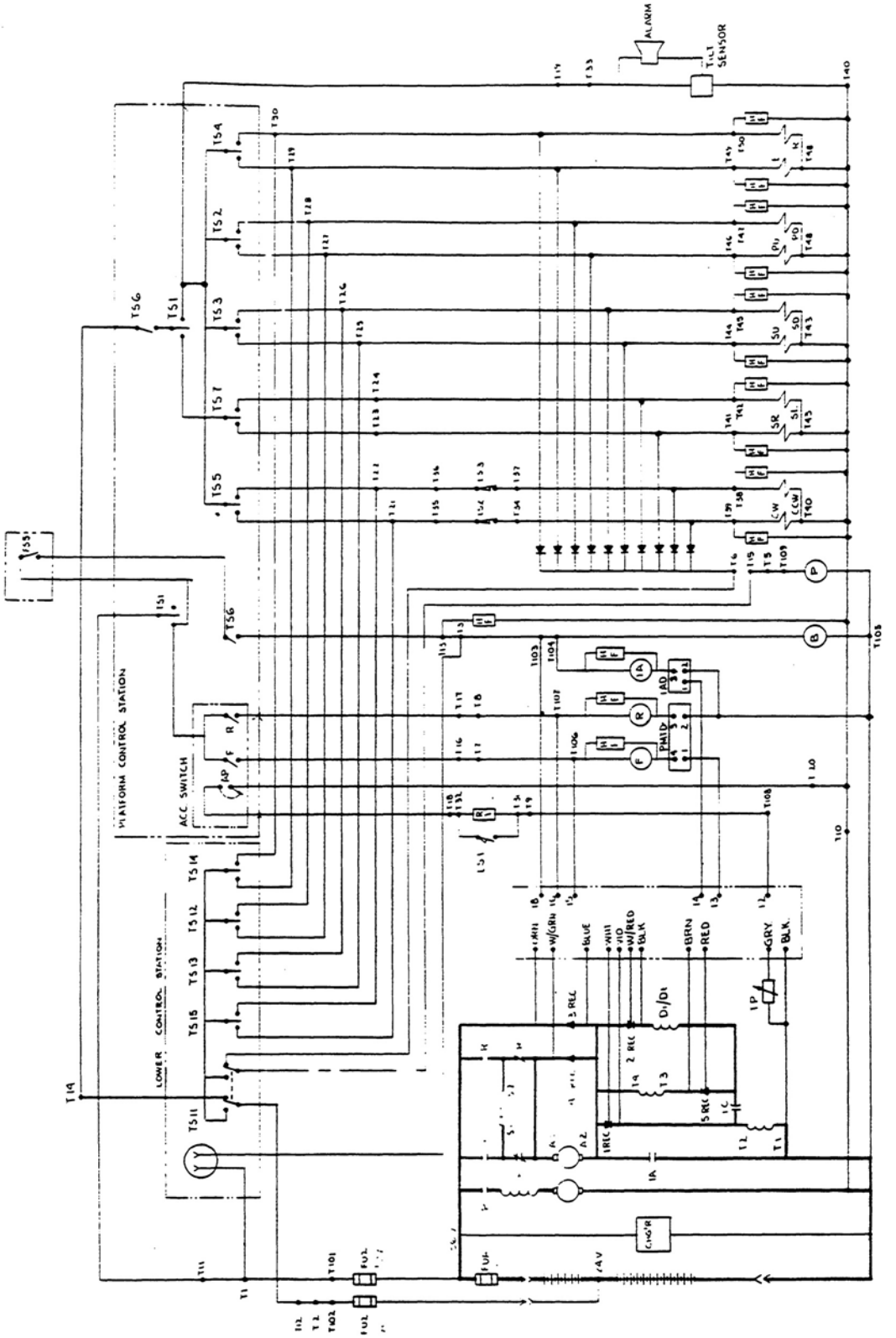


FIGURE 5-2
ELECTRICAL SCHEMATIC

ELECTRICAL SCHEMATIC

ITEM	DESCRIPTION	REF FIG./ ITEM	FUNCTION/ LOCATION
TS1	Mode Selector Toggle Switch	6-23/3	Selects either lift or drive mode/Platform Control Station
TS2	Primary Boom Toggle Switch	6-23/2	Controls elevation and lowering of upper boom/Platform Control Station
TS3	Secondary Boom Toggle Switch	6-23/2	Controls elevation and lowering of lower boom/Platform Control Station
TS4	Extension Boom Toggle Switch	6-23/2	Controls extension and retraction of upper boom/Platform Control Station
TS5	Turntable Rotation	6-23/2	Controls clockwise & counterclockwise turntable rotation/ Platform Control Station
TS6	Emergency Stop/Power On Toggle Switch	6-23/17	Energizes platform controls/Platform Control Station
TS7	Steering Toggle Switch	6-23/2	Controls steering functions/ Platform Control Station
TS11	Pump On/Neutral Toggle Switch	6-16/3	Energizes hydraulic power unit for ground level controls/ Lower Control Station Turntable

ITEM	DESCRIPTION	REF FIG./ ITEM	FUNCTION/ LOCATION
TS12	Ground Level Primary Boom Toggle Switch	6-16/2	Energizes primary boom hydraulic valve solenoid/Lower Control Station-Turntable
TS13	Ground Level Secondary Boom Toggle Switch	6-16 / 2	Energizes secondary boom hydraulic valve solenoid/ Lower Control Station- -Turntable
TS14	Ground Level Extension Boom Toggle	6-16 / 2	Energizes boom extend retract hydraulic valve Switch solenoid/ Ground Control Station-Turntable
TS15	Ground Level Turntable Rotation Toggle Switch	6-16 / 2	Energizes turntable rotation hydraulic valve solenoid/ Ground Control Station-Turntable
FSS	Foot Switch	6-26	Parking brake release switch/Platform Floor
1	Elevated Drive Speed Limit Switch	6-15 / 1	Senses when boom is fully lowered to allow maximum drive speed/ Turntable Riser Weldment
LS2	Clockwise Turntable Rotation Limit Switch	6-15 / 7	Senses when turntable is rotated to maximum clockwise position/ Turntable Underside
LS3	Counterclockwise Turntable Rotation Limit	6-15 / 7	Senses when turntable Switch is rotated to maximum counterclockwise position/ Turntable Underside

ITEM	DESCRIPTION	REF FIG./ ITEM	FUNCTION/ LOCATION
AP	Accelerator Potentiometer	6-24 / 1	Controls drive speed! Accelerator Switch- -Platform Control Station
F	Forward Switchette	6-24 / 2	Energizes forward (F) relay when accelerator lever pushed forward/ Accelerator Switch- Platform Control Station
R	Reverse Switchette	6-24 / 2	Energizes reverse (R) relay when accelerator lever pulled reverse/ Accelerator Switch Platform Control Station
FUA	300 Amp Fuse	6-4 / 19	Power circuit fuse/ SCR Charger Module - Chassis
FU2	10 Amp Fuse	6-4 / 23	Control circuit fuse/ SCR Charger Module - Chassis
RI	3.3 Ohm Resistor	6-4 / 23	Reduces input voltage to SCR card for drive speed reduction with platform elevated/ Printed Circuit Board - Turntable
F	Hash Filter		Supress induced voltage caused by contacts being energized and de-energized./Printed Circuit Board - Turntable

ITEM	DESCRIPTION	REF FIG./ ITEM	FUNCTION/ LOCATION
ALARM	Tilt Alarm	6-11/22	Sounds if chassis on uneven surface when power on and lift mode switch energized/ Turntable
TILT SENSOR	Tilt Sensor	6-11 / 25	Senses when chassis is on unlevel surface/ Turntable
CW	Clockwise Hyd. Valve	6-13 / 3	Activates clockwise solenoid turntable rotation valve spool/ Valve Manifold Assembly-Turntable
CCW	Counterclockwise Hyd. Valve Solenoid	6-13 / 3	Activates counterclockwise turntable rotation valve spool/ Valve Manifold Assembly Turntable
SR	Steer Right Hydraulic Valve Solenoid	6-13 / 3	Activates steer right valve spool/ Valve Manifold Assembly Turntable
SL	Steer Left Hydraulic Valve Solenoid	6-13 / 3	Activates steer left valve spool/ Valve Manifold Assembly Turntable
SU	Secondary Boom Up Solenoid	6-13 / 3	Activates lower boom cylinder up valve spool/ Valve Manifold Assembly- Turntable
SD	Secondary Boom Down Solenoid	6-13 / 3	Activates lower boom cylinder down valve spool/Valve Manifold Assembly- Turntable

ITEM	DESCRIPTION	REF FIG./ ITEM	FUNCTION/ LOCATION
PU	Primary Boom Up Valve Solenoid	6-13 / 3	Activates upper boom cylinder up valve spool/ Valve Manifold Assembly - Turntable
PD	Primary Boom Down Valve Solenoid	6-13 / 3	Activates upper boom cylinder down valve spool/ Valve Manifold Assembly - Turntable
E	Extension Boom Extend Cylinder Valve Solenoid	6-13 / 3	Activates extension boom extend valve spool/Valve Manifold Assembly - Turntable
R	Extension Boom Retract Cylinder Valve Solenoid	6-13 / 3	Activates extension boom retract valve spool/Valve Manifold Assembly - Turntable
B	Spring Applied, Electrically Released Parking Brake Coil	6-8 / 25	When energized, releases parking brake to allow driving/ Drive Train Assembly (coupled to electric drive motor)
P	Hydraulic Power Unit Electric Motor Solenoid	6-11 / 37	Closes contacts to start electric pump motor when energized/ SCR-Charger Module - Chassis
1A	1A Coil	6-7 / 4	Energizes 1A contacts to bypass SCR control for full speed forward or reverse/ SCR-Charger Module

ITEM	DESCRIPTION	REF FIG./ ITEM	FUNCTION/ LOCATION
R	Reverse Coil	6-7 / 6	Energizes reverse contactor to control current direction through electric motor/ SCR Charger Module
F	Forward Coil	6-7 / 6	Energizes forward contactor to control current direction through electric motor/ SCR Charger Module
1AD	1A Driver	6-7 / 5	Senses 1A contact short allows ground connection only if 1A OK/ SCR-Charger Module
PMTD	Pulse Monitor Trip Delay	6-7 / 5	Senses SCR short - allows ground connection only if SCR OK/ SCR-Charger Module
TP	TP Thermal Protector	6-6 / 2	Detects SCR temperature, cuts out drive when tripped/ SCR Charger Module
1 REC	No. 1 Rectifier	6-6 / 3	Main Silicon Controlled Rectifier (SCR). Controls motor speed and torque by varying voltage to the motor/ SCR-Charger Module
2 REC	No. 2 Rectifier	6-6 / 4	SCR that discharges IC capacitor to turn off 1Rec SCR-Charger Module

ITEM	DESCRIPTION	REF FIG./ ITEM	FUNCTION/ LOCATION
3 REC	No. 3 Rectifier	6-6 / 7	Fly-back diode, utilizes inductive motor properties to allow current flow through motor when SCR off/ SCR-Charger Module
4 REC	No. 4 Rectifier	6-6 / 6	Plugging diode - allows full speed direction reversal, senses oppositon current and reduces pulse rate/ SCR Charger Module
5 REC	No. 5 Rectifier	6-6 / 5	SCR which allows charging of capacitor IC for turn-off of 1 Rec/ SCR-Charger Module
IC	Capacitor IC	6-6 / 9	Used to turn off 1 Rec by applying reverse voltage to output of 1 Rec/ SCR-Charger Module
T1- T-50	Terminal Board Wire Junctions	6-4 / 9	Wire termination point/ Printed Circit Board - Turntable
T101- T-110	Terminal Board Wire Junctions	6-4 / 9	Wire termination point/ SCR/Charger Module
	Parking Brake Release	6-16 / 9	Allows connection of Switch Socket Connection parking brake release switch/ Lower Control Station - Turntable

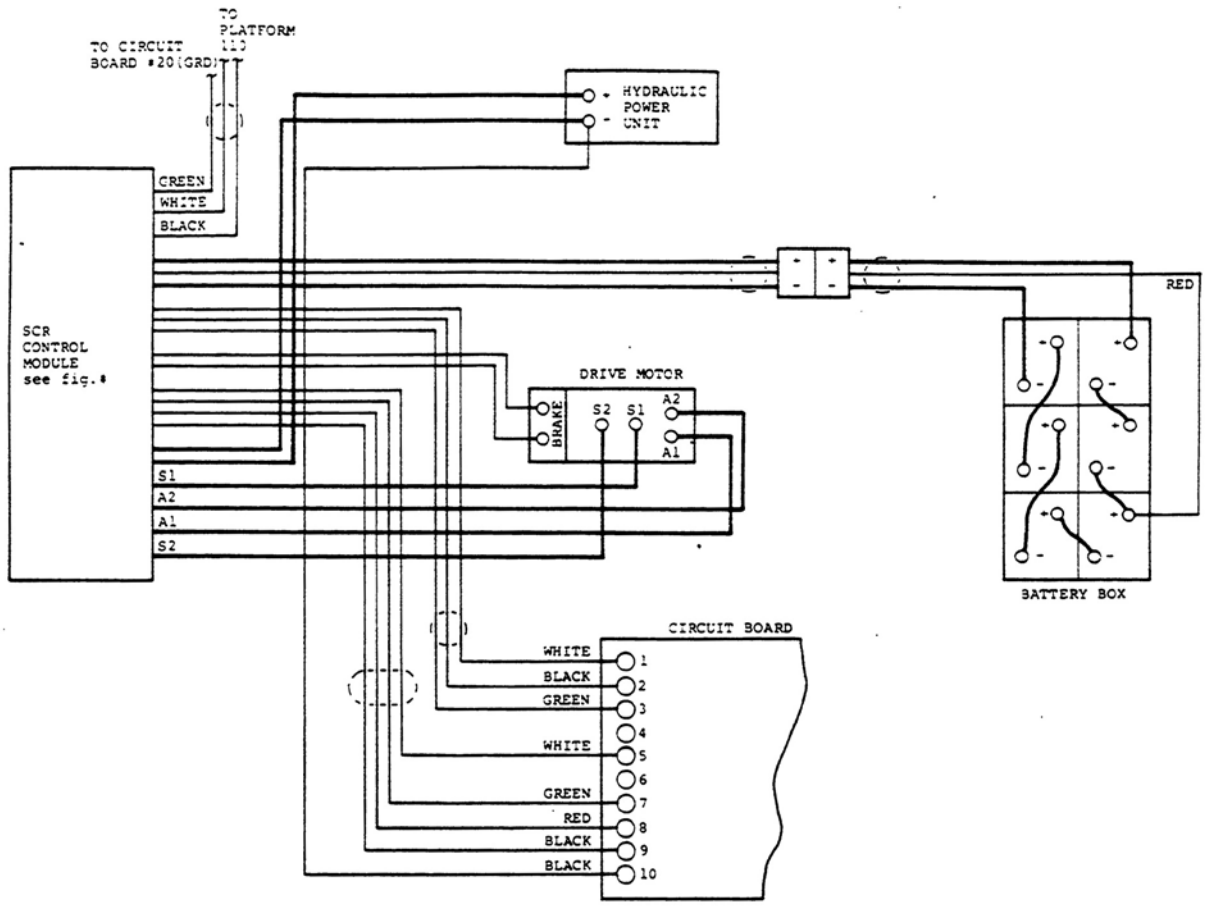


FIGURE 5-3
CHASSIS WIRING DIAGRAM

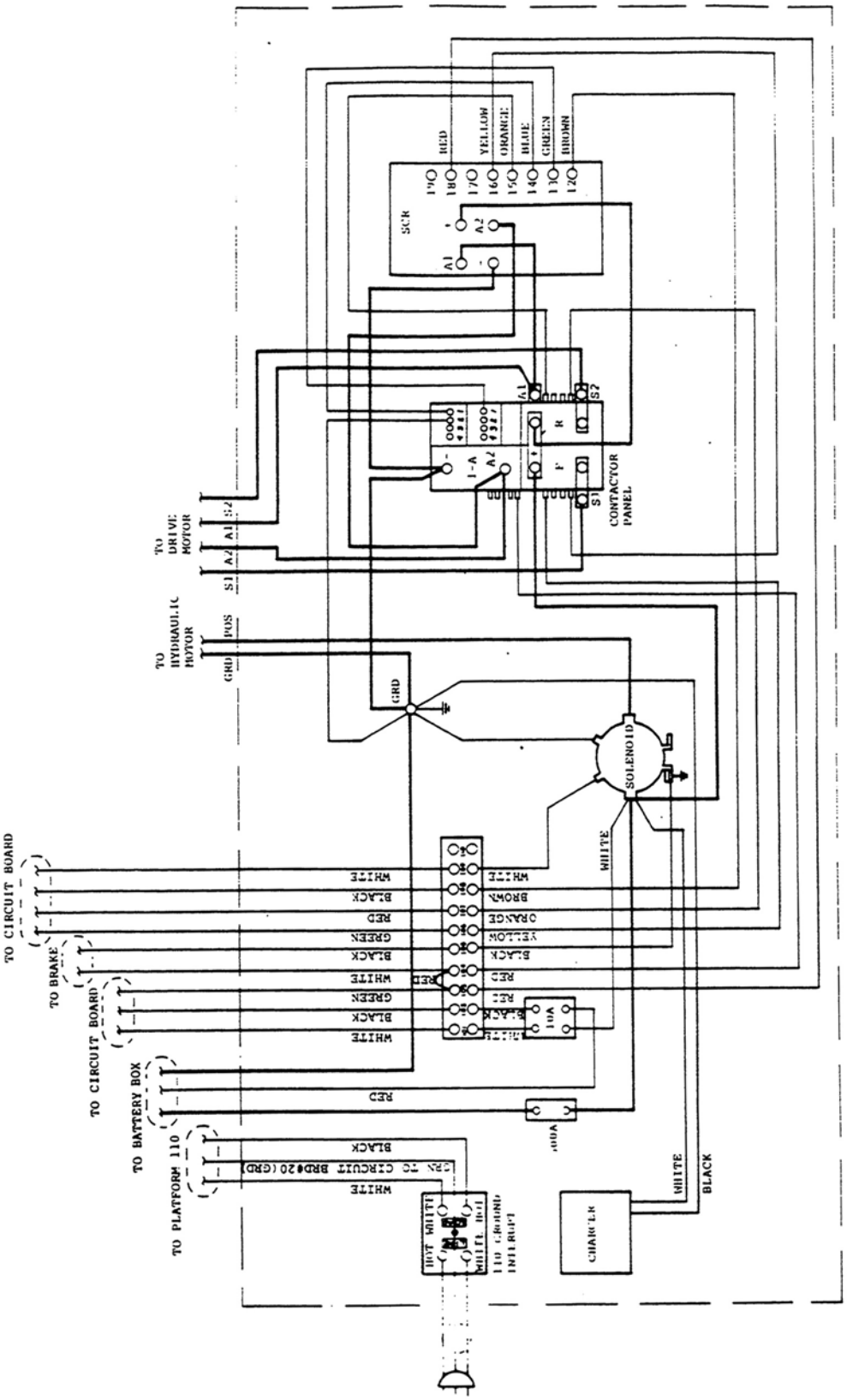


FIGURE 5-4
SCR / CHARGER MODULE WIRING

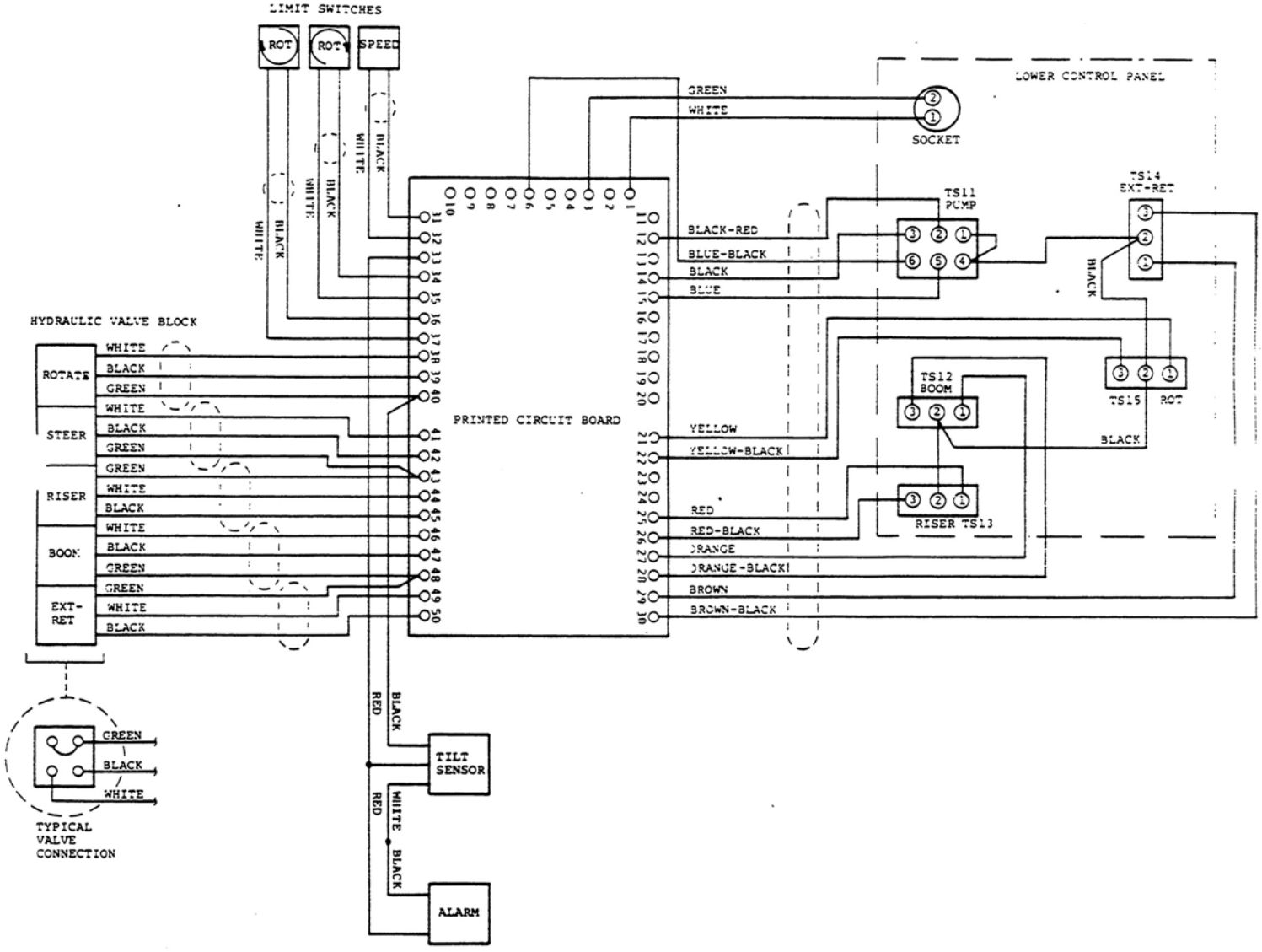


FIGURE 5-5
TURNTABLE WIRING

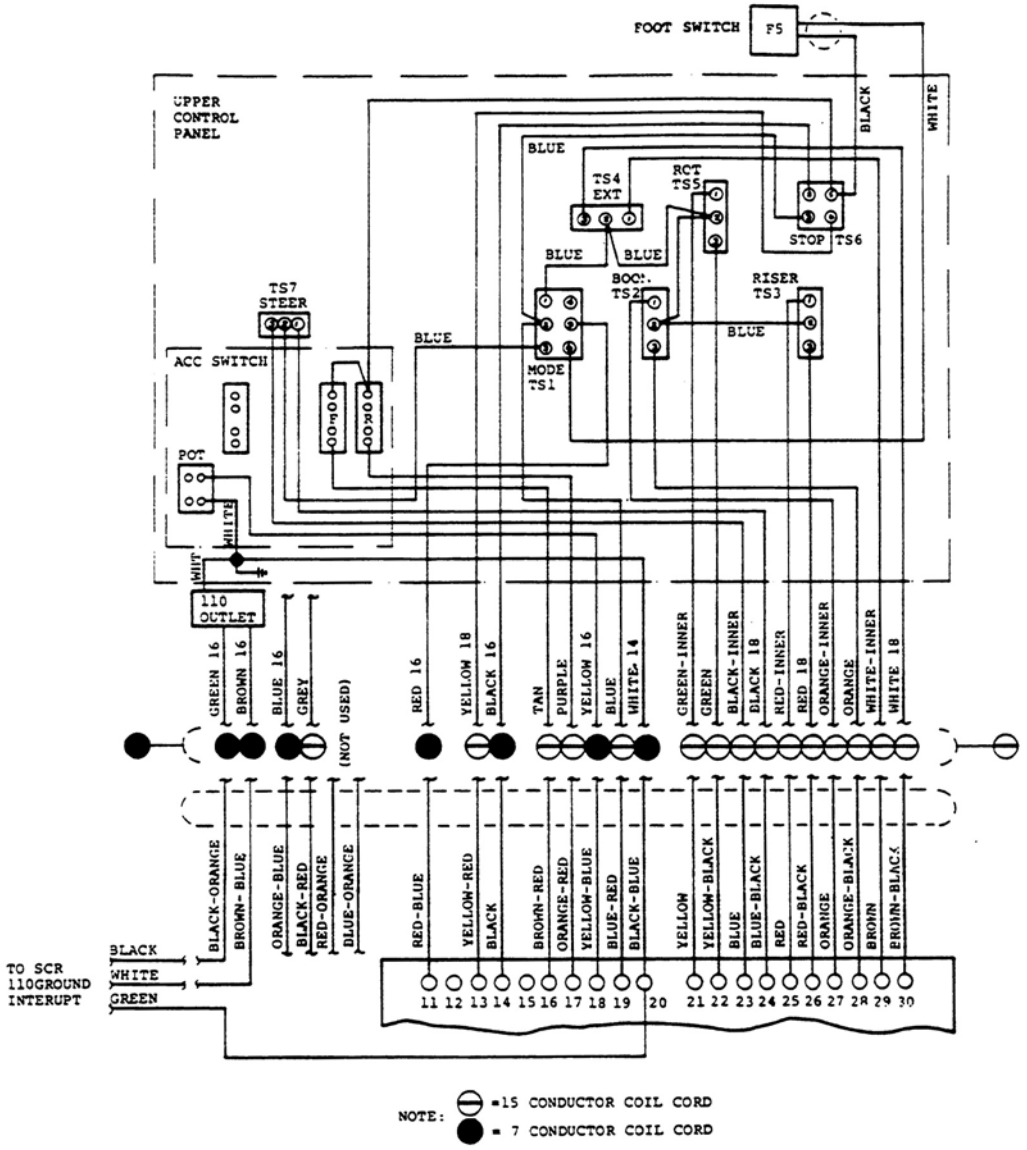


FIGURE 5-6
PLATFORM CONTROLLER WIRING

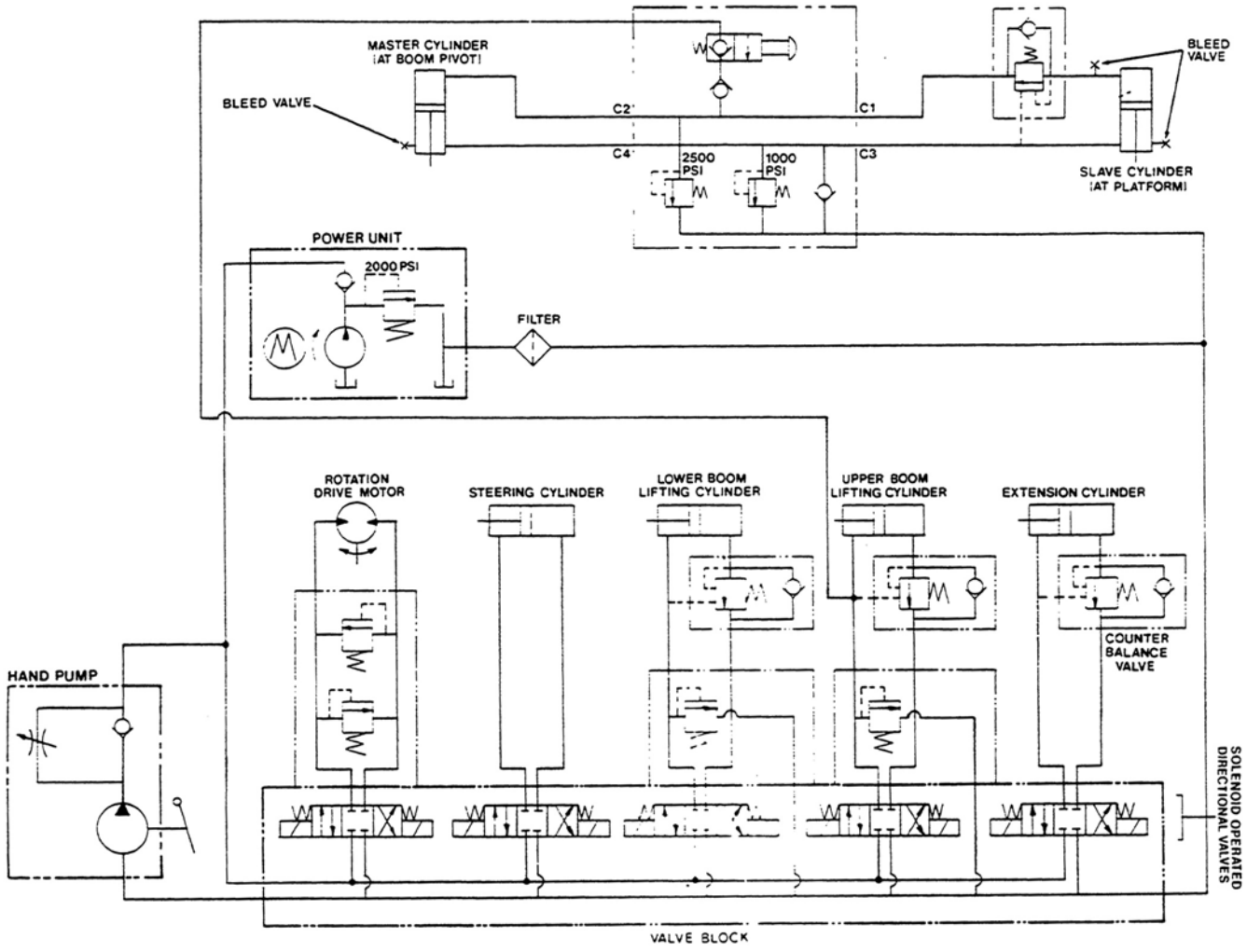


FIGURE 7-16
HYDRAULIC SCHEMATIC Z - 30/20 HD

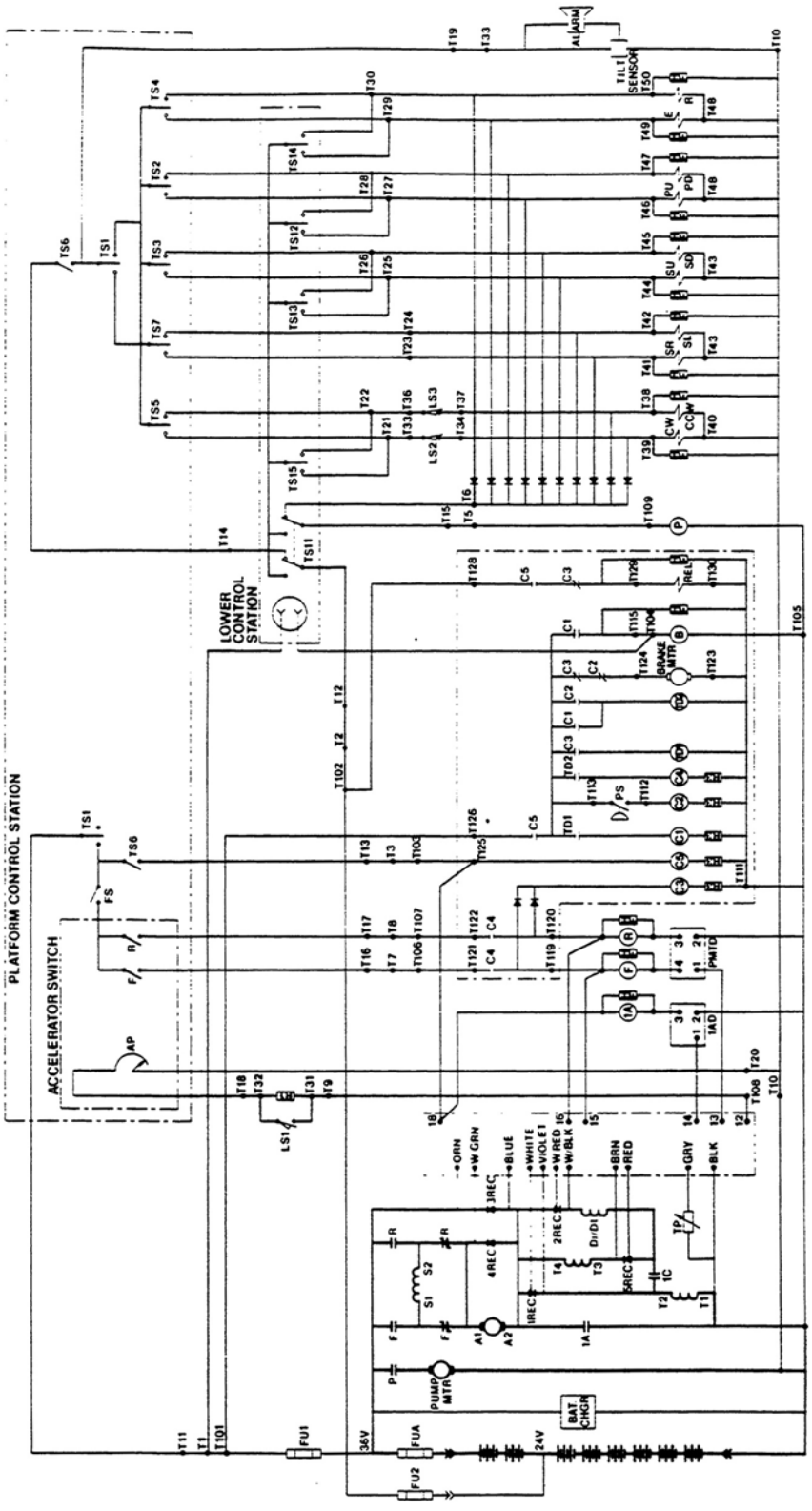


FIGURE 7-17
ELECTRICAL SCHEMATIC

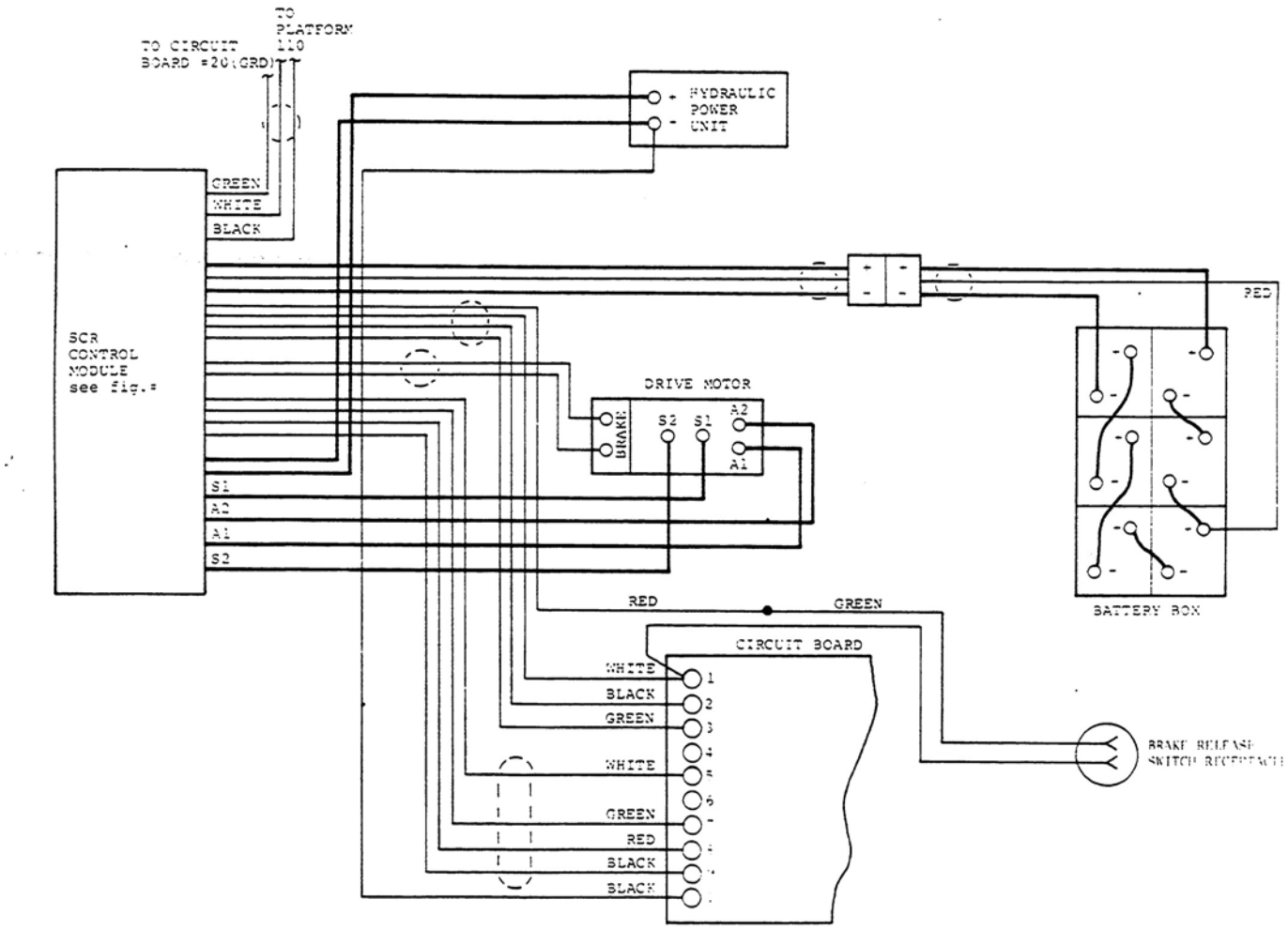


FIGURE 7-18
CHASSIS WIRING DIAGRAM

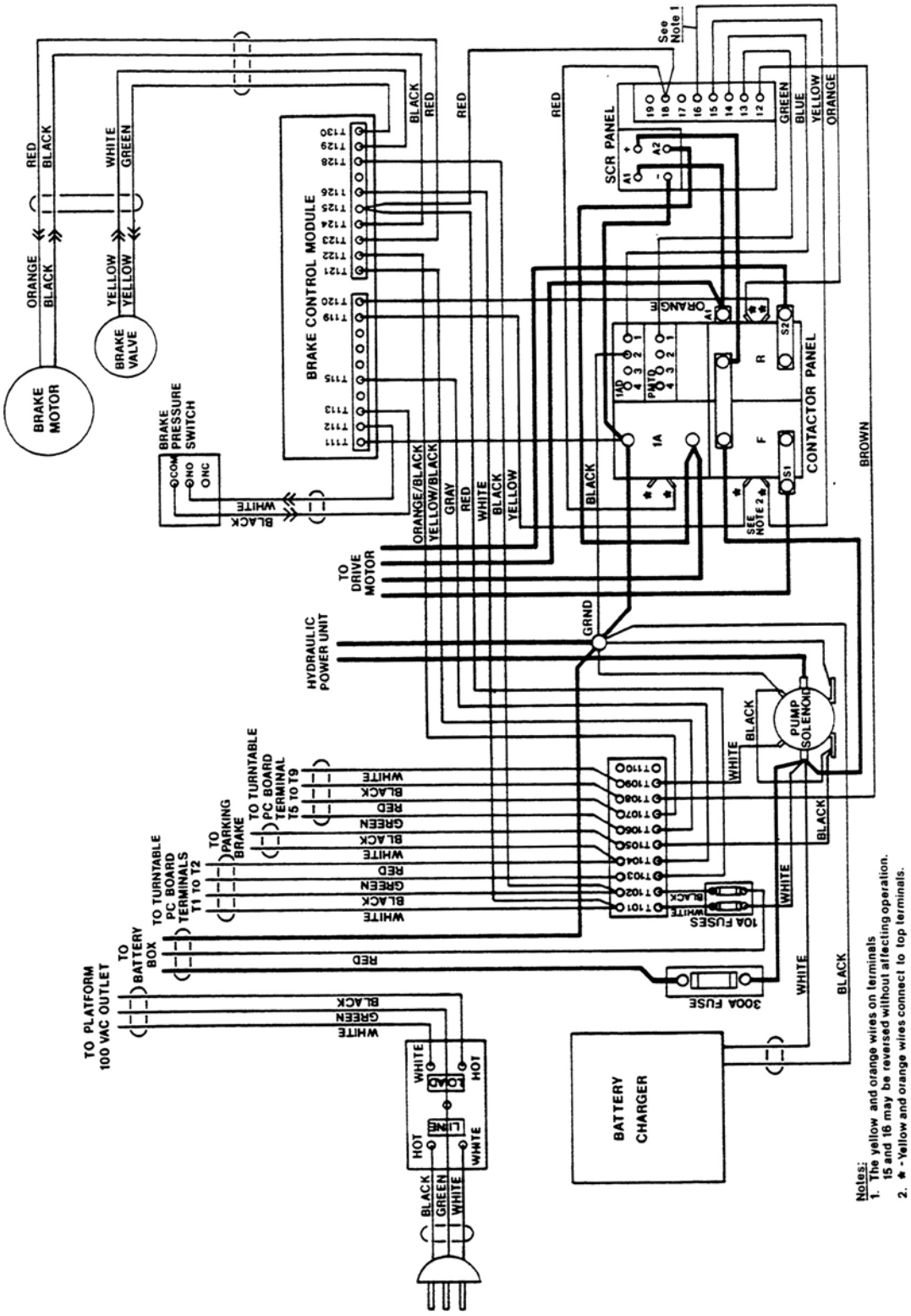


FIGURE 7-19
SCR / CHARGER MODULE WIRING

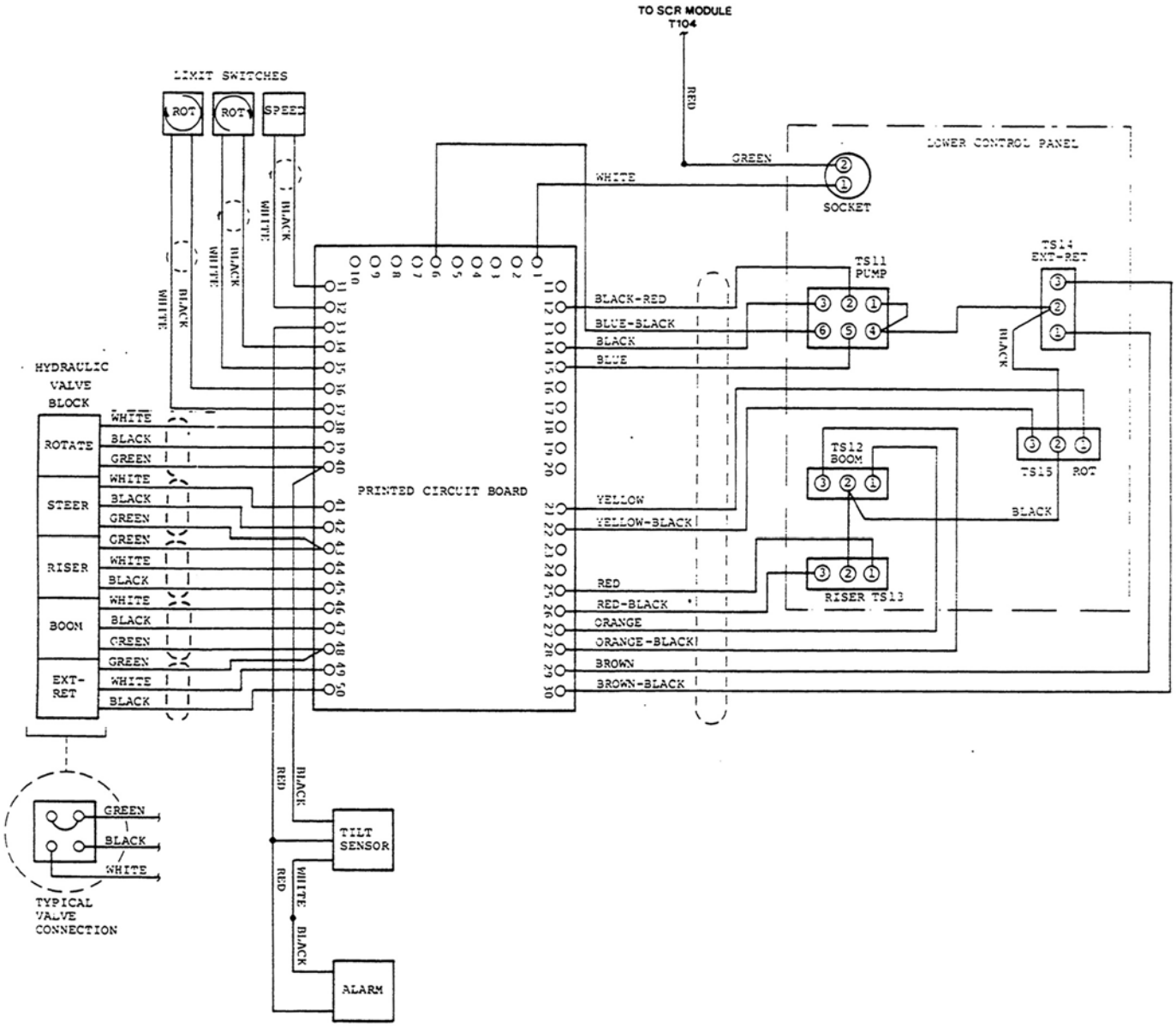
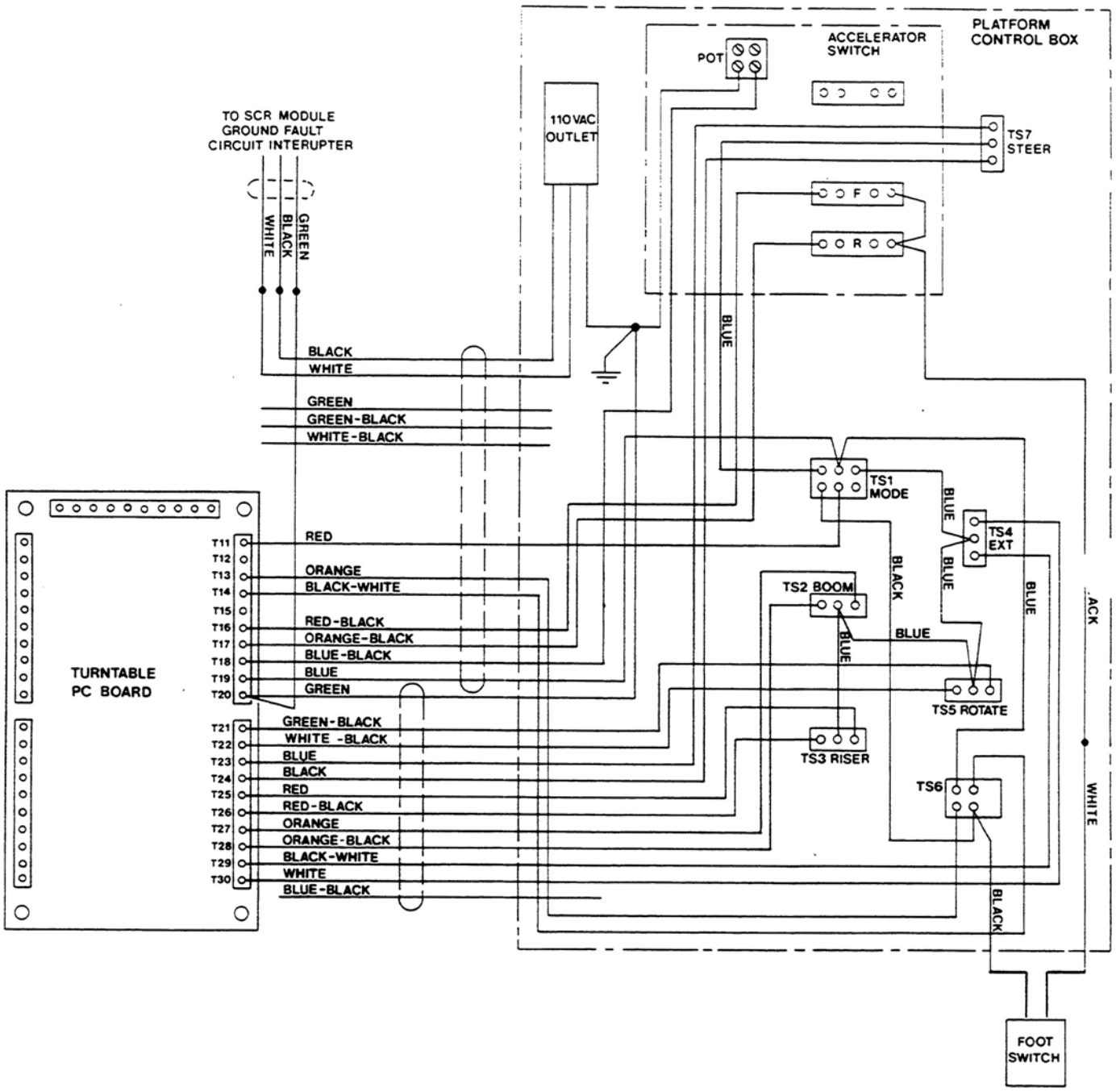
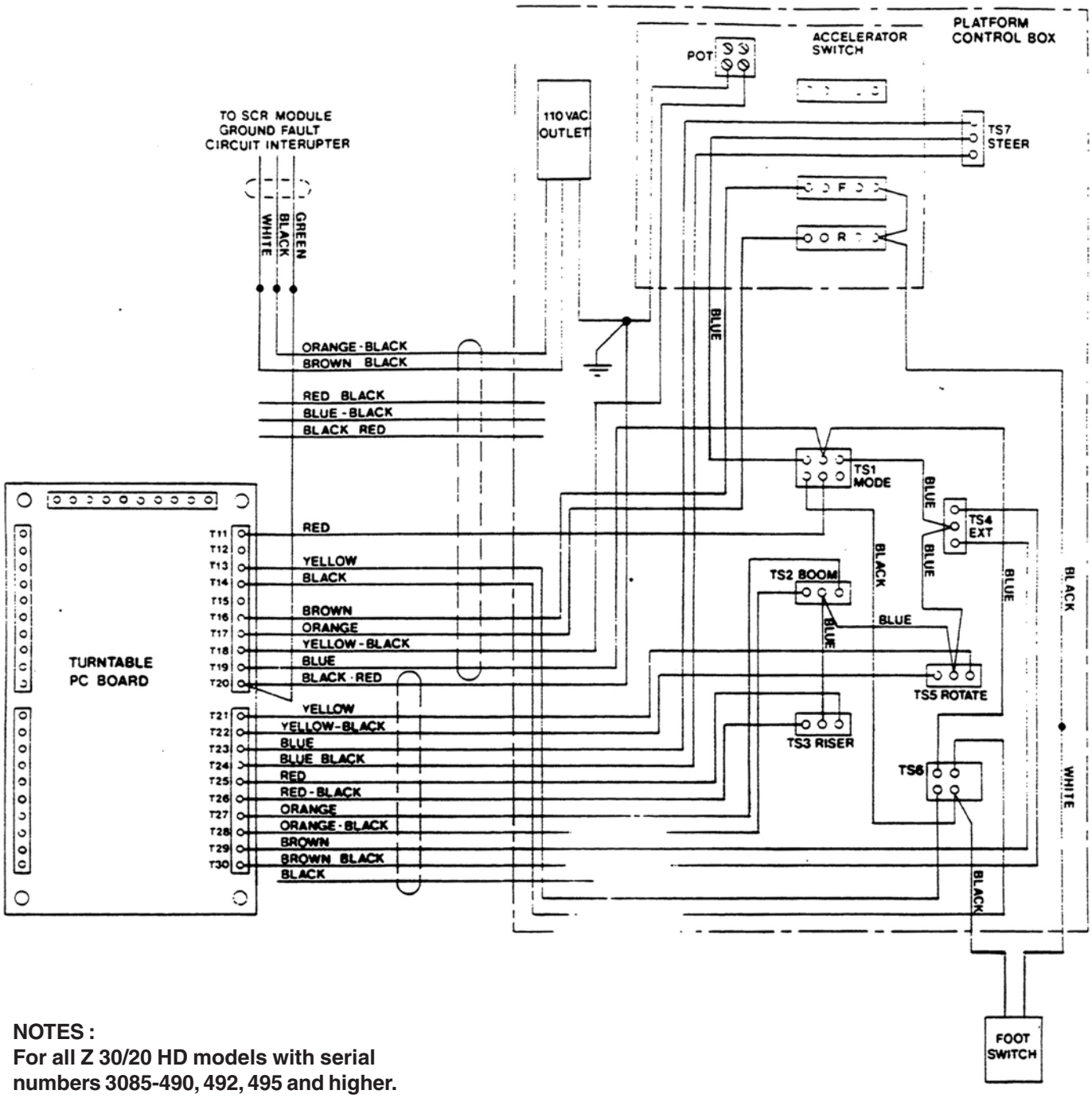


FIGURE 7-20
TURNTABLE WIRING



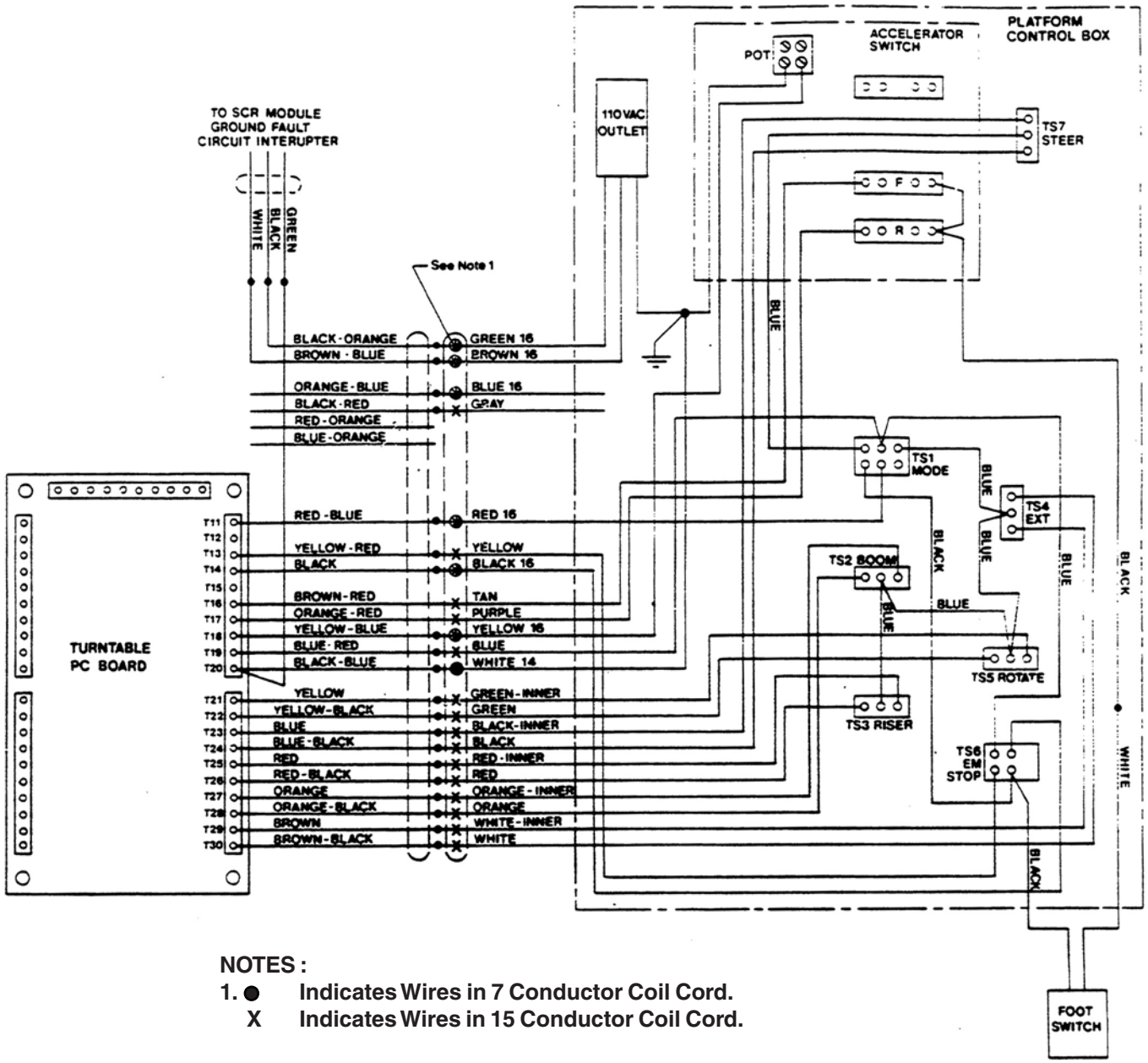
NOTES :
Obsolete October, 1985.
For Z 30/20HD models with serial numbers 3085-001 through 489 and 491,493 to 494.

FIGURE 7-21
CONTROL BOX WIRING Z 30/20 HD



NOTES :
For all Z 30/20 HD models with serial numbers 3085-490, 492, 495 and higher.

FIGURE 7-22
CONTROL BOX WIRING Z 30/20 HD



NOTES :

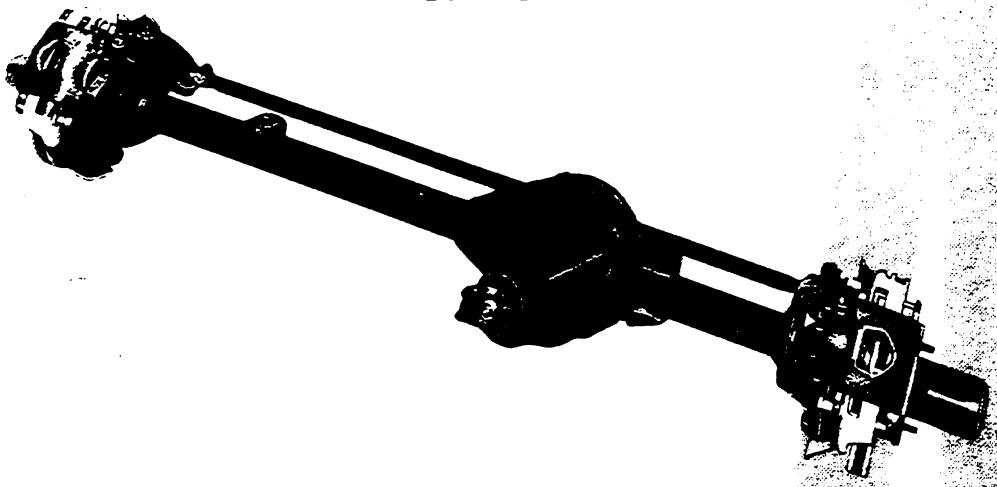
1. ● Indicates Wires in 7 Conductor Coil Cord.
   X Indicates Wires in 15 Conductor Coil Cord.

FIGURE 7-23
CONTROL BOX WIRING Z 30/20 HD

SPICER® AXLE

MAINTENANCE MANUAL

MODEL



FRONT AND REAR CARRIER TYPE

SPICER AXLE DIVISION DANA DANA CORPORATION

FORT WAYNE, INDIANA

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IMPORTANT SAFETY NOTICE

Should an axle assembly require component parts replacement, it is recommended that "Original Equipment" replacement parts be used. They may be obtained through your local service dealer or other original equipment manufacturer parts supplier. CAUTION: THE USE OF NON-ORIGINAL EQUIPMENT REPLACEMENT PARTS IS NOT RECOMMENDED AS THEIR USE MAY CAUSE UNIT FAILURE AND/OR AFFECT VEHICLE SAFETY.

Proper service and repair is important to the safe, reliable operation of all motor vehicles or driving axles whether they be front or rear. The service procedures recommended and described in this service manual are effective methods for performing service operations. Some of these service operations require the use of tools specially designed for the purpose. The special tool should be used when and as recommended.

It is impossible to know, evaluate and advise the service trade of all conceivable ways in which service might be done or of the possible hazardous consequences of each way.

Accordingly, anyone who uses a service procedure or tool which is not recommended must first satisfy himself thoroughly that neither his safety or vehicle safety will be jeopardized by the service methods he selects.

NOTE

Throughout this manual, reference is made to certain tool numbers whenever special tools are required. These numbers are numbers of the Miller Special Tools, 32615 Park Lane, Garden City, Michigan 48135. They are used herein for customer convenience only. Dana Corporation makes no warranty or representation with respect to these tools.

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Litho in U.S.A.

LUBRICATION

It is not our intent to recommend any particular brand or make of lubricant for Spicer axles. However, a S.A.E. 90 weight multipurpose gear lubricant meeting Mil. Spec. L-2105-B, or 80 W 90 multipurpose gear lubricant meeting Mil. Spec. L-2105-C, and suitable for A.P.I. Service Classificiation GL-5 is suggested as a minimum requirement.

IMPORTANT

As special equipment limited slip differentials are provided in many vehicles, the freedom from "chatter" is a function of the lubricant used and cannot be covered in the above specifications. In some applications, a special limited slip differential lubricant may be required. If required, these special lubricants are normally available through the original equipment manufacturer.

WHEEL BEARING LUBRICATION

Wheel bearings are lubricated by either grease packing the wheel bearing itself, or it can be lubricated from the hypoid gear lube in the housing.

For grease packing it is recommended that a number 2 consistency, lithium base 12 hydroxy stearate grease containing an E.P. additive be used. Such a lubricant would pass a load-carrying test at 40 pounds minimum with base oil pour point at —10° F. maximum.

Wheel bearings which depend on lubrication from the hypoid gear lube in the axle housing, it is recommended that a S.A.E. 90 multipurpose gear lube meeting Mil. Spec. L-2105-B be used.

CLOSED WHEEL END STEERING KNUCKLE LUBRICATION

The closed steering knuckle requires lubrication from a source other than the gear carrier assembly. Inboard tube seals contain the hypoid gear lube in the housing to provide an adequate lubricant level for the gears, bearings, etc. This then requires an additional lubricant level to be maintained outboard, in each steering knuckle, which can be observed by removing fill plugs on each knuckle. Adequate level would be to the bottom of the fill plug hole, when vehicle is observed to be in a normal horizontal position.

Recommended lubricant is a S.A.E. 140 grade, multipurpose gear lubricant meeting the Mil-L-2105-B specification.

COLD WEATHER OPERATION

If the vehicle is operated below 0 °F (−18 °C), it is advisable to use S.A.E. 80 multipurpose gear lubricant meeting Mil. Spec. L-2105-B and suitable for A.P.I. Service Classification GL-5.

SUBMERSION OR DEEP WATER FORDING

If the vehicle is exposed to water deep enough to cover the hubs of either the front or rear axles, it is recommended that the wheel ends be dissassembled and inspected for water damage, and/or contamination daily.

Clean, examine and replace damaged parts if necessary, prior to relubricating and assembling the wheel end components. Pay particular attention to the bearings and the closed steering knuckle on the front driving axle.

In the event the gear carrier housing should become submerged in water, particularly if over the breathers, it is recommended that the hypoid gear lubricant be drained daily and internal parts be inspected for water damage and/or contamination.

Clean, examine and replace damaged parts if necessary, prior to assembling the cover housing and refilling with the specified hypoid lubricant.

NOTE

It is recommended that whenever bearings are removed they are to be replaced with new ones, regardless of mileage.

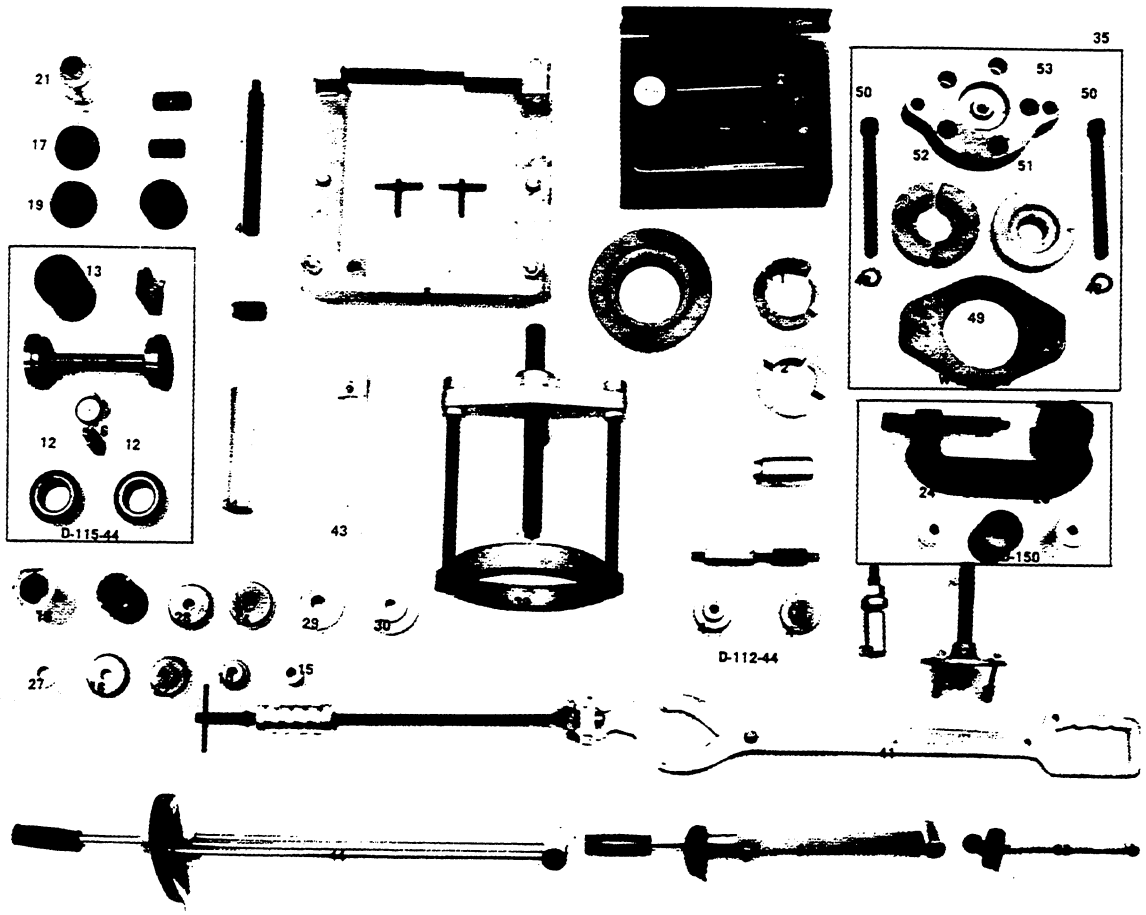


Figure 2 1009-2

The following is a detailed list of all Special Service Tools required to service the Model 44 Front and Rear Axles.

Item No.	Tool No.	Description
1	C-293-18	Adapter Set—Differential Bearing Cones
2	C-293-39	Adapter Set—Rear Pinion Bearing Cone
**** 3	D-112	Screw
**** 4	D-112-1	Installer—Front Axle—Differential Inner Oil Seal
5	D-113	Spreader
* 6	D-115	Scooter Gauge
* 7	D-115-1	Pinion Height Block
* 8	D-115-3	Arbor
* 9	D-115-4	Arbor Discs
10	D-112	Installer—Front Spindle Needle Bearing
11	D-131	Puller—Slide Hammer
*12	D-135	Master Bearing Differential
*13	D-139	Master Pinion Block
14	D-140	Installer—Front Brake Hub Cup (outer)
15	D-141	Installer—Front Spindle Bushing
16	D-142	Installer—King Pin Bearing Cup (Heavy Duty)
17	D-144	Installer—Front Pinion Bearing Cup
18	W-144A	Wrench—Wheel Bearing Adjusting (Nut Type)
19	D-145	Installer—Rear Pinion Bearing Cup
20	D-147	Remover—Front Pinion Bearing Cup
21	W-147-D	Installer—Pinion Oil Seal
22	D-148	Remover—Rear Pinion Bearing Cup
***23	D-150-1	Remover & Installer—Front Axle Ball Joint
***24	D-150-2	Adjuster—Ball Joint Removing
***25	D-150-3	Sleeve—Ball Joint Removing
***26	D-150-4	Sleeve—Ball Joint Installing
27	D-151	Installer—King Pin Bearing Cup

Item No.	Tool No.	Description
28	D-153	Installer—Front Brake Hub Inner Bearing Cup (Regular)
29	D-154	Installer—Front Brake Hub Inner Bearing Cup (Heavy Duty)
30	D-155	Installer—Front Brake Hub Grease Seal (Reg. & Heavy Duty)
31	D-156	Installer—Differential Side Bearings
32	D-157	Installer—Axle Shaft Outer Oil Seal
33	W-162	Installer—Flange or Yoke
34	W-262	Installer—Rear Pinion Bearing Cone
**35	W-343-44D	Remover & Installer—Axle Shaft Bearings
36	C-452	Remover—Flange or Yoke
37	C-524-A	Torque Wrench (100 ft. lb.)
38	C-685-A	Torque Wrench (300 inch lb.)
39	DD-914-P	Press
40	DD-914-9	Adapter Ring
41	C-3281	Holder—Flange or Yoke
42	C-293-3	Adapter Plug—Differential Hub
43	C-4049	Remover—Bearing Cups
44	C-4053	Torque Wrench (300 ft. lb.)
45	C-4169	Wrench—Upper Ball Joint Removing, Installing & Torquing
46	C-4170	Wrench—Wheel Bearing Adjusting (Lug Type)
47	C-4171	Handle—Universal
**48	SP-3020	Washers
**49	SP-5017	Adapter Ring
**50	SP-5026	Bolts
**51	SP-5439	Adapter Plate—Installer
**52	SP-5442-D	Adapter Set—Removing
**53	SP-5443-A	Flange Plate
54	D-128	Dial Indicator Set

*Pinion Setting Gauge and Master Differential Bearing Kit D-115-44

**Axle Shaft Bearing Removing and Installing Kit W-343-44D

***40 Degree Steer Front Ball Joint Removing and Installing Kit D-150

****Inner Axle Shaft Seal Installing Kit D-112-44

Note: Torque wrenches C-524A, C-685-A, and C-4053 are optional and can be purchased separately. These Torque wrenches are not included in the DW-44 Axle Tool Kit.

AXLE IDENTIFICATION

All Spicer axles are identified with a manufacturing date and the complete part number stamped in the right hand tube. Also each axle contains a gear ratio tag; and if the axle is equipped with a limited slip differential, it will contain a tag requesting the use of limited slip lubricant.

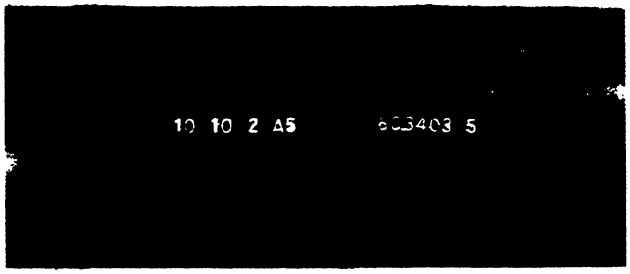


Figure 3 1009-3

In the figure the axle is identified with 1/8" high numbers stamped in the tube. For example, the numbers 10-10-2 A5 is the manufacturing or build date of the axle and is interpreted as follows. The first number is the month, the second number is the day of the month, the third number is the year, the letter is the shift and the last number is the line that built the axle. For example: October 10, 1972, first shift, line 5.

NOTE

In the event there are two build dates, the latter will be the date in which the brake components were assembled.

It is recommended that when referring to the axle, obtain the complete part number and build date. To do this, it may be necessary to wipe or scrape off the dirt, etc., from the tube.

NOTE

On front driving axles, the above numbers can be either on the long or short tube.

AXLE IDENTIFICATION

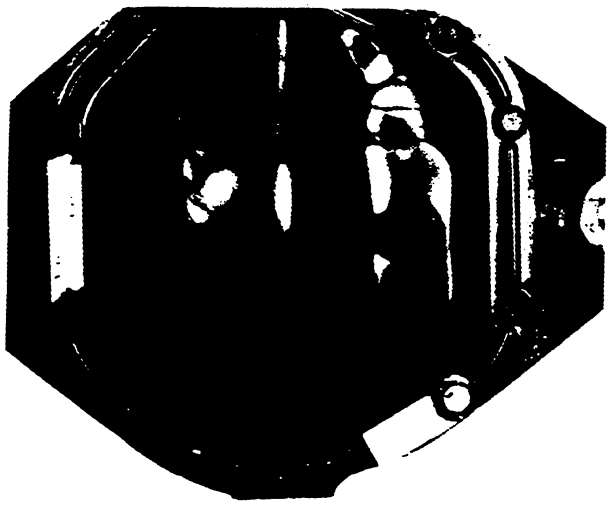


Figure 4 1009-4

The gear ratio tag is located on the left side of the cover plate and is held in place with two cover plate screws. This tag gives the tooth combination of the ring and pinion, the total gear ratio, and also the customer part number.

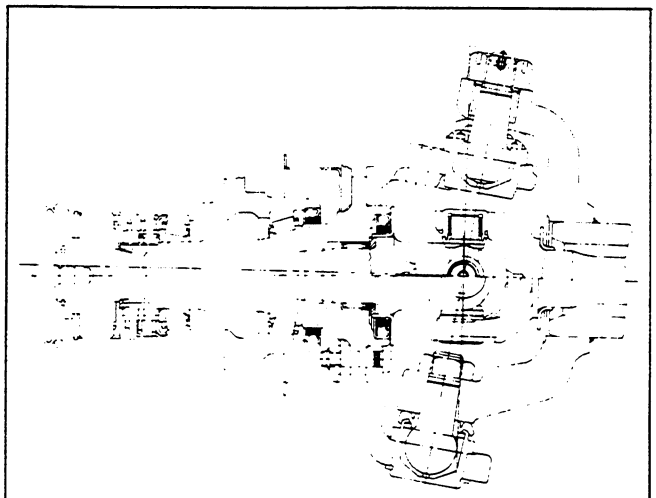


Figure 5 1009-5

40 DEGREE STEER WITH INTERNAL HUBS

FRONT AXLE

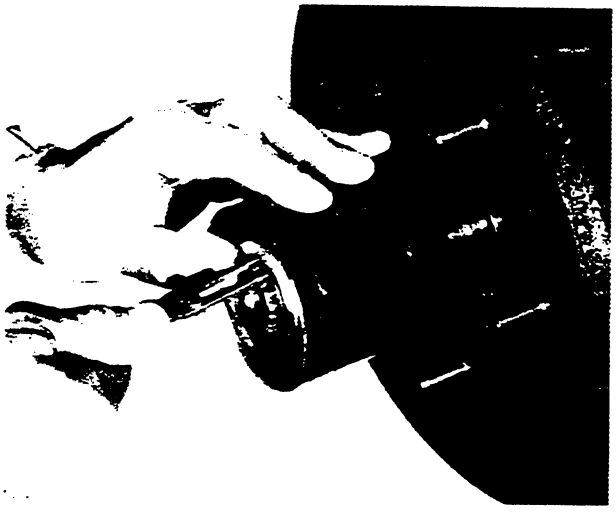


Figure 6 1009-6

Remove hub cap and snap ring.

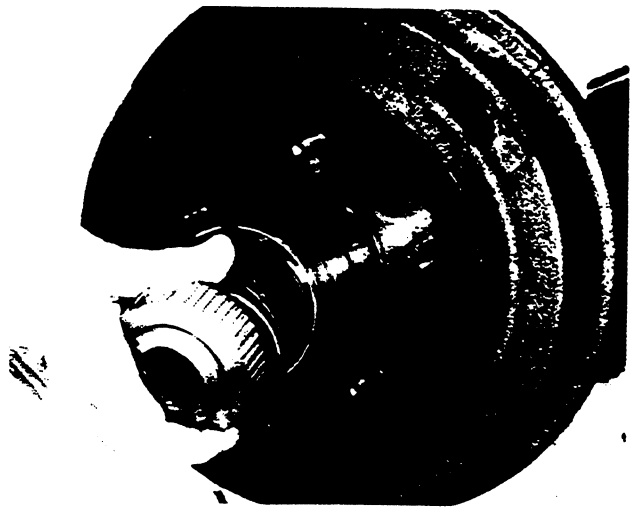


Figure 7 1009-7

Remove drive gear and pressure spring. If drive gear is stuck to the shaft, use a screw driver to pry out gear.

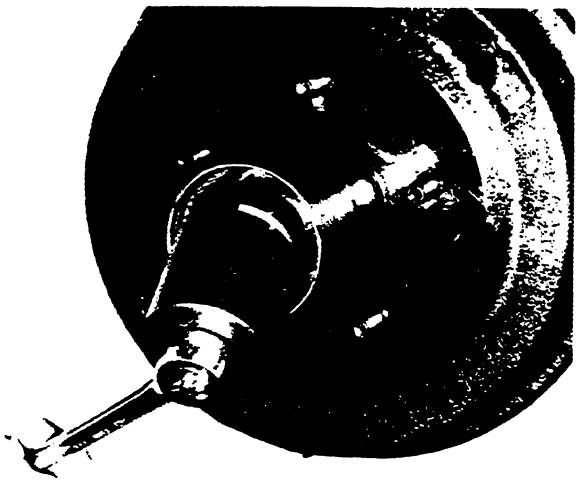


Figure 8 1009-8

Remove wheel bearing lock nut, lock ring and the wheel bearing adjusting nut.

Tool—#C-4170 Wheel bearing wrench.

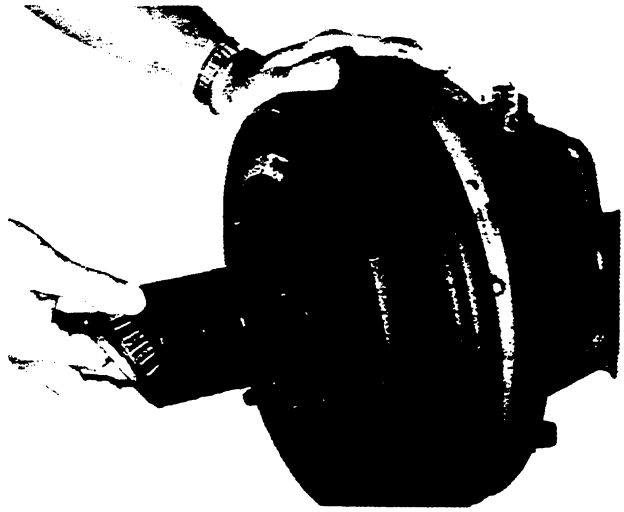


Figure 9 1009-9

Remove hub and drum assembly. Spring retainer and outer wheel bearing will slide out as drum is removed.

NOTE

If it is necessary to replace brake components such as drum, shoes, backing plate, etc., refer to vehicle service manual.

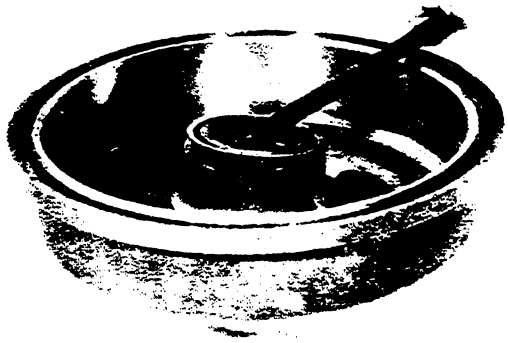


Figure 10 1009-10

Remove hub grease seal and inner wheel bearing cone.

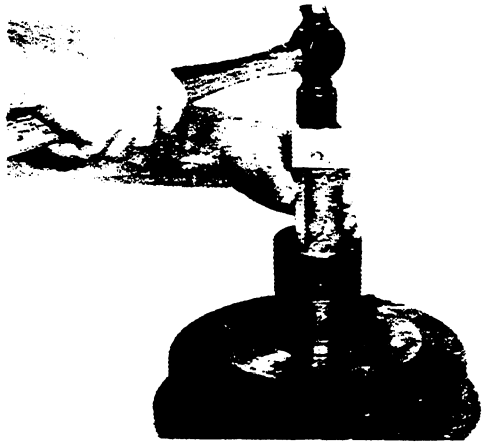


Figure 11 1009-11

Remove inner wheel bearing cup.

Tool—#C-4049 Wheel bearing cup remover.

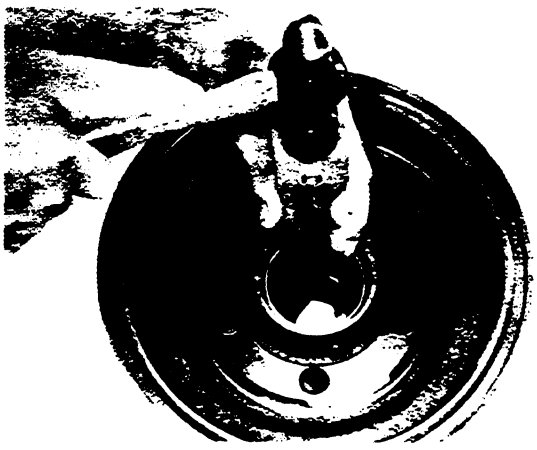


Figure 12 1009-12

Remove outer wheel bearing cup.

Tool—#C-4049 Wheel bearing cup remover.

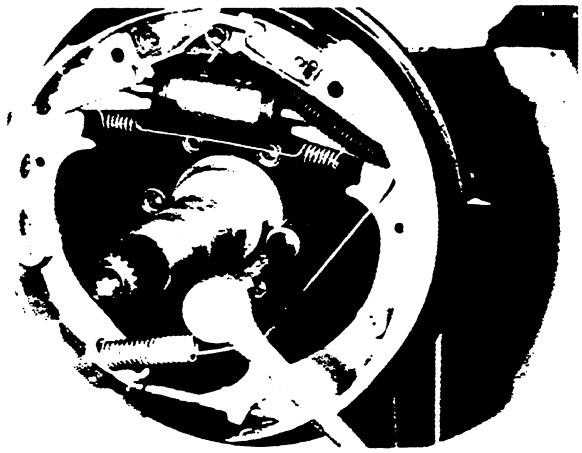


Figure 13 1009-13

Remove backing plate screws and remove backing plate.

> **NOTE**
>
> The brake backing plate assembly can be retained with screws or nuts. If the nuts are of the torque prevailing design, they are to be replaced with new ones.

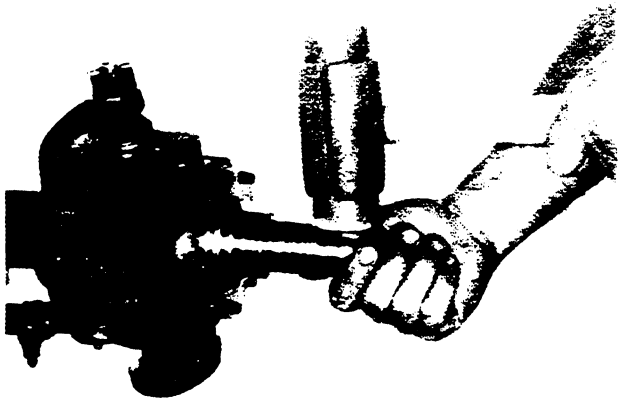


Figure 14 1009-14

Remove spindle. If necessary tap lightly with a rawhide hammer to free it from the knuckle. Check brone spacer located between shaft joint assembly and bearing. If wear is evident, replace with a new one.

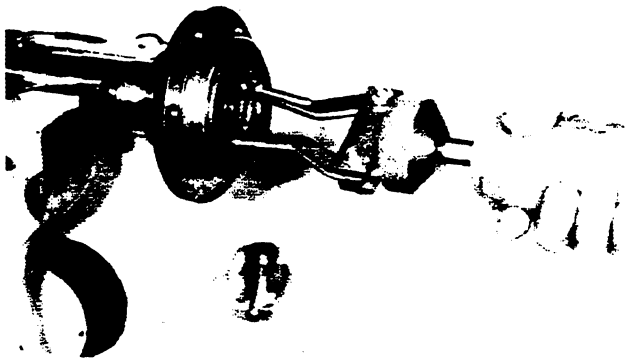


Figure 15 1009-15

Place spindle in vise. **Do not locate on bearing diameters.**

Remove grease seal. **Discard seal.**

Tool—#D-131 Slide hammer.

> **NOTE**
>
> Be sure that vise jaws are equipped with brass protectors or similar type to protect the machined surfaces of any parts that are to be placed in the vise.

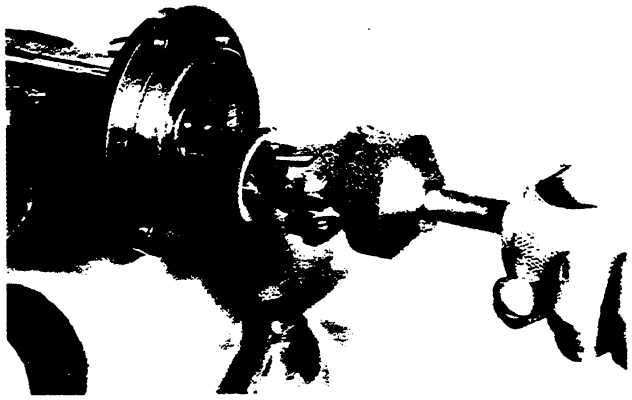


Figure 16 1009-16

Remove needle bearing. Bronze bushing may stick to the bearing as the spindle was removed, but can be removed when removing the needle bearing as shown.

Tool—#D-131 Slide hammer.

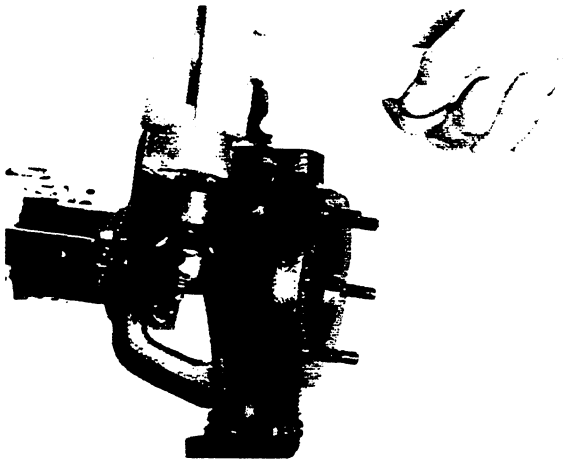


Figure 17 1009-17

Remove cotter key from tie rod nut. Remove nut. Tap on tie rod stud to free it from the steering arm.

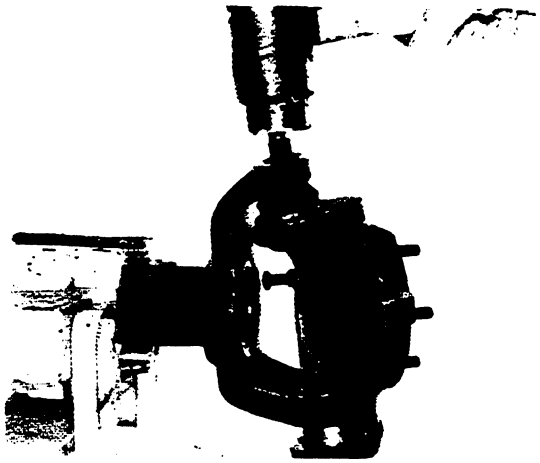


Figure 19 1009-19

Using a rawhide hammer, hit sharply on the top stud to free the knuckle from the tube yoke. After knuckle is free from the yoke, remove both the top and bottom nuts. **Discard bottom nut.** The nut on the bottom socket is of the torque prevailing design and is not to be reused.

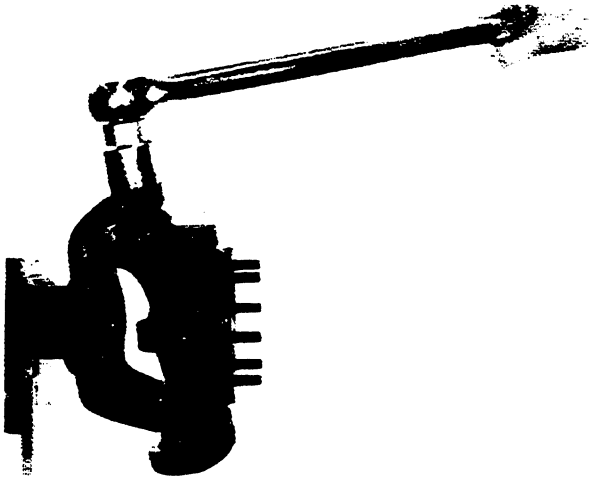


Figure 18 1009-18

Remove cotter key from top socket. Loosen both the top and bottom nuts.

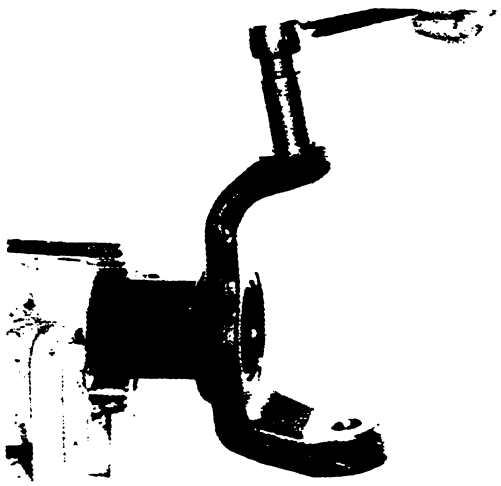


Figure 20 1009-20

Remove threaded sleeve from yokes with Tool #C-4169 socket wrench.

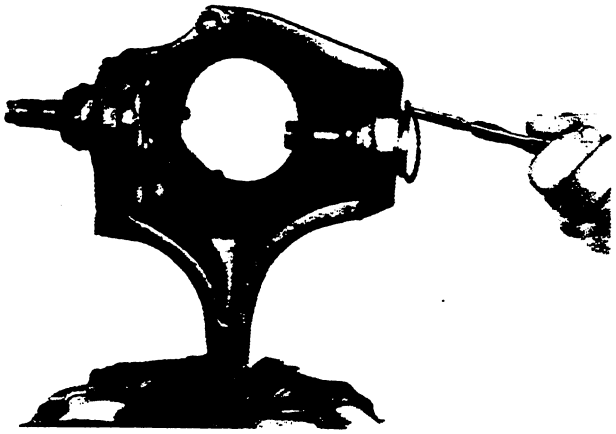


Figure 21 1009-21

Place knuckle in vise as shown. If bottom ball socket is equipped with a snap ring, remove as shown.

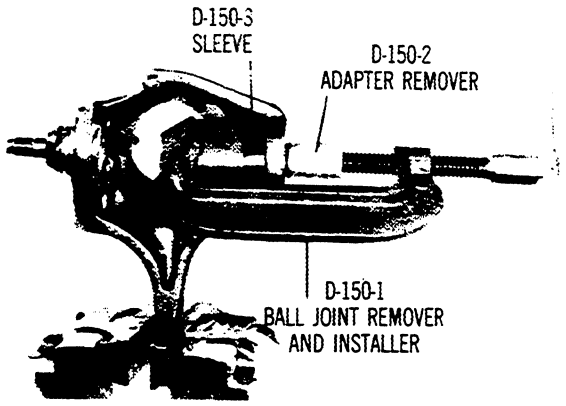


Figure 22 1009-22

NOTE: BOTTOM BALL SOCKET MUST BE REMOVED BEFORE THE TOP BALL SOCKET CAN BE REMOVED.

Assemble ball socket tools as shown. Turn forcing screw and push out bottom socket.

DISCARD BALL SOCKET

Tools—#D-150-1 Ball Joint Remover & Installer, #D-150-2 Adapter Remover, and #D-150-3 Sleeve.

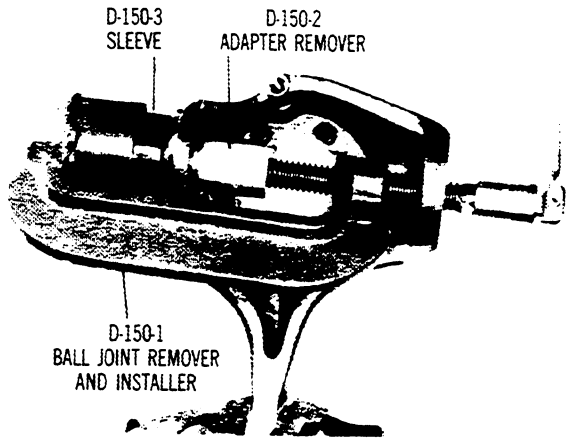


Figure 23 1009-23

Assemble ball socket tools as shown. Turn forcing screw and push out top socket.

Discard Ball Socket

Tools—#D-150-1 Ball Joint Remover & Installer, #D-150-2 Adapter Remover, and #D-150-3 Sleeve.

ASSEMBLY

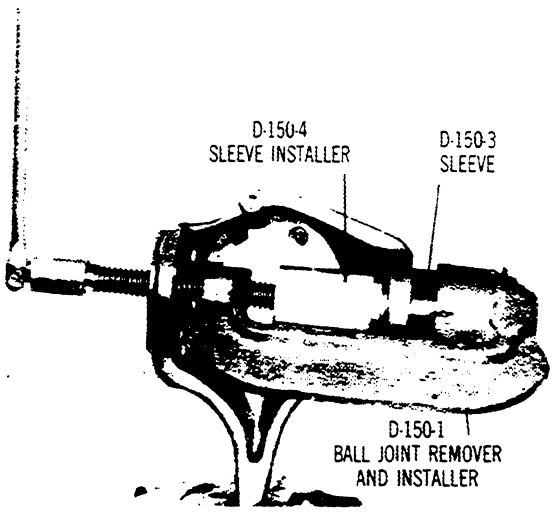


Figure 24 1009-24

(Lower ball socket does not have a cotter key hole in the stud end.)

Assemble bottom socket into the knuckle. Make sure socket is straight.

Assemble tools as shown. Turn forcing screw and push socket into knuckle as far as it will go.

Tools—#D-150-1 Ball Joint Remover & Installer, #D-150-3 Sleeve, & #D-150-4 Sleeve Installer.

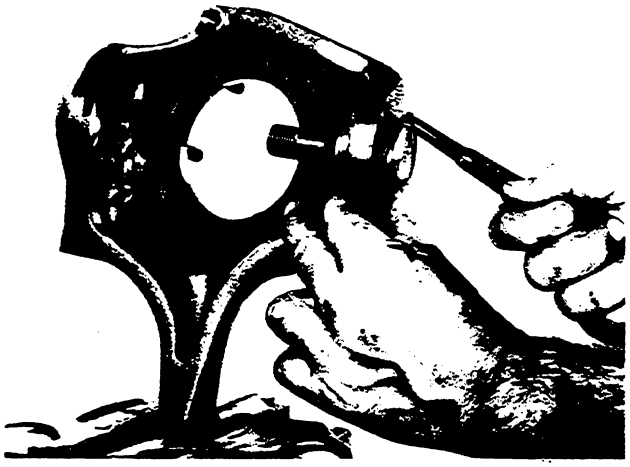


Figure 25 1009-25

If required, assemble snap ring on bottom socket.

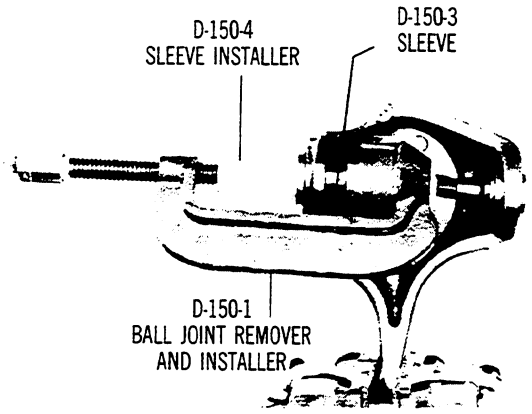


Figure 26 1009-26

Upper ball socket has a cotter key hole in the stud end. Assemble socket into knuckle. Make sure socket is straight.

Assemble tools as shown. Turn forcing screw and push socket into knuckle as far as it will go.

Tools—#D-150-1 Ball Joint Installer & Remover, #D-150-3 Sleeve, & #D-150-4 Sleeve Installer.

Remove tools. Make sure this area is free from dirt, etc.

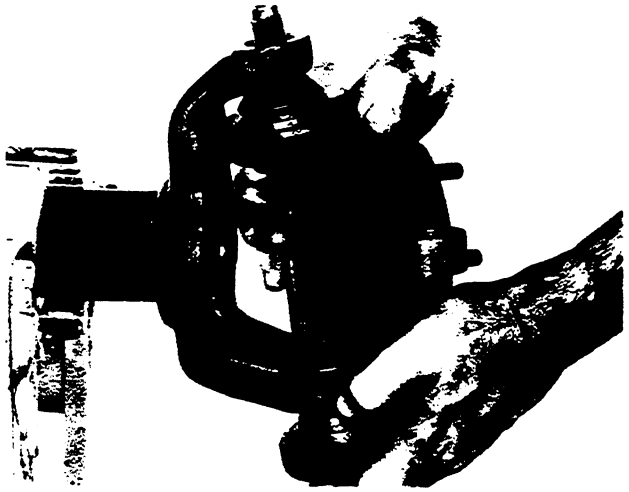


Figure 27 1009-27

Assemble knuckle and socket assembly to yoke as shown.

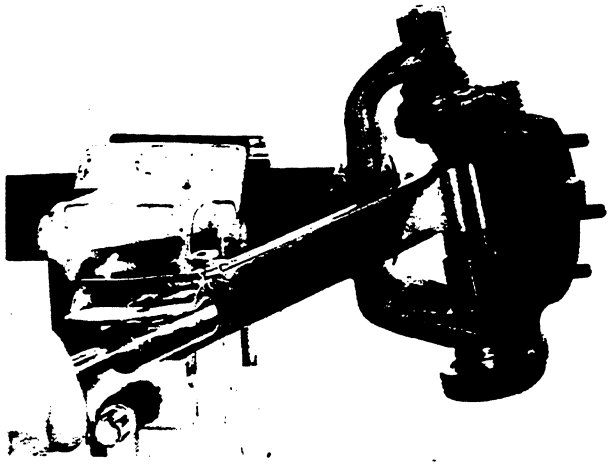


Figure 28 1009-28

Assemble new torque prevailing nut on bottom socket finger tight.

Assemble top nut on top socket. **Do not assemble at this time.**

Torque top nut until it is tight. This will pull the studs of the bottom socket into the tapered hole of the yoke.

Torque bottom nut to 80 lbs. ft.

Tool—#C-524-A Torque wrench.

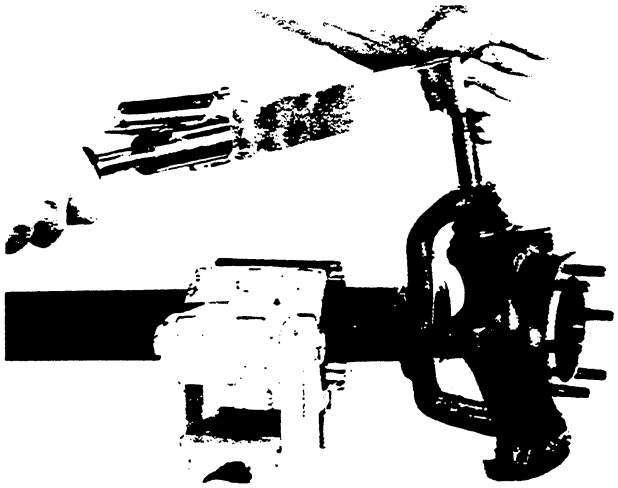


Figure 29 1009-29

Assemble new threaded sleeve into top of yoke. Using tool as shown torque sleeve to 50 lbs. ft.

Tools — #C-4169 Sleeve socket, #C-524-A Torque wrench.

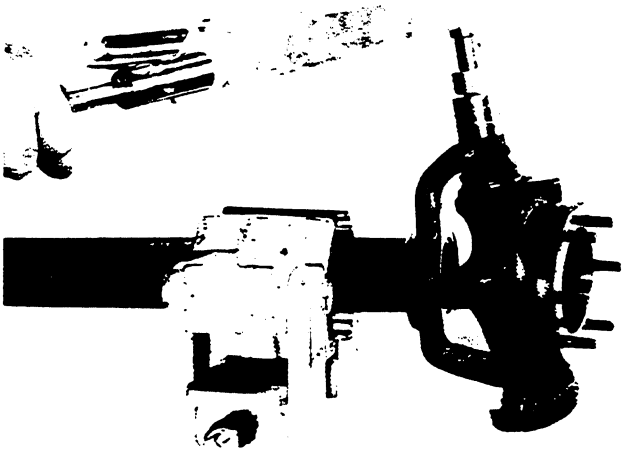


Figure 30 1009-30

Assemble top socket nut. Torque nut to 100 lbs. ft. After nut has been torqued, tighten nut to line up the cotter key hole of the stud with the next castellation or slot of the nut. **Do not loosen nut.**

Tool—#C-524-A Torque wrench.



Figure 31 1009-31

Assemble cotter key.

NOTE

In the event that knuckles are received with the sockets and snap ring assembled to the knuckle, along with new top and bottom nuts, split sleeve and cotter key. Follow procedures as illustrated through Figues 27 through 31 for assembly.

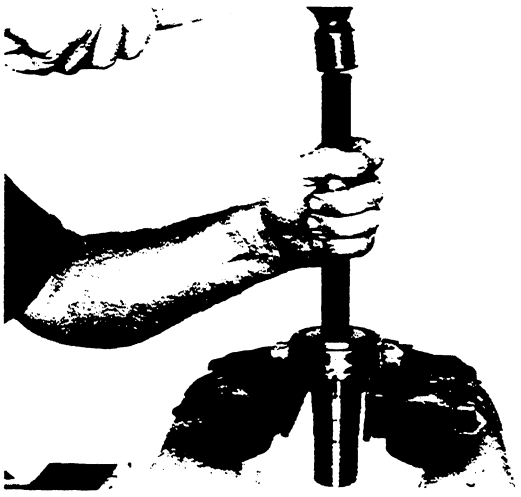


Figure 32 1009-32

Assemble new needle bearing into spindle.

Tools—#D-122 Installer, #C-4171 Handle.

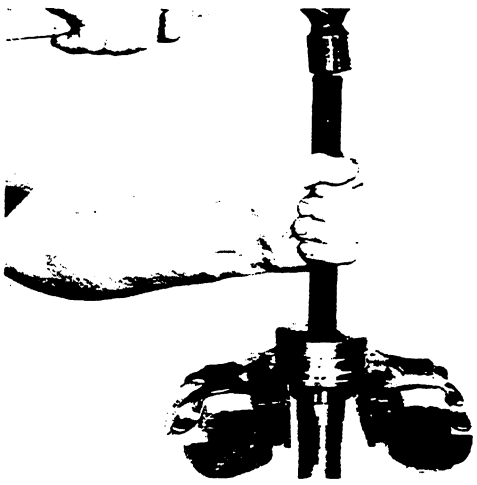


Figure 33 1009-33

Assemble new grease seal into spindle.
Tools—#D-155 Installer, #C-4171 Handle.

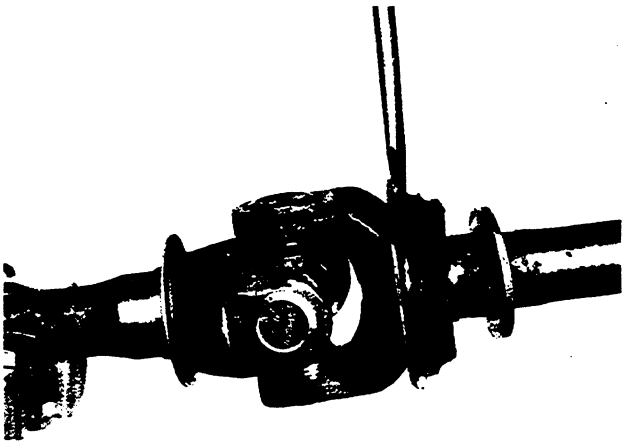


Figure 34 1009-34

Some front axles are equipped with a "V" seal which is assembled to the axle shaft stone shield as shown. If seal is worn, remove and replace with a new one.



Figure 35 1009-35

Assemble new seal as shown. Lip of the seal is to be directed towards the spindle.



Figure 36 1009-36

Pack the area around the thrust face area of the shaft and seal full of grease. Also, fill the seal area of the spindle with grease.

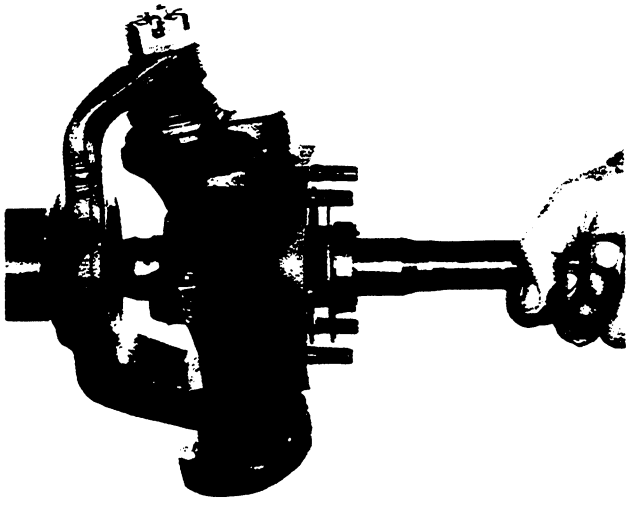


Figure 37 1009-37

Assemble axle shaft joint assembly into tube.

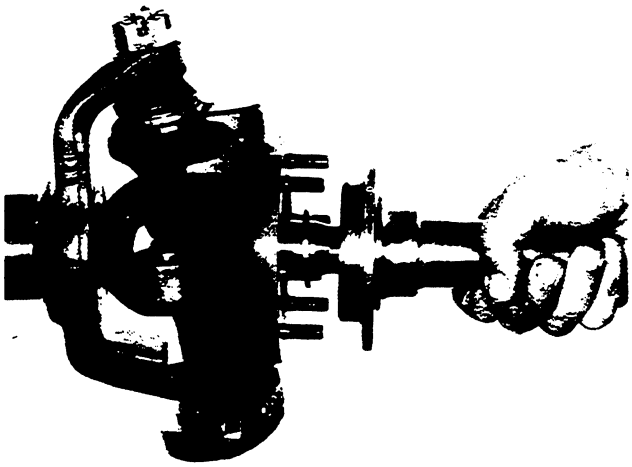


Figure 38 1009-38

Assemble new bronze spacer and spindle.

NOTE

Be sure chamfer end of spacer is directed toward the seal slinger of the axle shaft joint.

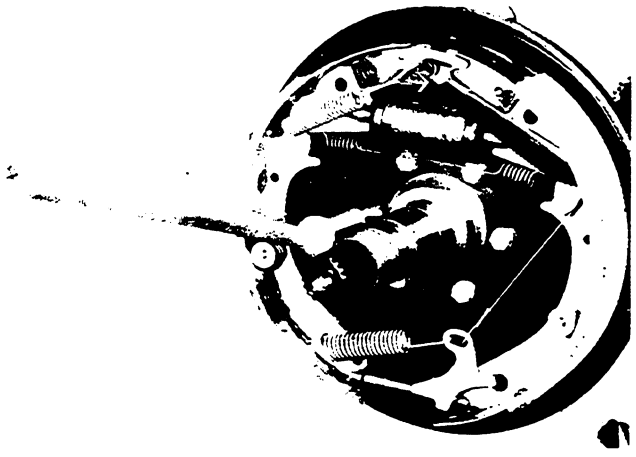


Figure 39 1009-39

Assemble brake backing plate assembly. Assemble new nuts. Torque nuts to 25-30 lbs. ft.

Tool—#C-524-A Torque wrench.

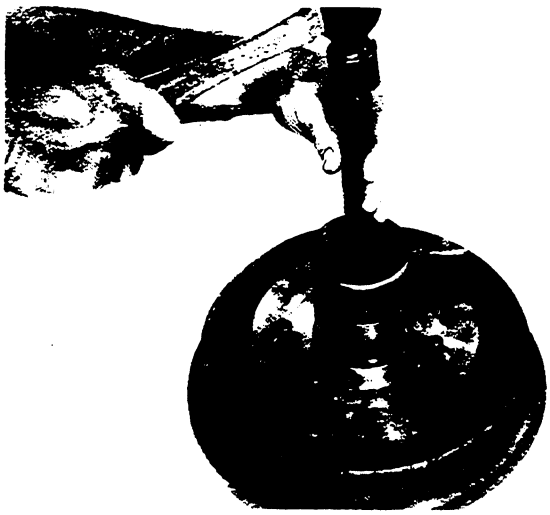


Figure 40 1009-40

Assemble new outer wheel bearing cup.

Tools—#D-140 Installer, #C-4171 Handle.



Figure 41 1009-41

Assemble new inner wheel bearing cup.

Tools—#D-153 Installer, #C-4171 Handle.

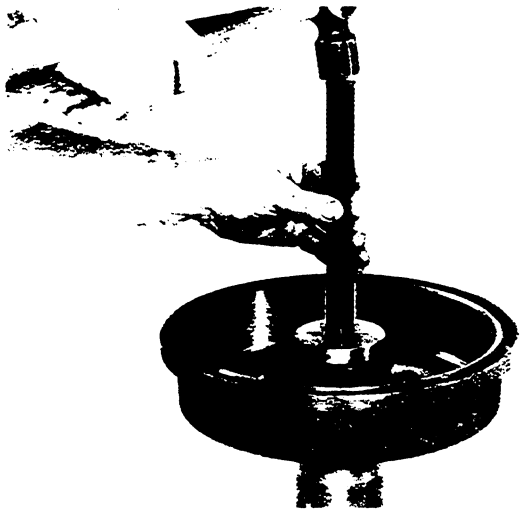


Figure 42 1009-42

Assemble new wheel bearing grease seal.
Tools—#D-155 Installer, #C-4171 Handle.



Figure 43 1009-43

Assemble brake drum and outer wheel bearing cone to spindle. Assemble inner wheel bearing adjusting nut. Torque nut to 50 lbs. ft. Rotate hub, then back off nut 90° maximum. Assemble lockwasher, line tap up with keyway of spindle, turn nut to nearest hole of the lockwasher. Assemble outer locknut. Torque nut to 50 lbs. ft. minimum.

Tool—#C-4170 Wheel bearing wrench.

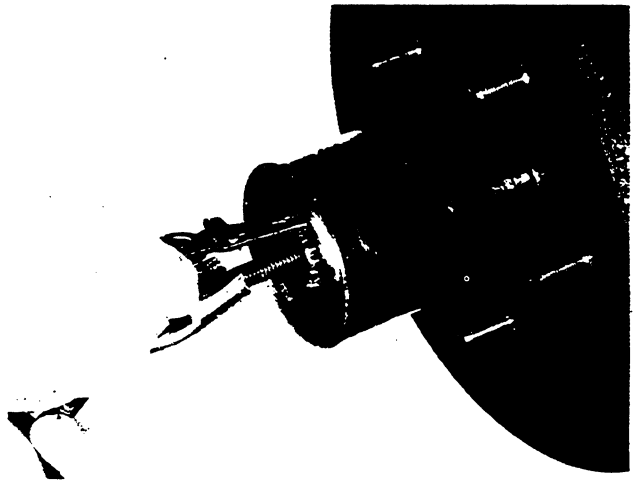


Figure 44 1009-44

Assemble drive gear and snap ring. Assemble bolt into shaft. Pull on bolt, push on gear to allow clearance of the snap ring groove. Be sure snap ring is seated in snap ring groove.

40 DEGREE STEER— INTERNAL HUBS WITH DISC BRAKES DISASSEMBLY

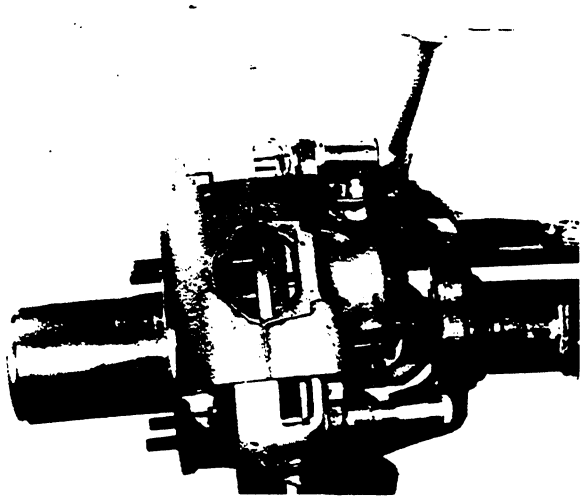


Figure 45 1009-45

Remove both brake caliper assembly bolts.



Figure 46 1009-46

Remove brake caliper assembly.

To remove the hub and brake disc assembly follow the same procedures as illustrated in Figures 7 thru 9.

To remove wheel bearings and seal from the hub follow the same procedures as illustrated in Figures 1009-10 thru 1009-12.

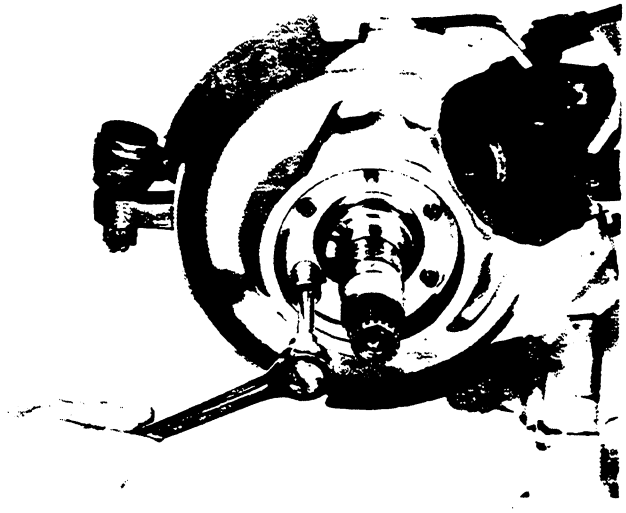


Figure 47 1009-47

Remove six (6) torque prevailing nuts from brake disc shield.

NOTE

These nuts are of the torque prevailing design and should be discarded and replaced with new ones during assembly.

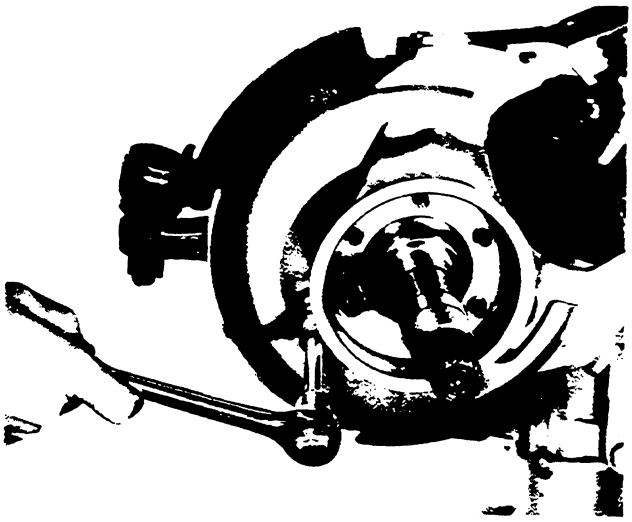


Figure 48 1009-48

Remove shield bolt which is retained in the knuckle.

Remove shield and bracket assembly from spindle.

To remove spindle, spindle seals, spindle bearings and axle shaft joint assembly, follow the same procedures as illustrated in Figures 1009-14 thru 1009-16.

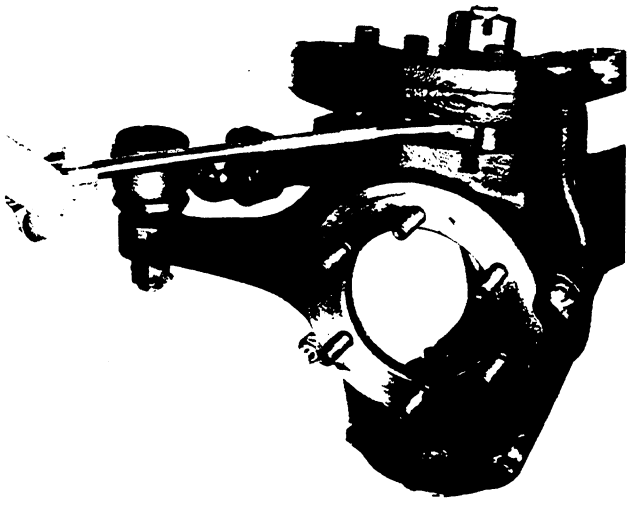


Figure 49 1009-49

Remove three steering arm nuts and cone washers and remove steering arm. Use a rawhide hammer and tap lightly on arm to free it from knuckle. Also a screw driver as shown to remove arm.

Remove cotter key, tie rod nut and remove tie rod.

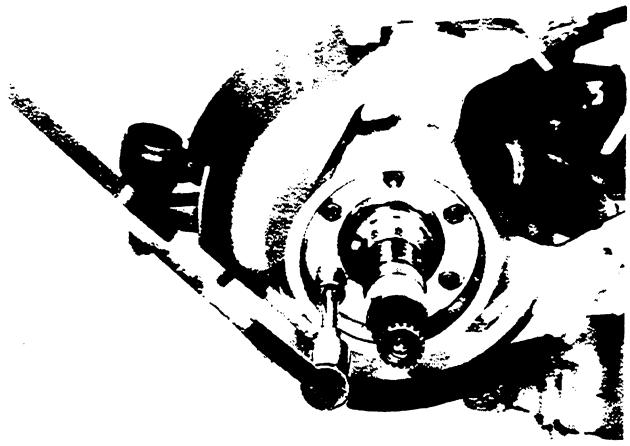


Figure 50 1009-50

Assemble brake shield bracket assembly to spindle using new torque prevailing nuts.

Torque nuts to 30-40 lbs. ft.

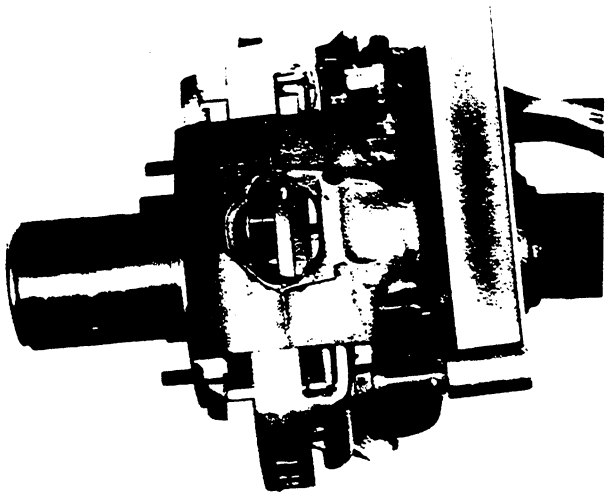


Figure 52 1009-52

Assemble brake caliper bolts. Torque bolts to 30-40 lbs. ft.

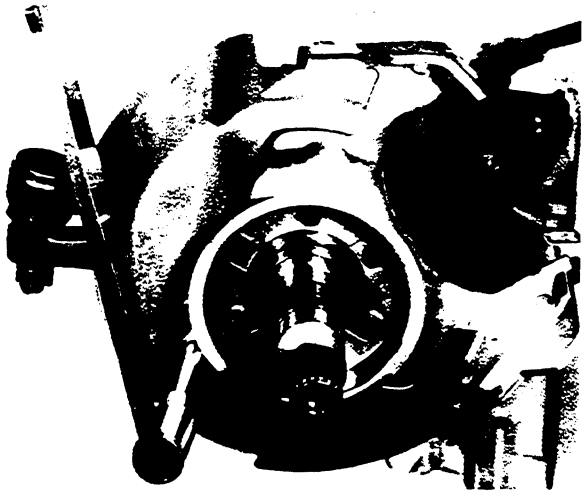


Figure 51 1009-51

Assemble shield bolt to knuckle. Torque bolt to 5-10 lbs. ft.

To assemble new wheel bearings and new seal to hub and brake disc assembly, follow the same procedure as illustrated in Figures 1009-40 thru 1009-42.

40 DEGREE STEER WITH EXTERNAL HUBS

DISASSEMBLY

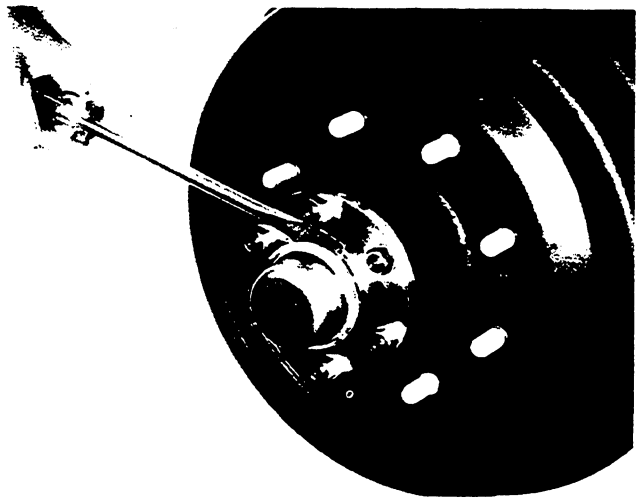


Figure 53 1009-53

Remove hub cap.

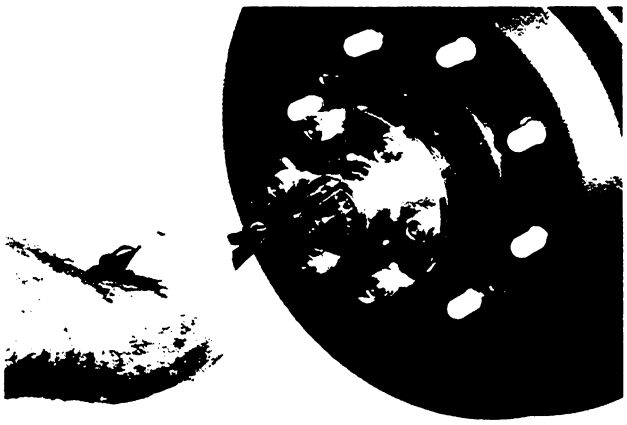


Figure 54 1009-54

Remove snap ring.



Figure 55 1009-55

Remove six flange nuts and lockwashers.

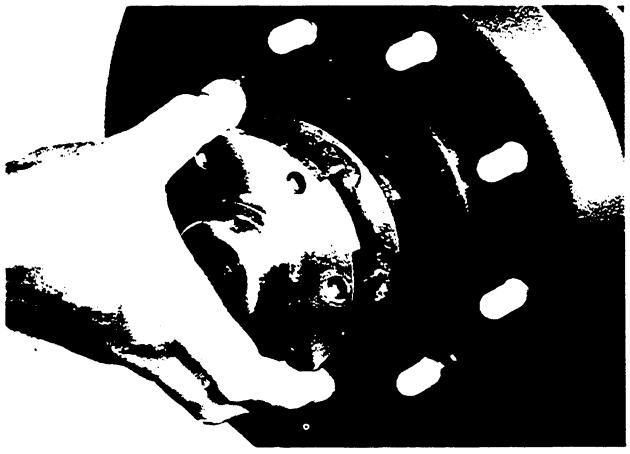


Figure 56 1009-56

Remove drive flange and gasket. **Discard gasket.** To free flange from hub, tap lightly with a rawhide hammer. Replace new gasket at time of assembly.

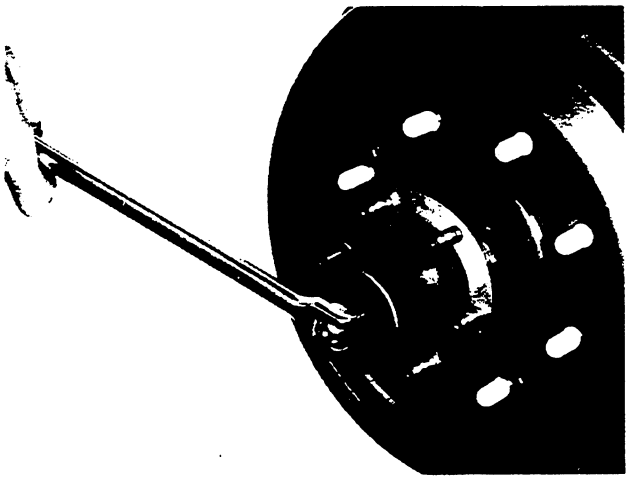


Figure 57 1009-57

Remove outer lock nut, lock ring, and wheel bearing adjusting nut.



Figure 58 1009-58

Remove drum assembly. Outer wheel bearing will slide out as drum is removed.

NOTE

If it is necessary to replace brake components such as drum, shoes, backing plate, etc., refer to Vehicle Service Manual.

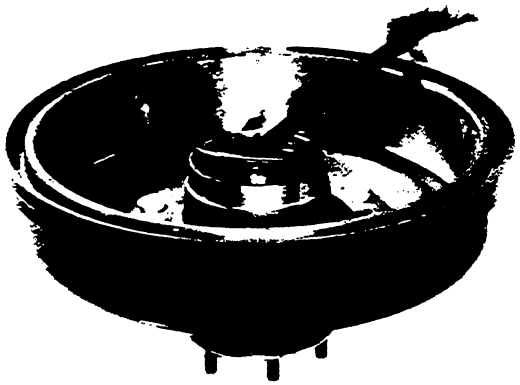


Figure 59 1009-59

Remove wheel bearing grease seal and inner bearing cone.



Figure 60 1009-60

Remove outer wheel bearing cup. Locate tool on cup and drive out.
Tool—#C-4049.

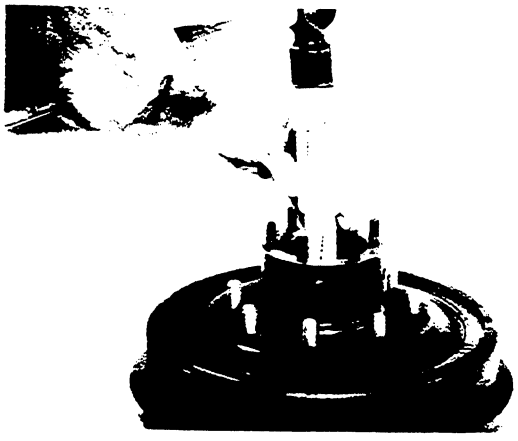


Figure 61 1009-61

Remove inner wheel bearing cup. Locate tool on cup and drive out.
Tool—#C-4049.

ASSEMBLY

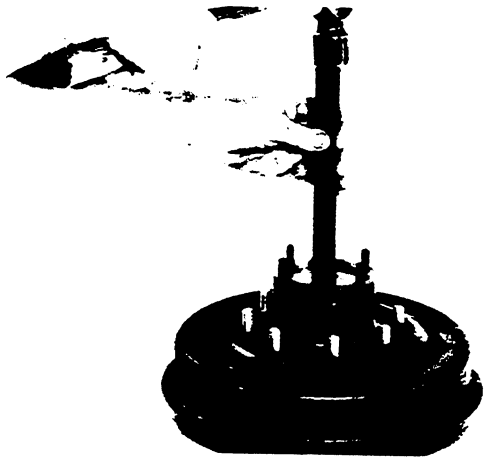


Figure 62 1009-62

Assemble new outer wheel bearing cup.
Tools—#C-4171 Handle, #D-140 Installer.

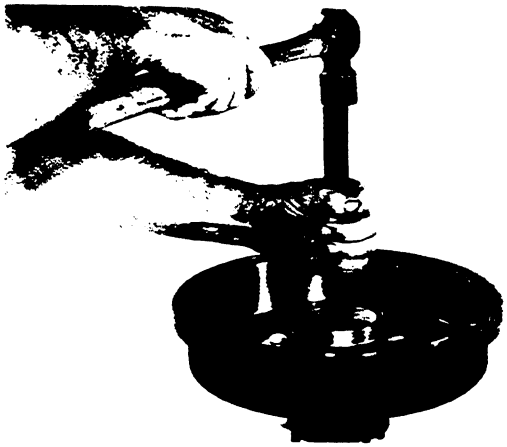


Figure 63 1009-63

Assemble new inner wheel bearing cup.
Tools—#C-4171 Handle, #D-154 Installer.

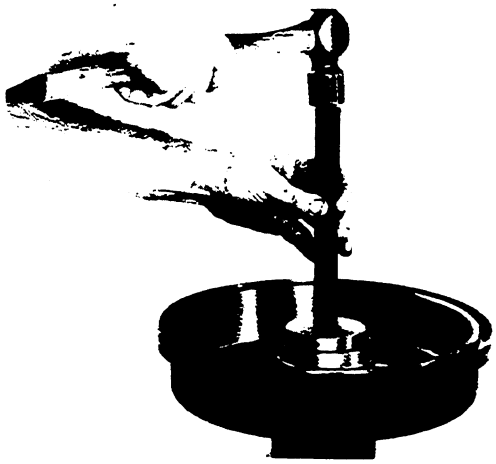


Figure 64 1009-64

Assemble new wheel bearing grease seal.
Tools—#C-4171 Handle, #D-155 Installer.

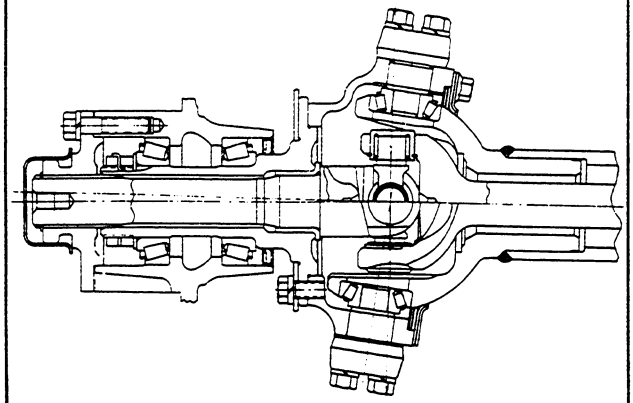


Figure 65 1009-65

LD-65.

KNUCKLE OIL SEAL CONVERSION

NOTE

Some Spicer front driving axles of the closed knuckle design are available with a unitized (one piece) spherical ball knuckle oil seal.

For field conversion from the four piece seal construction (retainer plates (2), felt, and sealing ring), follow the steps as shown in Figures 1009-66 thru 1009-61. Remove retaining screws from the knuckle retaining plates.

Discard screws and both retainer plates.

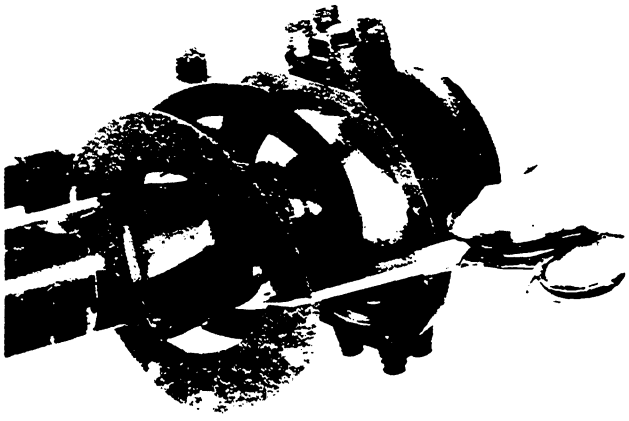


Figure 66 1009-66

Cut felt seal in half as shown and discard. Spread split of old sealing ring over tube and discard.

ASSEMBLY

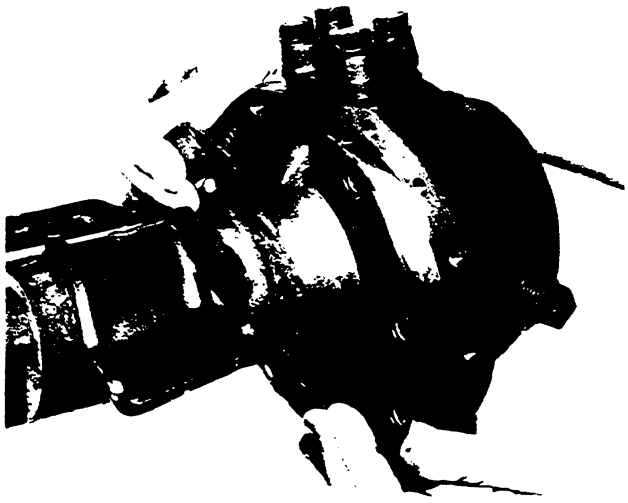


Figure 67 1009-67

Assemble new unitized seal by spreading split over tube as shown, with rubber portion towards knuckle. Be sure split of seal is at the top side of knuckle. Do not spread seal further than necessary.

Assemble new tensil lock screws. Torque screws evenly to 15-20 lbs. ft.

NOTE

It is recommended that when the seal is disassembled from the knuckle for any reason, the seal is to be replaced along with new screws.

CLOSED TYPE KNUCKLE STANDARD VERSION DISASSEMBLY

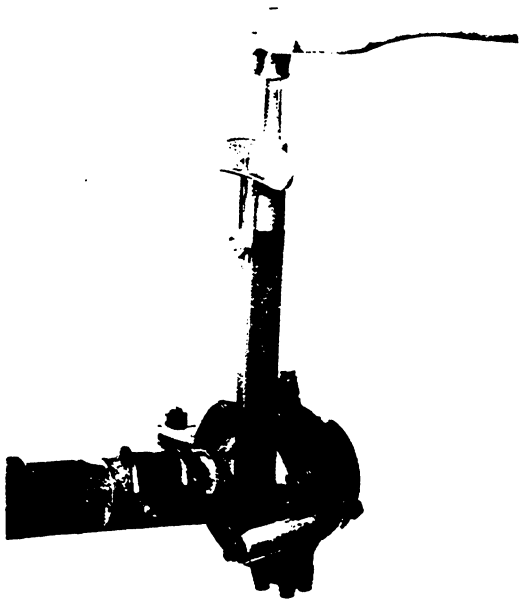


Figure 68 1009-68

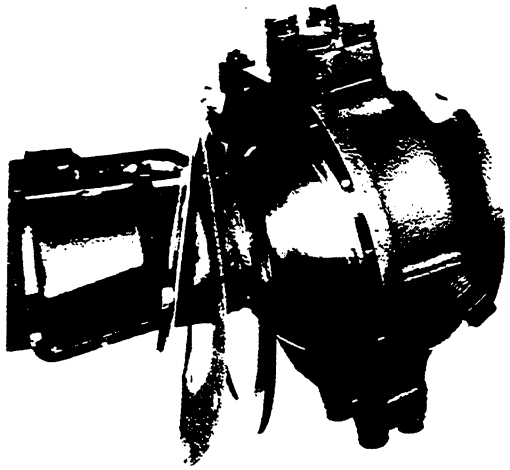


Figure 69 1009-69

Remove eight cap screws from knuckle. Remove two retainer plates, felt and seal. Discard plates, felt and seal. They are to be replaced with new parts.

Cut felt in half to remove over tube. Spread seal far enough to slip over tube.

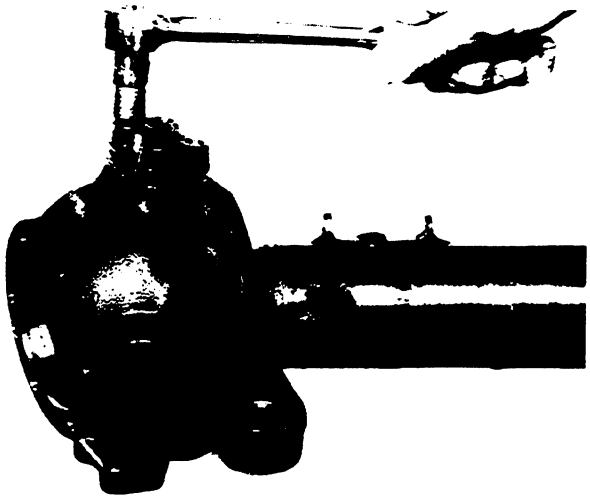


Figure 70 1009-70

Remove cap screws from the top and bottom bearing caps and nuts from steering arm if so equipped. Shims are located on the top bearing cap between the knuckle and cap. These shims control the king pin bearing preload. Save these shims since they will be required at time of assembly.

NOTE

Some front axles are designed with a bronze bushing in the top king pin instead of a roller bearing. Bushing can be either the spline or key design.

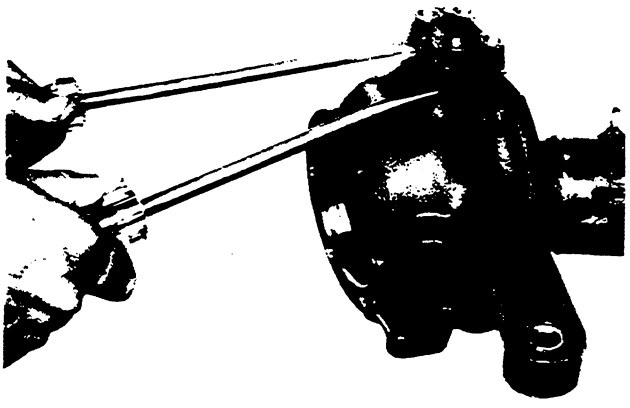


Figure 71 1009-71

Pry bearing caps loose with screwdrivers if necessary. When removing knuckle, the bottom bearing may fall out. To prevent damage, catch the bearing by hand.

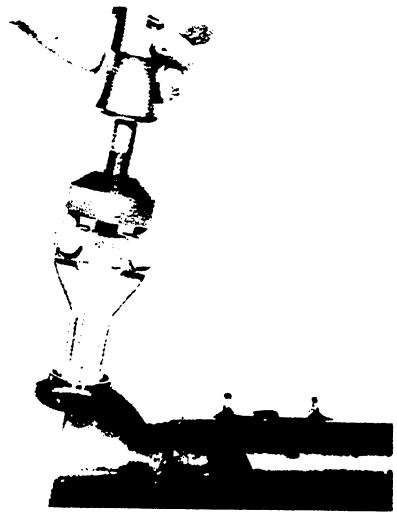


Figure 72 1009-72

Remove bearing cups from ball yoke, using puller as shown.

Tool—#D-131 Slide hammer.

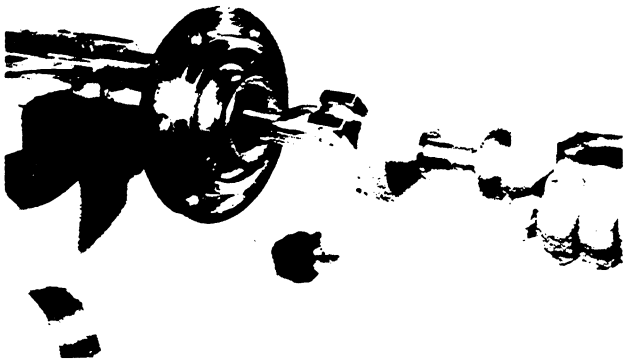


Figure 73 1009-73

Place spindle in vise. Do not clamp on bearing diameters. Remove bronze bushing using puller.

Tool—#D-131 Slide hammer.

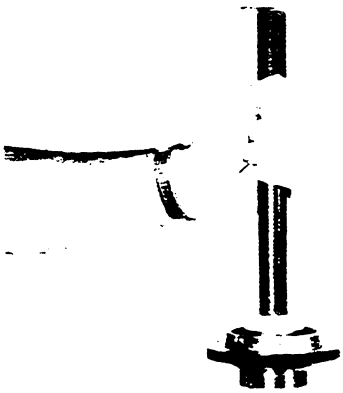


Figure 74 1009-74

Assemble new bronze bushing.

Tools—#C-4171 Handle, #D-141 Installer.

If needle bearing is used, use tool as shown in Figure 1009-32.



Figure 75 1009-75

Assemble new felt seal over ball yoke. Apply a thin coat of oil over ball to allow felt to slide and prevent it from tearing.



Figure 76 1009-76

Assemble new seal over tube. Spread seal just enough to clear tube; otherwise, it may become distorted. Metal portion of seal is to be towards the knuckle.

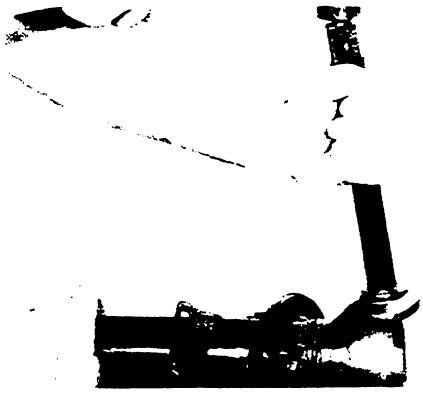


Figure 77 1009-77

Assemble new king pin bearing (top and bottom) into ball yoke.

Tools—#C-4171 Handle, #D-151 Installer.



Figure 78 1009-78

Grease top and bottom bearing cones with the specified grease.

Assemble bottom bearing cap and bearing to knuckle. Assemble top bearing into bearing cup and assemble knuckle over ball yoke.

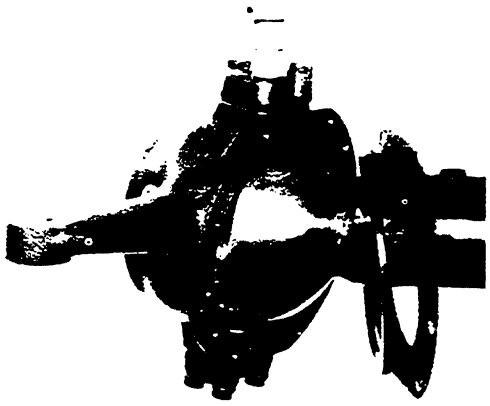


Figure 79 1009-79

Assemble preload shims top bearing cap on king pin. Assemble cap screws.

Torque screws to 30-40 lbs. ft. (top and bottom).

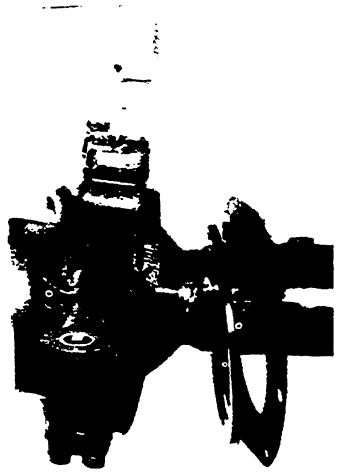


Figure 80 1009-80

Locate torque wrench on one screw to check for proper preload. Torque specification to rotate knuckle is 5-10 lbs. ft. If equipped with bronze bushing, torque specification is 10-20 lbs. ft. starting torque.

To increase torque reading, remove shims; to decrease torque reading, add shims.

NOTE

When checking king pin bearing preload, make sure the tie rod is disconnected, and also the knuckle oil seals, etc., are still disassembled.

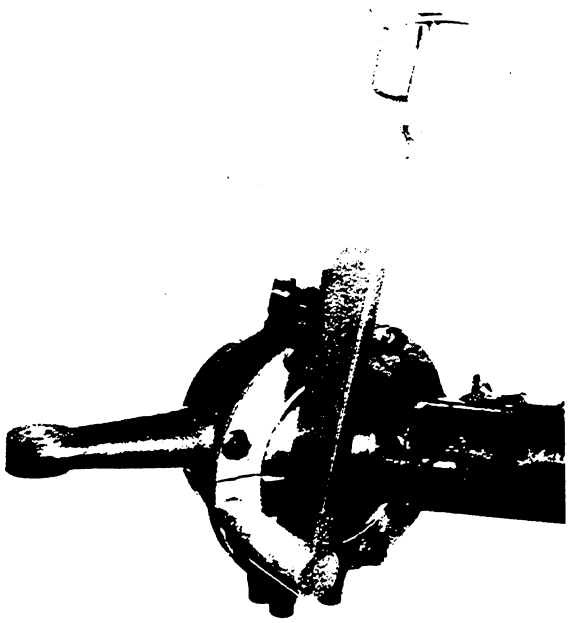


Figure 81 1009-81

Assemble new seal into knuckle, new felt seal, new retainer plates, and new screws. Torque screws to 10-25 lbs. ft.

Assemble axle shaft joint assembly, spindle wheel ends, etc.

Refer to Vehicle Service Manual for proper torque specification, etc.

Also, refer to Vehicle Service Manual for proper setting of toe in.

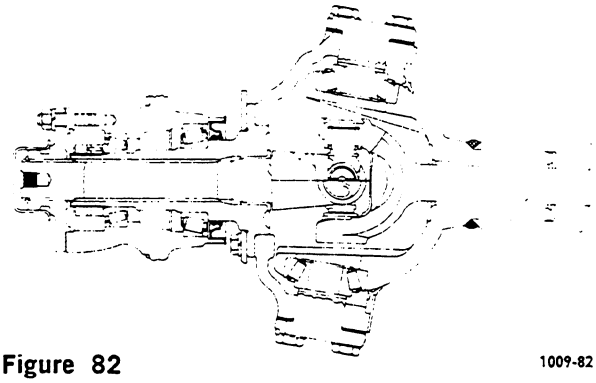


Figure 82 1009-82

CLOSED KNUCKLE-HEAVY DUTY DESIGN

Remove twelve (12) cap screws which retain the oil seal to the knuckle.

FRONT AXLE

DISASSEMBLY

Remove four (4) cap screws from bottom bearing cap. Use a screwdriver to pry cap loose from knuckle.

The king pin bearing preload shims are located between the bottom bearing cap and knuckle as shown. Keep shims intact as they will be used later during assembly.

These shims are available in thicknesses .003, .005, .010, and .030.

CAUTION

When removing the knuckle the bottom bearing cone will fall out of the cup. Catch it with your hand to prevent it from becoming damaged.

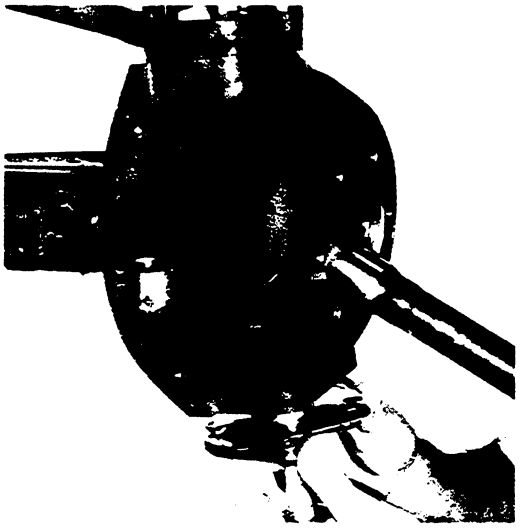


Figure 83 1009-83

Remove axle shaft joint assembly.

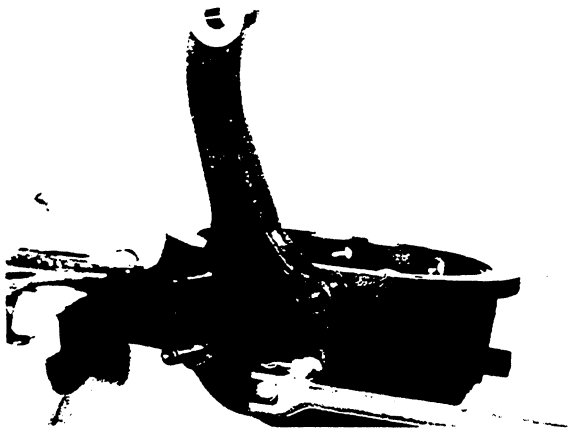


Figure 84 1009-84

Place knuckle in vise as shown. Remove the top bearing cap nuts.

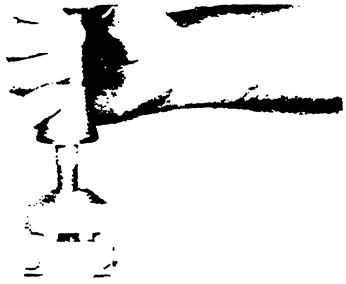


Figure 85 1009-85

Remove steering arm. Tap lightly wtih a rawhide hammer to free it from the knuckle.

NOTE

There is a constant shim pack between the steering arm and knuckle. This pack is to be saved and reused during assembly.



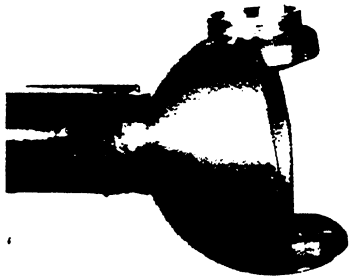


Figure 86 1009-86

Remove king pin bearing cups from spherical ball. Use puller as shown.

Tool—#D-131.

NOTE

Some axles are equipped with a bronze bushing on the top bearing cap, instead of a roller bearing. Remove bushing by using two (2) large screwdrivers until it is free of the king pin. If woodruff key is used, discard and replace with a new one during assembly.

ASSEMBLY

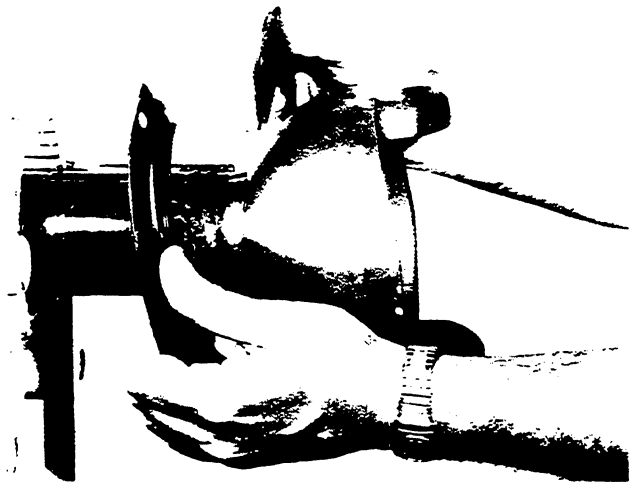


Figure 87 1009-87

Assemble new grease seal with rubber portion towards knuckle. Do not spread seal any further than necessary, this will prevent distortion of the seal.

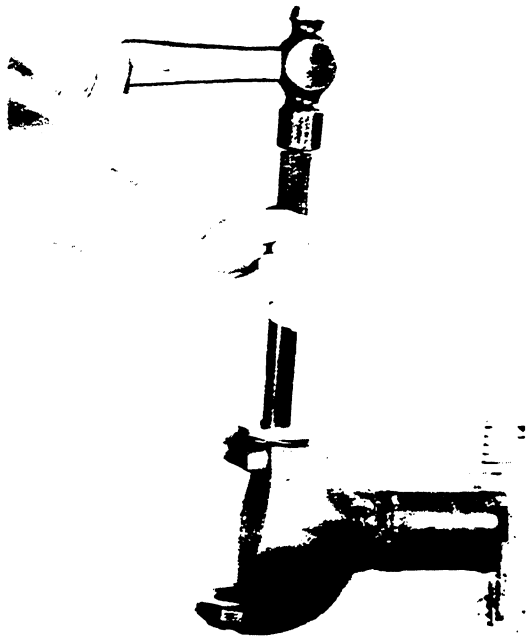


Figure 88 1009-88

Assemble new bearing cup to ball yoke.
Tools—#C-4171 Handle, #D-142 Installer.

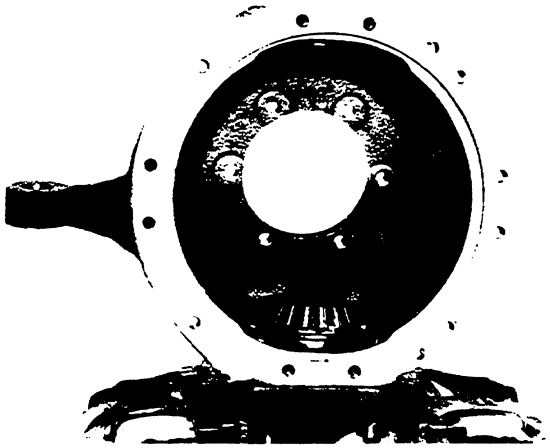


Figure 89 1009-89

Assemble steering arm king pin assembly to knuckle. Assemble new bearing cone to king pin. Grease bearing with the specified grease.

If bronze bushing is used, line up key-way of the bushing with the key-way of the pin and use new key. If bushing is of the spline design, line up the splines with those of the pin. Use a brass hammer to seat bushings.

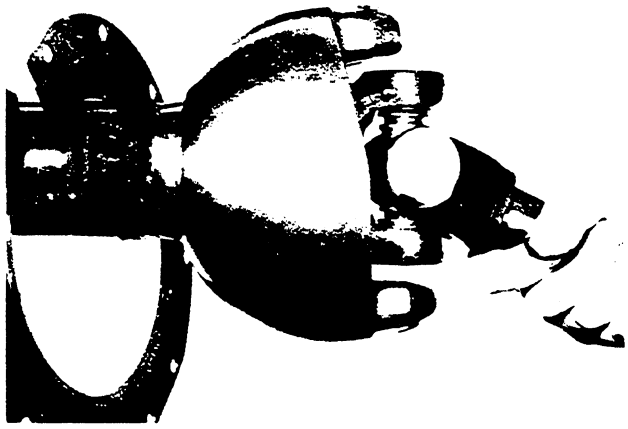


Figure 90 1009-90

Assemble axle shaft joint assembly to axle.

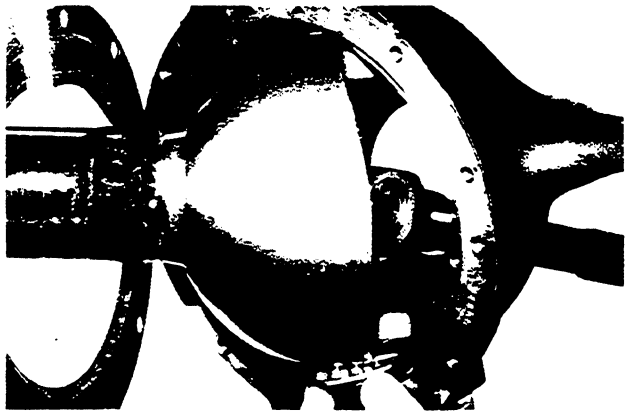


Figure 91 1009-91

Assemble knuckle to ball yoke. Hold bottom bearing as shown to prevent it from falling out.

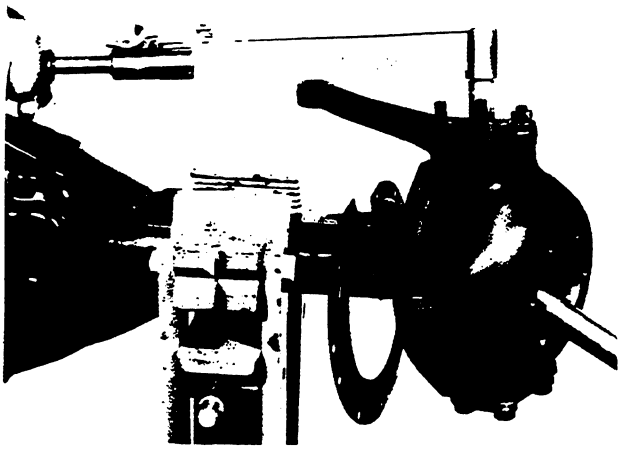


Figure 92 1009-92

Assemble bottom bearing cap with preload shims. Torque screws to 80-90 lbs. ft.

Torque top four (4) nuts on top bearing cap to 80-90 lbs. ft.

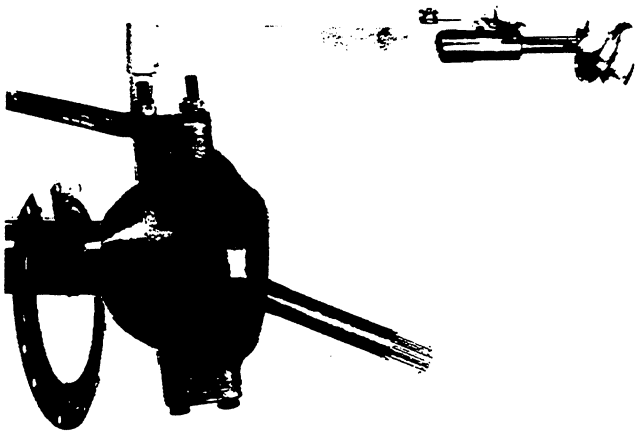


Figure 93 1009-93

Apply a torque wrench on one screw as shown. Torque to actuate knuckle with roller bearings is 10-15 lbs. ft. With bronze bushing 15-35 lbs. ft.

When checking torque rotation of knuckle, make sure tie rod and seals are not assembled to the knuckle.

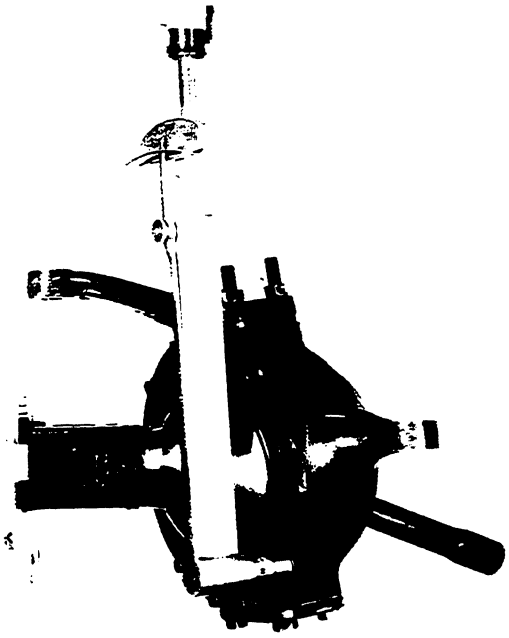


Figure 94 1009-94

Assemble grease seal to knuckle. Be sure split of seal is located at the top of the axle.
Torque screws to 10-15 lbs. ft.

UNIT WHEEL BEARING DESIGN LUBRICATED WITH HYPOID LUBRICANT

NOTE
Unit wheel bearings that are dependent on lubrication from the hypoid gear lube in the axle housing, rather than grease, are not equipped with an inner axle shaft oil seal as shown in Figue 1009-105.

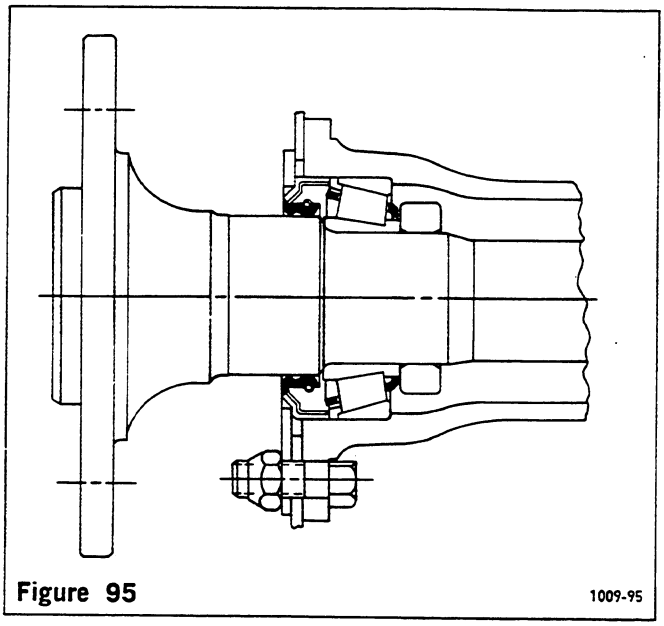


Figure 95 1009-95

Unit wheel bearing L/D without grease seal.

DISASSEMBLY



Figure 96 1009-96

After wheel is removed, remove brake drum.

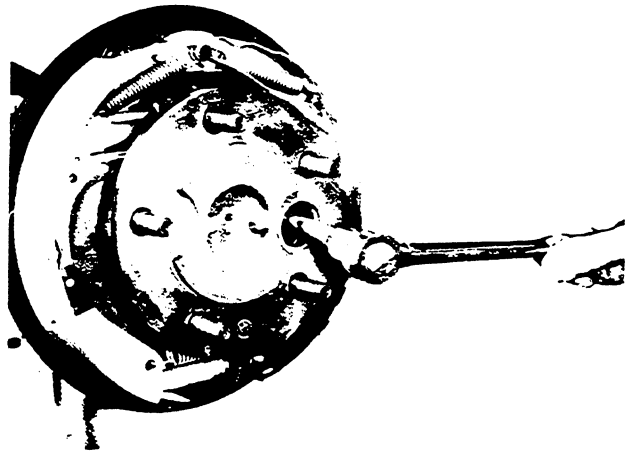


Figure 97 1009-97

Remove backing plate nuts which hold the brake backing plate to the axle housing. **Discard nuts, replace with new ones at time of assembly.** Nuts are of torque prevailing design and are not to be reused.

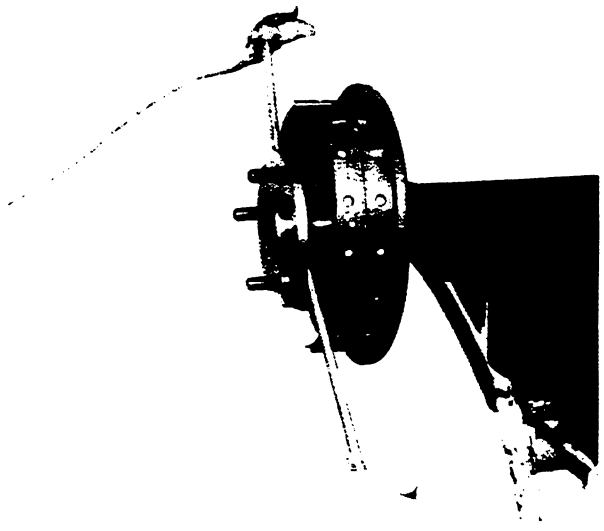


Figure 98 1009-98

Remove the axle shaft by pulling on the axle. It may be necessary to free the axle by prying it loose with two screwdrivers or pry bars as shown.

NOTE
Backing plate can normally be wired to the frame, without loosening the hydraulic brake line connection at the wheel cylinder, if desired. Use caution to avoid damage to brake line.

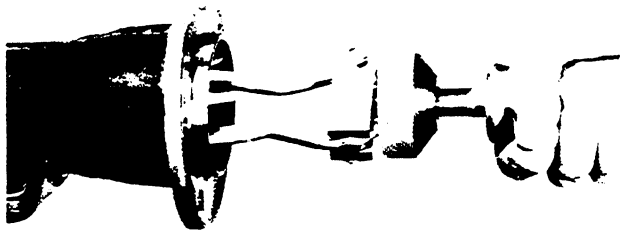


Figure 99 1009-99

The bearing cup will normally stay in place in the housing. To remove bearing cup, use puller as shown.

Tool—#D-131 Slide Hammer.

CLEANING, INSPECTING AND RELUBRICATING WHEEL UNIT BEARING

Clean bearing cup with any of the standard metal cleaning solvents. Inspect cup for any possible wear, nicks, etc.

The cone assembly can be cleaned in place on the axle shaft. Use any standard metal cleaning solvent and a stiff bristle brush to remove any dirt or any other contamination that might be present, then use compressed air. Air should be directed at the cone assembly so that it goes through the bearing from one end of the rollers to the other. It is important not to "spin dry" the bearing with compressed air. Spinning the dry bearing may score the raceways and rollers due to lack of lubricant.

Use a standard metal cleaning solvent to clean out the bearing bore in the housing. Wipe this area clean making sure it is free from dirt or any other contamination that might be present.

After the bearing has been inspected and approved for continued service, it must be lubricated prior to installation. The bearing must be lubricated by applying a small amount of the specified lube around the rollers of the bearing cone.

ASSEMBLY



Figure 100 1009-100

Assemble backing plate bolts and backing plate assembly.



Figure 101 1009-101

Assemble bearing cup into bearing bore of the tube. Make sure the cup backface is against the bearing seat of the tube.



Figure 102 1009-102

Assemble axle shaft into housing. Care should be taken not to damage the bearing rollers.

Line up the holes of the retainer plate with the bolts, push axle shaft into the housing as far as possible.



Figure 103 1009-103

Start nuts on backing plate bolts by hand. Use a speed wrench as shown and tighten to approximately 15 lbs. ft.

The nuts should be tightened in a manner that assures that the seal and cup rib ring are drawn evenly against the cup in the housing.

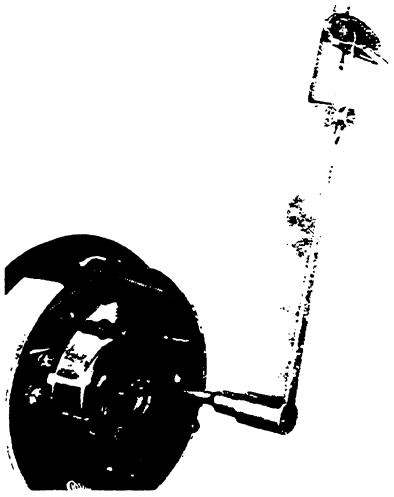


Figure 104 1009-104

Using a torque wrench as shown, torque nuts to 25-35 lbs. ft. Assembly brake drums, retainer nuts, wheels, etc.

Tool—#C-524-A Torque wrench.

UNIT WHEEL BEARING DESIGN LUBRICATED WITH GREASE

NOTE

Unit wheel bearings that are dependent on grease for lubrication, rather than hypoid gear lube from the axle housing, are equipped with an inner axle shaft oil seal as shown in Figure 1009-105.

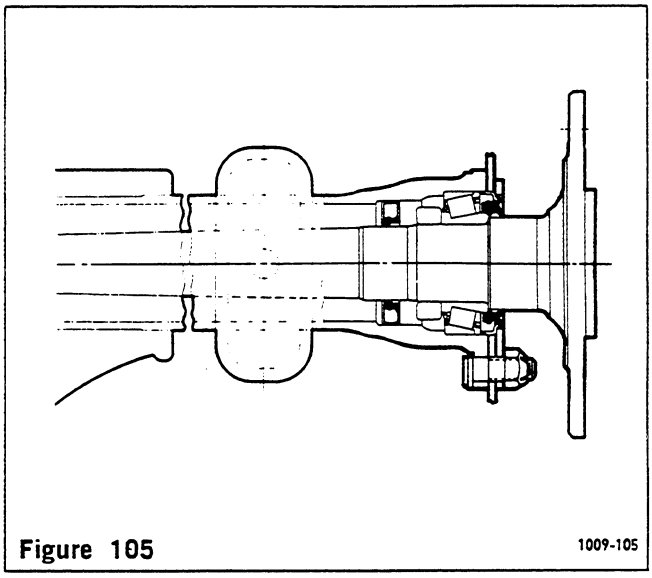


Figure 105 1009-105

Unit wheel bearing L/D with grease seal.



Figure 106 1009-106

Remove inner axle shaft seal using puller as shown.

Tool—#D-131 Slide hammer.

Discard seal and replace with new one at time of assembly.

NOTE

Avoid contacting seals with cleaning solvent in cleaning operation.

CLEANING, INSPECTING AND RELUBRICATING UNIT BEARINGS

Clean bearing cup with any of the standard metal cleaning solvents. Inspect cup for any possible wear, nicks, etc.

The cone assembly can be cleaned in place on the shaft. Use a standard metal cleaning solvent and a stiff bristle brush to loosen the old grease. To insure removal of the old grease and any contamination that might be present, use compressed air. Air should be directed at the cone assembly so that it goes through the bearing from one end of the rollers to the other. It is important not to "spin dry" the bearing with compressed air. Spinning the dry bearing may score the raceways and rollers due to the lack of lubricant.

Use a standard metal cleaning solvent to clean out the bearing and oil seal bore in the housing. Wipe this area clean making sure it is free from any old grease or other contamination that might be present.

After the bearing has been inspected and approved for continued service, it must be lubricated prior to installation.

The grease should be a good quality number 2 E.P. (extreme pressure), lithium soap, wheel bearing grease.

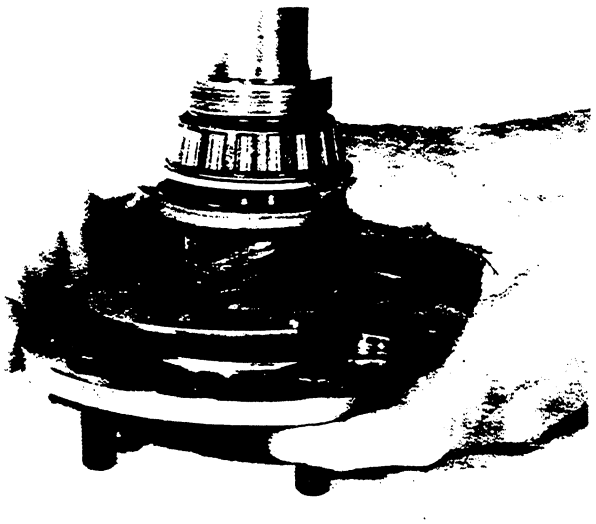


Figure 107 1009-107

Push seal and retainer away from the bearing to allow a cavity between the seal and bearing.

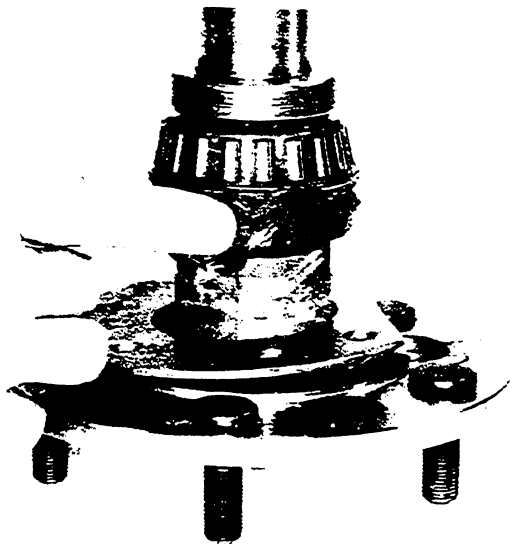


Figure 108 1009-108

Fill the area or cavity between the seal and bearing with the recommended grease.

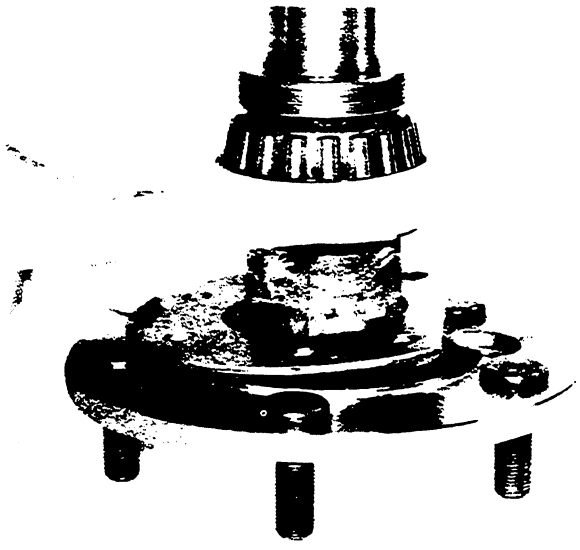


Figure 109 1009-109

After the cavity is full of grease, wrap tape compeltely around the rib ring and seal as shown to enclose the cavity.

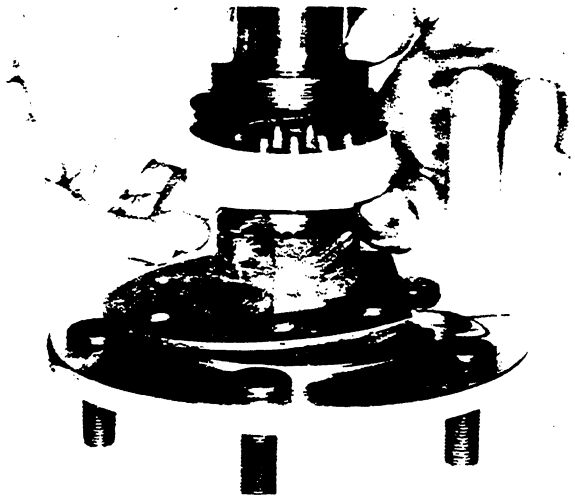


Figure 110 1009-110

With tape still wrapped around the ring, push seal up until it contacts the rib ring. This will force the grease up through the rollers.

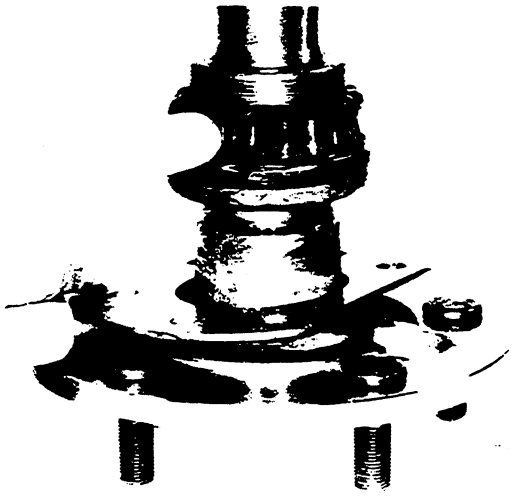


Figure 111 1009-111

NOTE

If grease is not apparent on small end of rollers, repeat these same steps until grease appears.

Remove tape and wipe excess grease on roller bodies.

ASSEMBLY

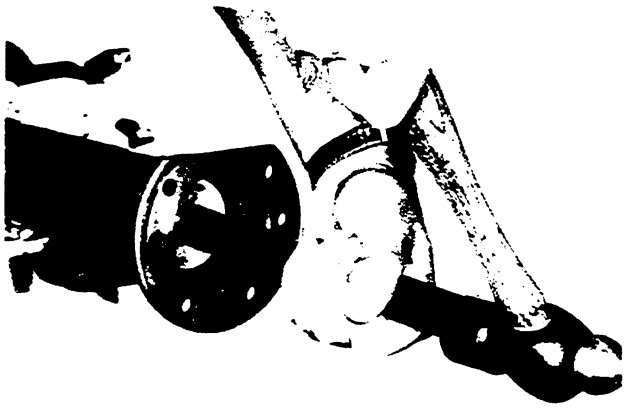


Figure 112 1009-112

Assemble new grease seal into housing.

Tools—#D-157 Seal Installer, #C-4171 Handle.

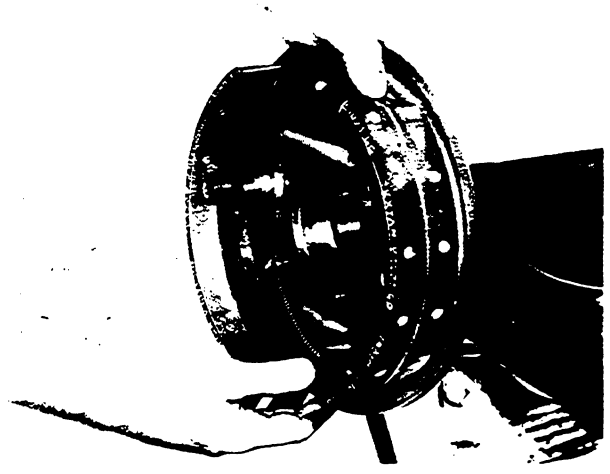


Figure 113 1009-113

After seal has been assembled, grease lip of seal.

Assemble backing plate bolts and backing plate assembly.

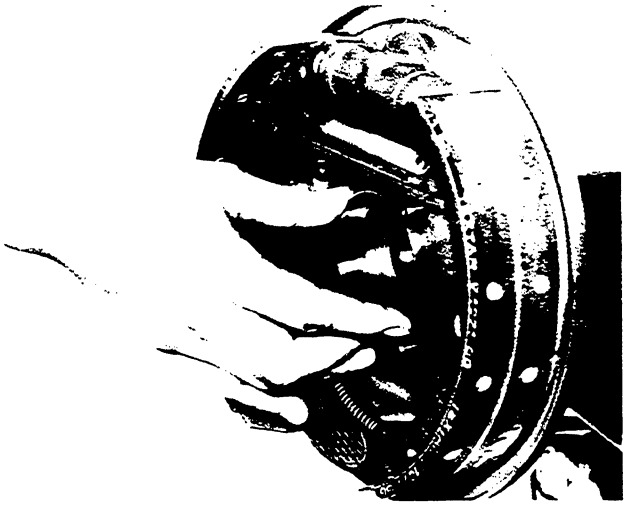


Figure 114 1009-114

Assemble bearing cup into bearing bore of the tube. Make sure the cup backface is against the bearing seat of the tube.



Figure 115 1009-115

Assemble axle shaft into housing. Care should be taken not to damage the seal lip and bearing rollers.

Line up the holes of the retainer plate with the bolts; push axle shaft into the housing as far as possible.

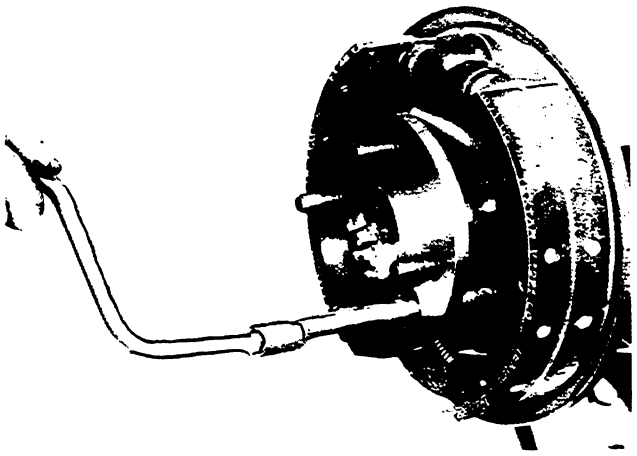


Figure 116 1009-116

Start nuts on backing plate by hand. Use a speed wrench as illustrated and tighten to approximately 15 lbs. ft.

The nuts should be tightened in a manner that assures the seal and cup rib ring are drawn evenly against the cup in the housing.

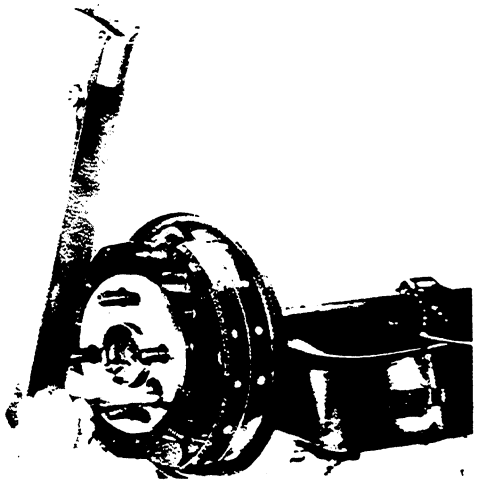


Figure 117 1009-117

Use a torque wrench and torque nuts to 25-35 lbs. ft.

REMOVAL OF UNIT BEARING FROM AXLE SHAFT

NOTE

To disassemble axle shaft from housing, follow the procedures illustrated in Figures 1109-95 thru 1009-99.

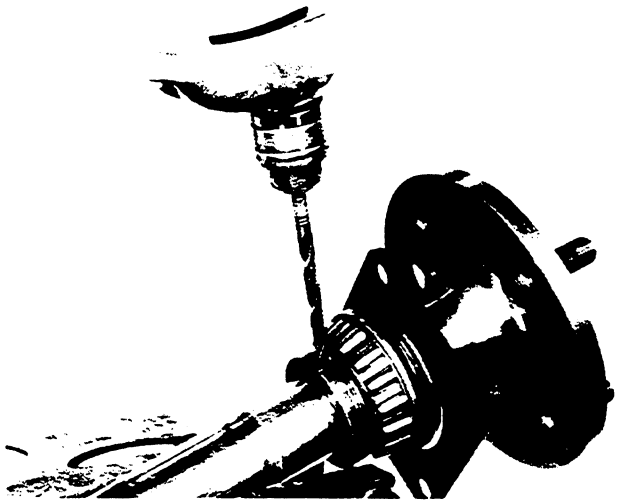


Figure 118 1009-118

Place axle shaft in a vise. Drill a ¼" hole in the outside of the retainer ring to a depth approximately ¾ the thickness of the ring. Do not drill all the way through the ring; the drill could damage the axle shaft.

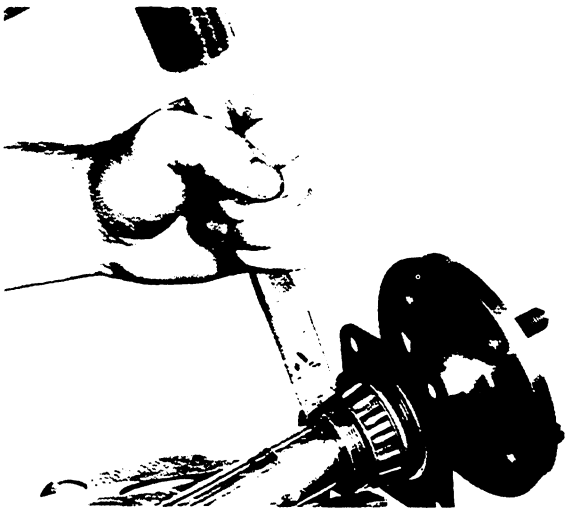


Figure 119 1009-119

After drilling the ring, use a chisel positioned across the hole and strike sharply to break the ring. Discard and replace with a new one at time of assembly.

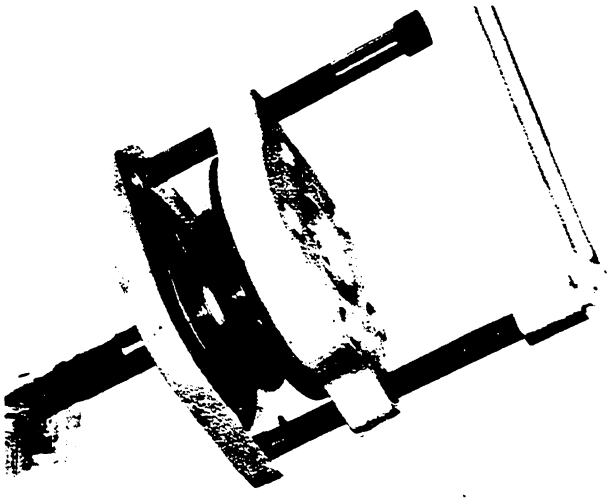


Figure 120 1009-120

Push retainer plate and seal towards flange of axle shaft. Install the flange plate to the flange of the axle shaft. Install bolts into flange plate. Slide forcing plate over the axle shaft. Install the adapters so they seat under the cup rib ring.

Gradually tighten the bolts until they locate in the dimples on the backside of the forcing plate.

Tools—#SP-5443-A Flange plate, #SP-5017 Adapter ring, #SP-5442-D Adapters, #SP-5026 Bolts.

Tighten bolts of tool alternately until bearing cone is removed from axle shaft. Be careful not to mar the machined surfaces of the axle shaft.

CAUTION

Do not heat or cut the bearing cone assembly with a torch to remove. Damage to the axle shaft will result.

Remove seal and retainer plate. Discard seal. Replace with new one at time of assembly.

Inspect retainer plate for possible distortion. If any portion of the retainer plate is damaged, it should be replaced.

Inspect machined surfaces of the axle shaft, such as the seal and bearing diameters. Clean axle shaft, remove all nicks or burrs.

INSTALLATION OF NEW UNIT BEARING

NOTE

The retainer ring area of the axle shaft is 1.3790 minimum in diameter, and the retainer ring inside diameter is 1.374 maximum. Therefore, it should require some 6,000 lbs. minimum press to seat the ring against the unit bearing.

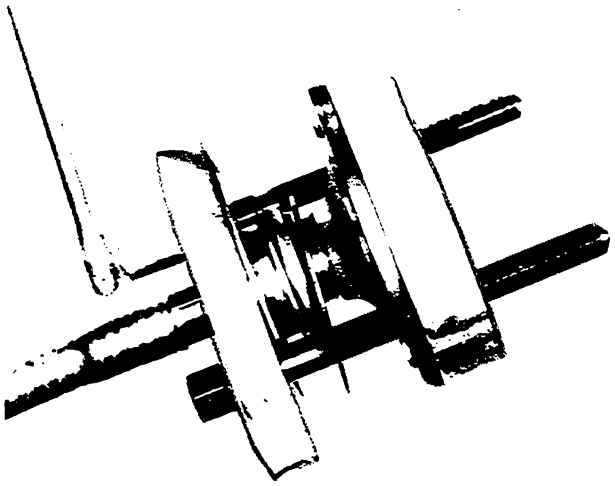


Figure 121 1009-121

Flange plate should still be assembled to the flange of the axle shaft. Remove bolts from flange plate.

Assemble new retainer plate and oil seal. The rubber portion of the oil seal, which extends beyond the casing has numbers bonded in the rubber. These numbers are to face toward the flange of the axle shaft.

Assemble new unit wheel bearing on axle shaft.

Slide installing ring on axle shaft. Be sure to locate unit wheel bearing on the inside of the installing ring. Slide forcing plate on axle shaft and locate on installing ring. Install bolts and washers through the holes in the forcing plate and into the flange plate.

Tools—#SP-5443-A Flange plate, #SP-5017 Adapter ring, #SP-5439 Adapter plate installer, #SP-5026 Bolts, #SP-3020 Washers.

Tighten bolts alternately and evenly making sure bearing is not cocked on axle shaft. Continue until unit wheel bearing is seated. To make sure bearing is seated, use a .0015" feeler gage between bearing seat and bearing. If gage enters, force bearing further on the axle shaft, until gage does not enter.

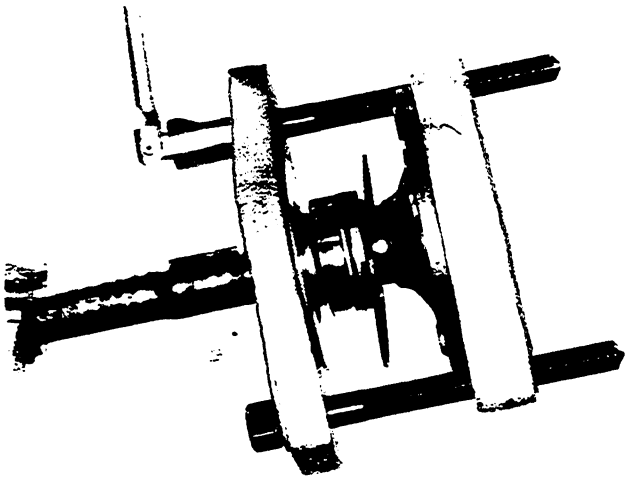


Figure 122 1009-122

Install retainer ring on axle shaft. Follow the same procedures as illustrated in Figure 1009-121 to assemble the retainer ring.

Use a .0015" feeler gage between the bearing and retainer ring to be sure that the retainer ring is seated. At least one point should exist, where the gage will not enter between the retainer ring and bearing. If gage enters completely around the diameter, retainer ring must be forced further onto the axle shaft.

To assemble axle shaft assembly into housing, follow steps as illustrated in Figures 1009-115 thru 1009-117.

LUBRICATING NEW UNIT BEARING WITH GREASE

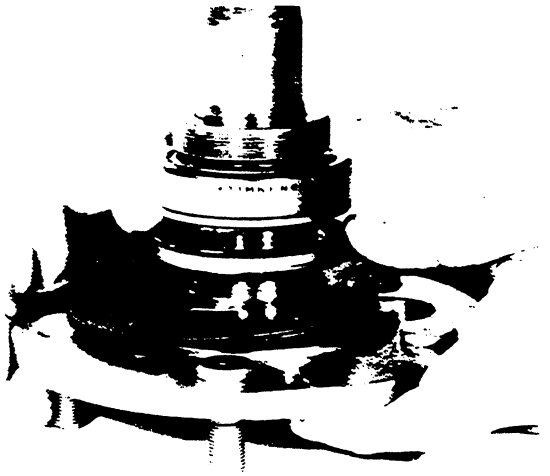


Figure 123 1009-123

Push seal and retainer away from bearing to allow a cavity between the seal and bearing.

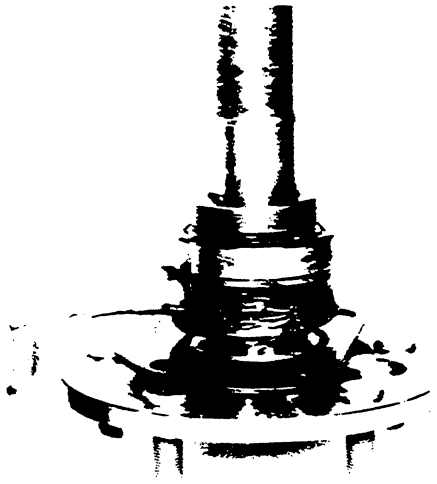


Figure 124 1009-124

Fill cavity with a good quality #2 E.P. (extreme pressure), lithium soap, wheel bearing grease.

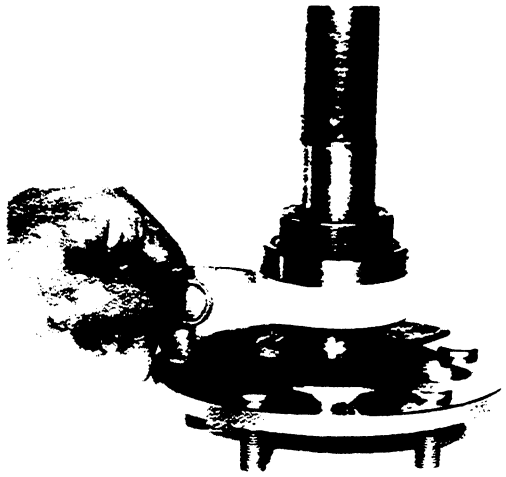


Figure 125 1009-125

After cavity is full of grease, wrap tape completely around rib ring, and seal to enclose the cavity.

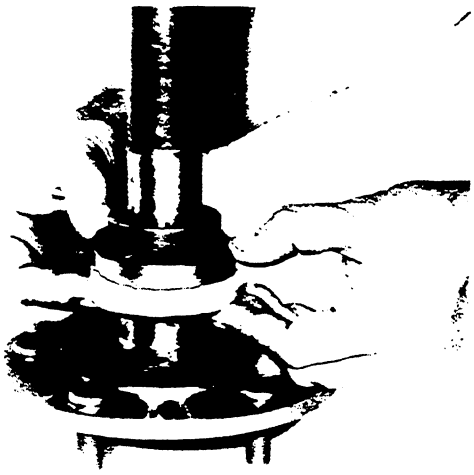


Figure 126 1009-126

Push seal towards the bearing until it contacts the rib ring. This will force the grease between the rollers and cup.

NOTE

If grease is not apparent on the small ends of the rollers, repeat the same steps until grease is evident between the small end of the roller and cup. **Remove tape.**

CARRIER SECTION

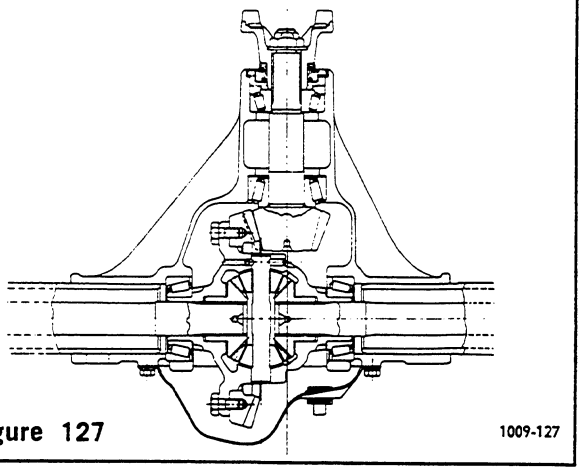


Figure 127 1009-127

L/D Carrier.

DISASSEMBLY

NOTE

If it becomes necessary to disassemble any parts inside the carrier, it is suggested that the entire axle be removed from the vehicle and held tight in a stand or rack.

Remove drain plug and drain lubricant. If there is no drain plug in the carrier, the lube will drain out as the cover plate is removed.

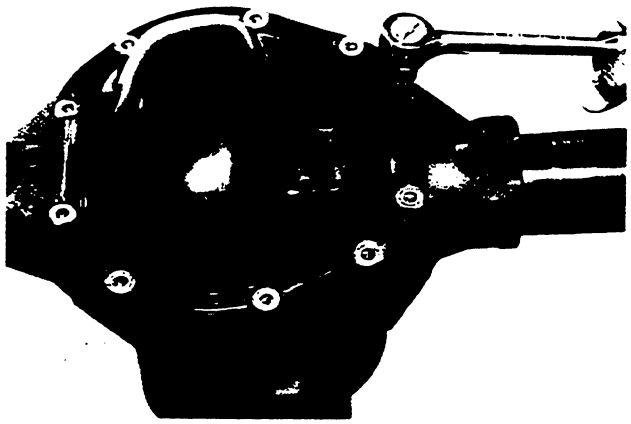


Figure 128 1009-128

Remove cover plate screws, cover plate, and cover plate gasket. **Discard old gasket.** Tip carrier to allow lube to drain completely.

Also, during this time clean the cover face of the carrier, making sure it is free from any nicks and any particles left by the old gasket.

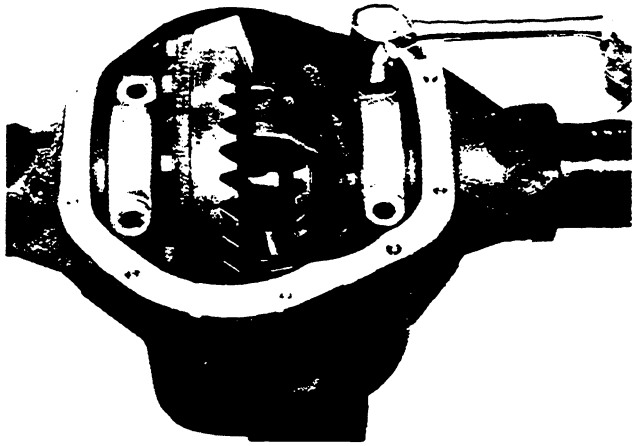


Figure 129 1009-129

Remove bearing caps. Note mating letters stamped on caps and carrier. This is important at time of assembly as they are to be assembled exactly as removed. Letters or numbers are in horizontal and vertical position.

CAUTION

Before removing differential case and ring gear, make sure the axle shafts are pulled out far enough for clearance to remove differential.

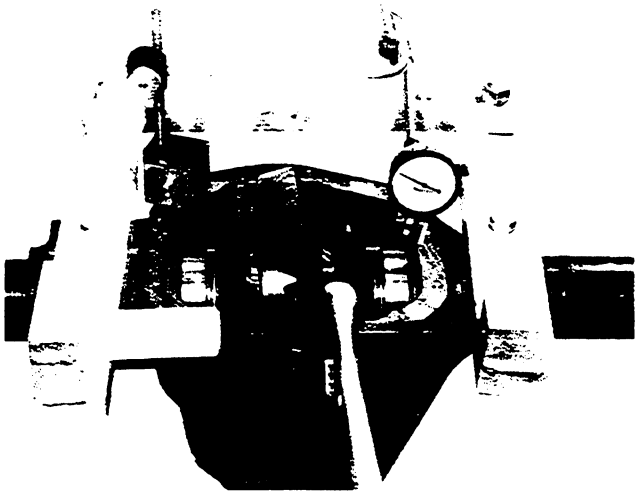


Figure 130 1009-130

Mount spreader to housing. **Do not spread carrier over .020".** Use dial indicator as shown. **Note:** This spreader can also be used on the Spicer Model 44 axle.

Tools — #D-113 Spreader, #D-128 Indicator set.

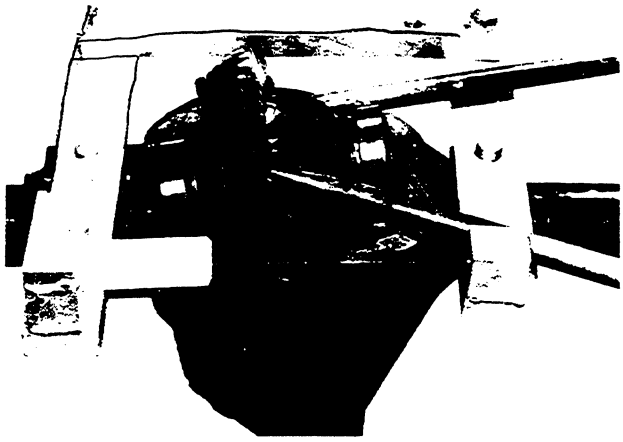


Figure 131 1009-131

Pry differential case from carrier with two pry bars as shown. **After differential case has been removed, remove spreader.** Use caution to avoid damage to ring and pinion. Mark on tag bearing cups indicating from which side they were removed.

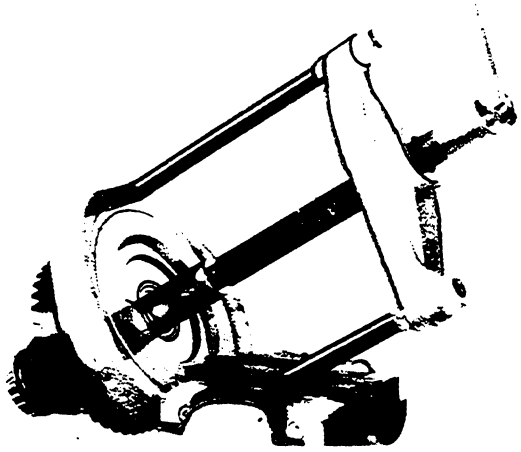


Figure 132 1009-132

Remove differential bearings with a puller as shown. Wire shims, bearing cup and bearing cone together. Identify from which side they were removed (ring gear side or opposite side). If shims are mutilated, replace with new shims at the time of assembly. Shims are available in thicknesses of .003", .005", .010", and .030". Reposition case in puller and remove other bearing cone as described above.

Tools—#DD-914-9P Press and Adapter Ring, #C-293-3 Adapter Plug, #C-293-18 Adapter Set.

NOTE

It is recommended that whenever bearings are removed, they are (regardless of mileage) to be replaced with new ones.

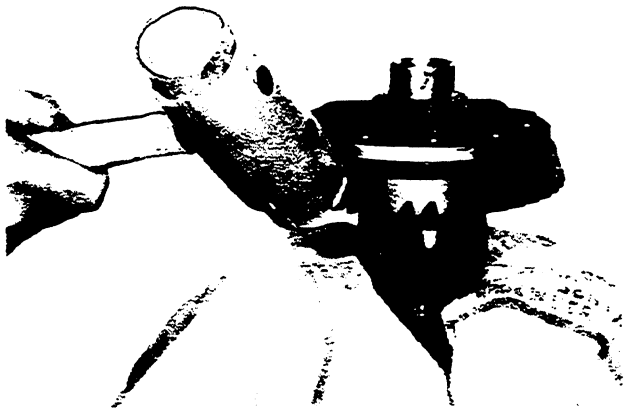


Figure 133 1009-133

Place a few shop towels over the vise to prevent the ring gear teeth from being nicked after it is free from the case.

Place case in vise. Remove ring gear screws. Tap ring gear with a rawhide hammer to free it from the case. Remove case and ring gear from vise.

NOTE

It is recommended that whenever the ring gear screws are removed, they are to be replaced with new ones.

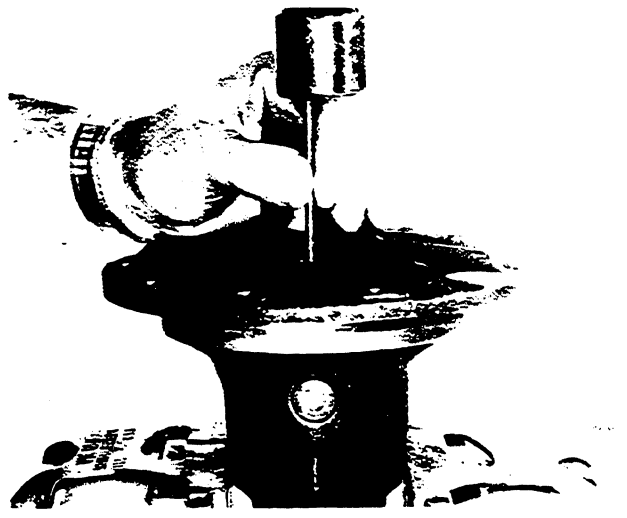


Figure 134 1009-134

Replace case in vise and drive out lock pin which secures the pinion mate shaft. Use a small drift as shown.

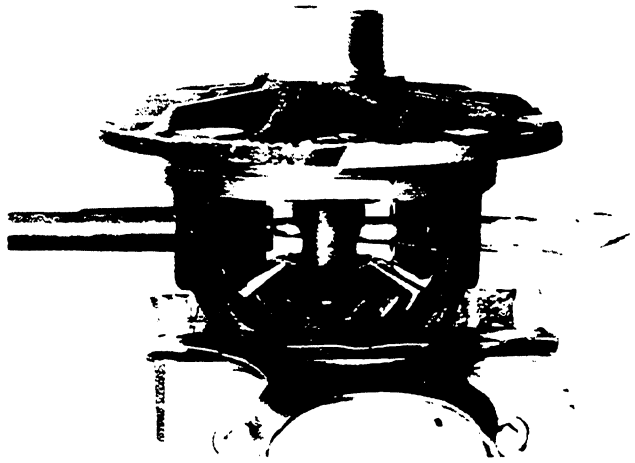


Figure 135 1009-135

Remove pinion mate shaft with drift as shown.

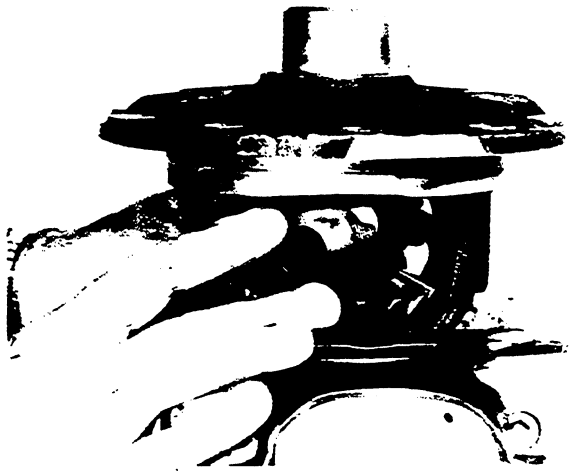


Figure 136 1009-136

To remove side gears and pinion mate gears, rotate the side gears. This will allow the pinion mate gears to turn to the opening of the case. Remove pinion mate gears and also the spherical washers behind the gears. Lift out gears and thrust washers. Inspect all parts, including the machined surfaces of the case itself. Where necessary replace all worn parts. If excessive wear is visible on all parts, it is suggested that the complete differential assembly be replaced. If any one of the gears are to be replaced, **they are to be replaced as a set.**

NOTE

Axle shafts which require end play adjustment have a spacer block in the differential case. The spacer block controls the end thrust of the axle shaft. If the ends of the spacer block are worn, it is to be replaced during assembly. Spacer block must not be used with ball or unit wheel bearings.

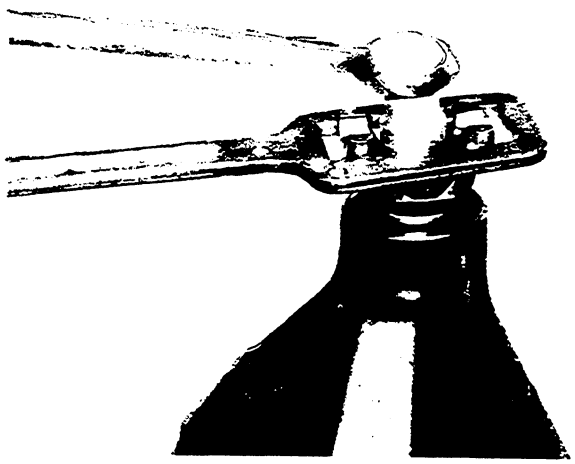


Figure 137 1009-137

Turn nose of carrier in a horizontal position to remove pinion nut. Hold end yoke or flange with tool similar to the one shown, and remove pinion nut and washer.

Tool—#C-3281 Holding wrench.

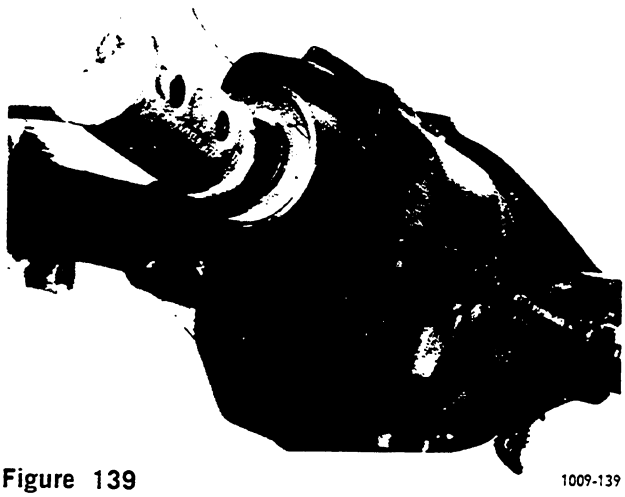


Figure 139 1009-139

Remove pinion by tapping with a rawhide hammer. Catch the pinion with your hand to prevent it from falling to the ground and being damaged.

NOTE

On the spline end of the pinion, there are bearing preload shims. These shims may stick to the bearing — pinion — or even fall out. The shims are to be collected and kept together since they will be used later in assembly. Try not to mutilate shims. If shims are mutilated, replace with new ones; shims are available in thicknesses of .003", .005", .010", and .030".

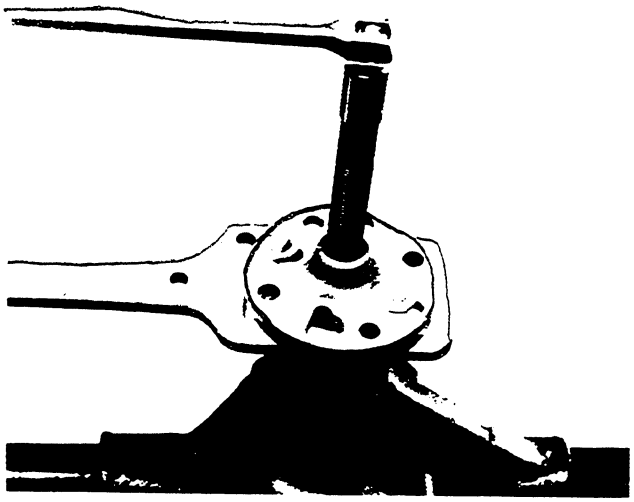


Figure 138 1009-138

Remove end yoke or flange with tools as shown. If yoke or flange shows wear in the area of the seal contact, it should be replaced.

Tool—#C-452.



Figure 140 1009-140

Pull out pinion seal with puller as shown. **Discard seal.** Replace with new seal at time of assembly. Remove bearing cone and outer pinion oil slinger.

Tool—#D-131 Slide hammer.

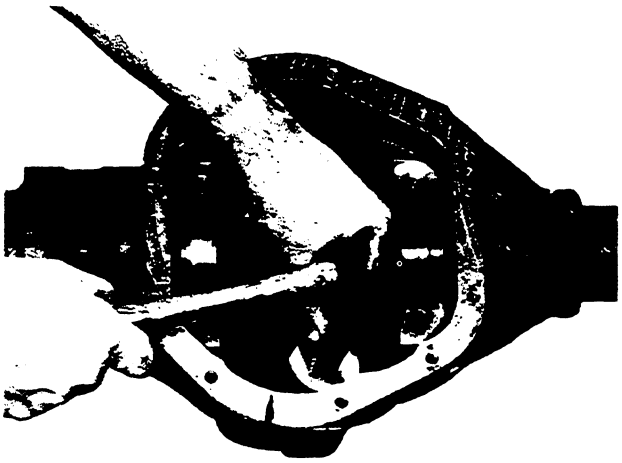


Figure 141 1009-141

Turn nose of carrier down. Remove outer pinion bearing cup as shown. Locate driver on back edge of cup; drive cup out of carrier. **Caution: Do not nick carrier bore.**

Tools—#D-147 Remover, #C-4171 Handle.

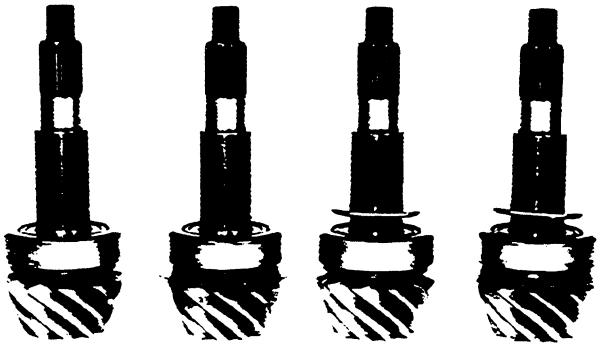


Figure 142 1009-142

NOTE

The front and rear axle carrier section may vary in pinion bore depth due to the possibility of the need for either a baffle or slinger or both.

The baffle serves the same purpose of assisting the lube to flow up through the oil channels to lubricate the pinion bearings. If used, they are part of the pinion setting adjustment. In Figure 1009-142 we show the four different options.



Figure 143 1009-143

Remove the inner bearing cup with tools as shown.

Tools—#D-148 Removed, #C-4171 Handle.

NOTE

Shims are located between the bearing cup and carrier bore, and, as illustrated in Figure 142, may also include an oil baffle. If shims and baffle are bent or nicked, they should be replaced at time of assembly. Wire the stacks together and measure each. If stack has to be replaced, replace with the same thickness.

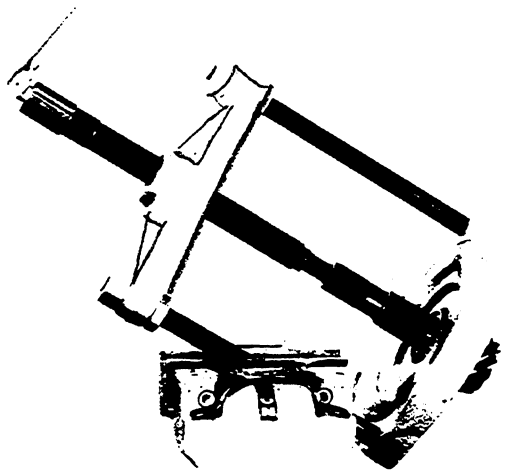


Figure 144 1009-144

Remove inner pinion bearing cone with tools as shown.

Tools—#DD-914-P Press, #DD-914-9 Adapter Ring, #C-293-39 Adapter Set.

NOTE

Both baffle and slinger are part of the pinion adjustment shims and are to be kept intact for assembly.

ASSEMBLY

On all front axles there are axle shaft oil seals which are pressed into the tube ends of the carrier. There are two different designs.

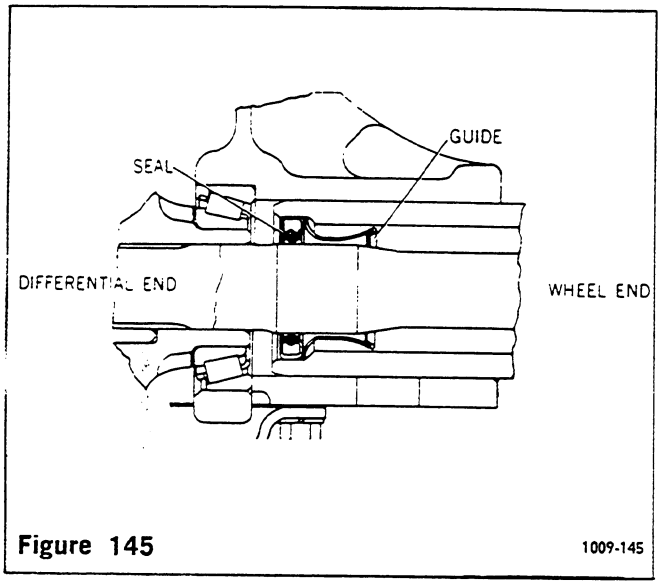


Figure 145 1009-145

As shown in Figure 1009-145, this design consists of an axle shaft guide and seal. (One guide and one seal for each side.)

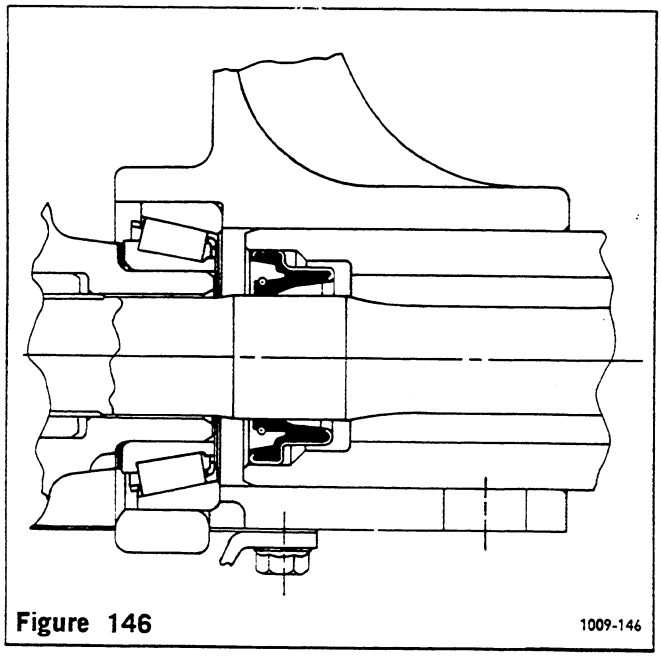


Figure 146 1009-146

As shown in Figure 1009-146, this design consists of the integral seal (unit) whereby the seal and guide are combined. (One seal for each side.)

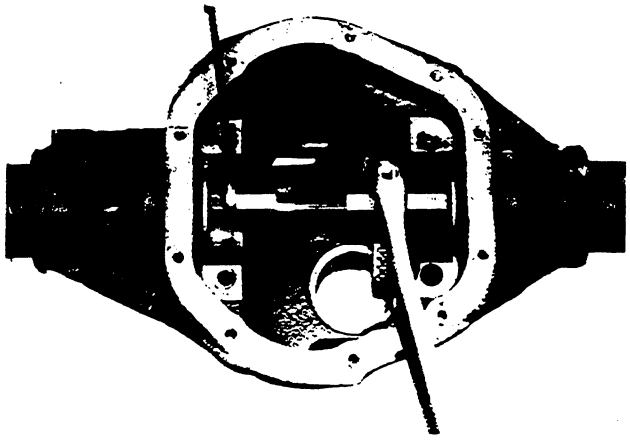


Figure 147 1009-147

Assemble inner axle shaft seals and guides. To assemble axle shaft guides and seals, use tools as described.

Tools—#D-112 Screw, #D-112-1 Adapter.

When assembling the seals make sure they are positioned straight and do not get cocked.

Turn forcing screw until it stops; seal will then be seated.

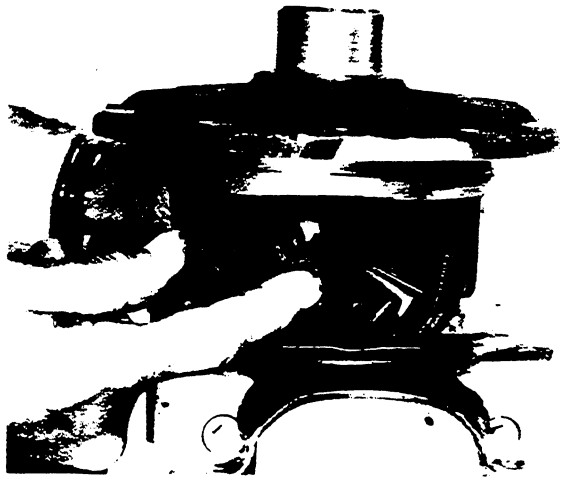


Figure 148 1009-148

Place differential case in vise as shown. Apply grease to new side gear thrust washers and hubs of side gear. Assemble both side gears. Apply grease to new pinion mate spherical washers and the pinion mate gears. Assemble pinion mate gears. An easy way to assemble the side gears and pinion mate gears is to have all parts lubricated before assembly. Assemble both side gears and thrust washers, hold them in place with hand, then assemble the pinion gears to hold the side gears in place.

Rotate the side gears until the holes of the washers and pinion gears line up with the holes of the case. If the gears cannot be rotated by hand, install one of the axle shafts into the side gear spline and use a pipe wrench to turn the shafts.

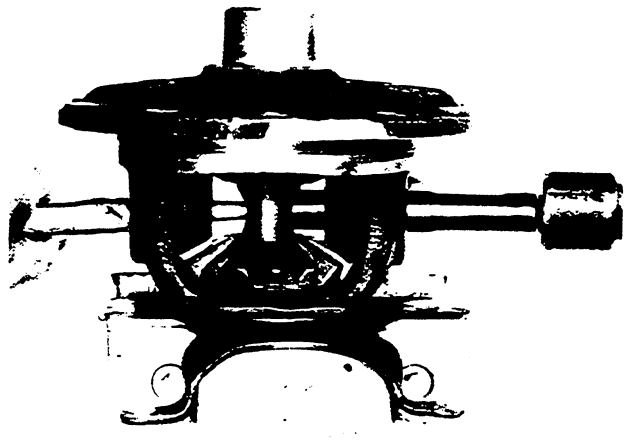


Figure 149 1009-149

If spacer block is used, assemble as shown. Use a drift to line holes of the gears up with the case. Assemble shaft, drive on shaft to remove drift. Be sure vertical lock pin hole is lined up with that of the case, and that the pinion mate spherical washers are in place and lined up with gear and case.

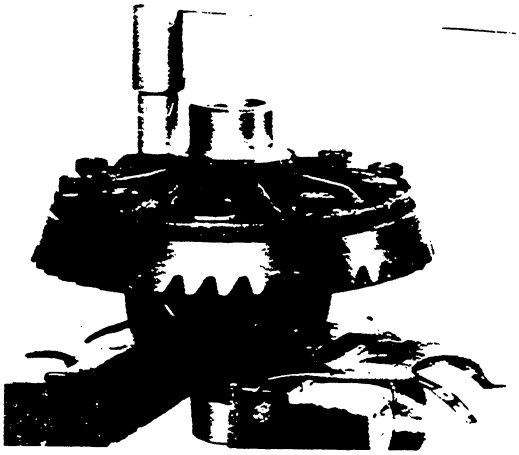


Figure 151 1009-151

Be sure flange face of the case is free of nicks or burrs. Assemble ring gear to case **using new ring gear screws.** Line up holes of gear and case. Draw up screws alternately and evenly.

Torque screws to 45-60 lbs. ft.

Tool—#C-524-A Torque wrench.

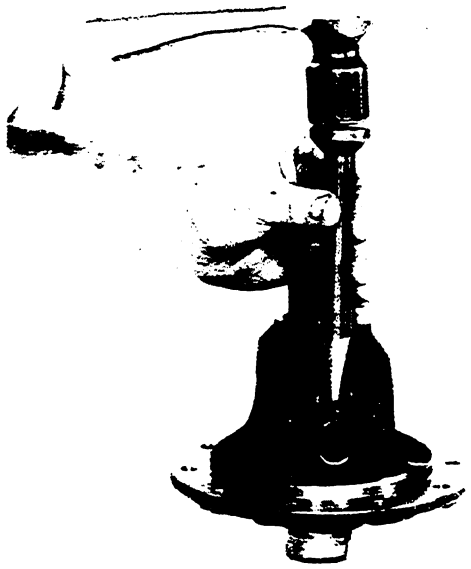


Figure 150 1009-150

Assemble lock pin. Peen metal of case over pin to lock in place.

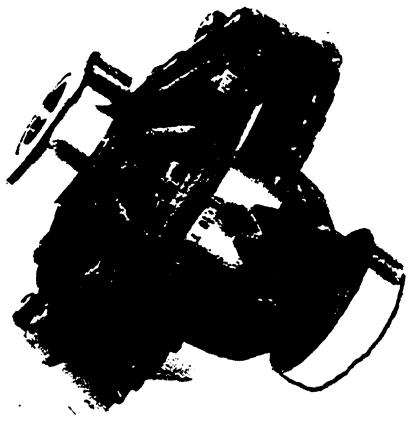


Figure 152 1009-152

Install master differential bearing onto case. Remove all nicks, burrs, dirt, etc., from hubs to allow master bearings to rotate freely.

Tool—#D-135 Master bearings.

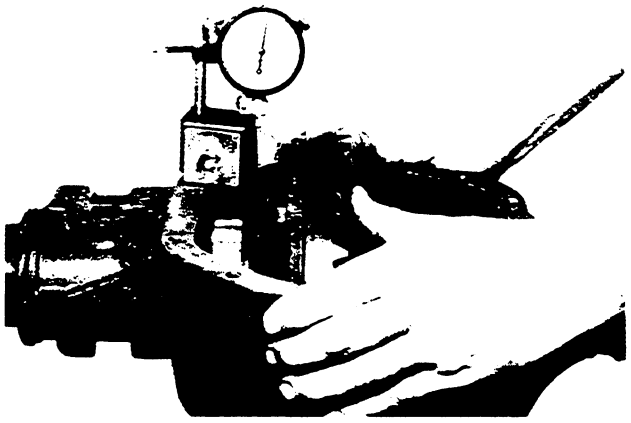


Figure 153 1009-153

Assemble differential case into carrier (less pinion). Mount dial indicator with a magnetic base as shown. Locate tip of indicator on flat surface of one of the gear screws. Mark screw with a piece of chalk. Force the differential assembly as far as possible in the direction towards the indicator. With force still applied, set indicator at zero (0).

Tool—#D-128 Indicator.

> **NOTE**
> Indicator should have a minimum of .200" travel.

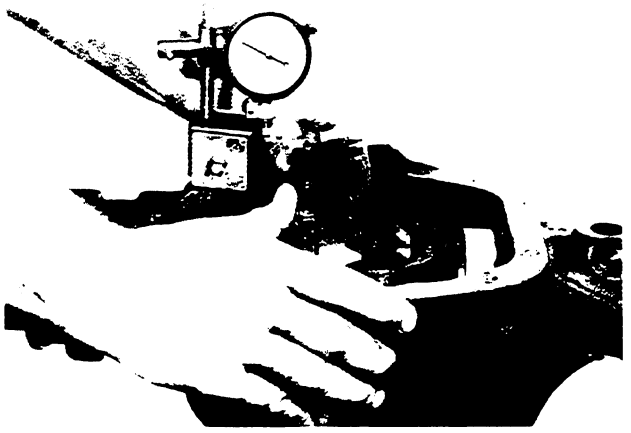


Figure 154 1009-154

Force the differential assembly as far as it will go in the opposite direction. Repeat these steps until the same reading is obtained.

Record the reading of the indicator.

This will be the total amount of shims required (less preload) and will be calculated later during assembly.

After making sure the readings are correct, remove indicator and differential assembly from housing. **Do not remove master bearings from differential case at this time.**

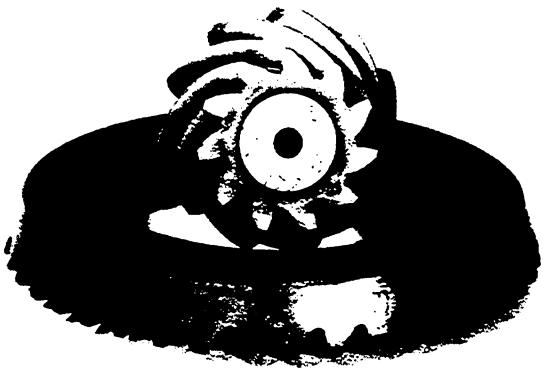


Figure 155 1009-155

View of ring and pinion set.

Ring gears and pinions are supplied in matched sets only. Matching numbers on both the pinion and ring gear are etched for verification. If a new gear set is being used, verify the numbers of each pinion and ring before proceeding with assembly.

The distance from the centerline of the ring gear to the button end of the pinion for the Model 44 (Front and Rear) axle is 2.625 inches.

On the button end of each pinion there is etched a plus (+) number, a minus (—) number, or a zero (0) number, which indicates the best running position for each particular gear set. This dimension is controlled by the shimming behind the inner bearing cup.

For example — if a pinion is etched +3, this pinion would require .003" less shims than a pinion etched "0". This means by removing shims, the mounting distance of the pinion is increased to 2.268" which is just what a —3 indicates. Our if a pinion is etched —3, we would want to add .003" more shims than would be required if the pinion were etched "0". By adding .003" shims the mounting distance of the pinion was decreased to 2.622" which is just what a —3 etching indicated.

If the old ring and pinion set is to be reused, measure the old shim pack and build a new shim pack to this same dimension. If a baffle is in the axle assembly, it is considered as part of the shim pack.

To change the pinion adjustment, shims are available in thicknesses of .003", .005", and .010".

> **NOTE**
> If baffle or slinger is bent or mutilated, it should be replaced.

Measure each shim separately with a micrometer and add together to get total shim pack thickness from original build up.

If a new gear set is being used, notice the (+) or (—) etching on both the old and new pinion and

adjust the thickness of the new shim pack to compensate for the difference of these two figures.

For example: If the old pinion reads (+) 2 and the new pinion is (—) 2, add .004" shims to the original shim pack.

The above procedures also apply to pinion adjustment on the front axle which includes the oil slinger between the inner bearing cone and pinion, and baffle between the inner bearing cup and carrier.

CARRIER SECTION

Old Pinion Marking	New Pinion Marking								
	−4	−3	−2	−1	0	+1	+2	+3	+4
+4	+0.008	+0.007	+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	0
+3	+0.007	+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	0	−0.001
+2	+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	0	−0.001	−0.002
+1	+0.005	+0.004	+0.003	+0.002	+0.001	0	−0.001	−0.002	−0.003
0	+0.004	+0.003	+0.002	+0.001	0	−0.001	−0.002	−0.003	−0.004
−1	+0.003	+0.002	+0.001	0	−0.001	−0.002	−0.003	−0.004	−0.005
−2	+0.002	+0.001	0	−0.001	−0.002	−0.003	−0.004	−0.005	−0.006
−3	+0.001	0	−0.001	−0.002	−0.003	−0.004	−0.005	−0.006	−0.007
−4	0	−0.001	−0.002	−0.003	−0.004	−0.005	−0.006	−0.007	−0.008

Figure 156 1009-156

Pinion setting chart shown. Use this chart as a guideline to set pinion.



Figure 157 1009-157

View of master pinion block, pinion height block, scooter gage, cross arbor, and master bearing discs.

NOTE

Cross arbor and master bearing discs can be used on both the Model 30 and Model 44 axles. Use large diameter discs for Model 44 axle.

Be sure that all carrier bores are free from all nicks, dirt or any other contamination.



Figure 158 1009-158

Place the master pinion block into the pinion bore of the carrier as shown.

Tool—#D-139 Master pinion block.

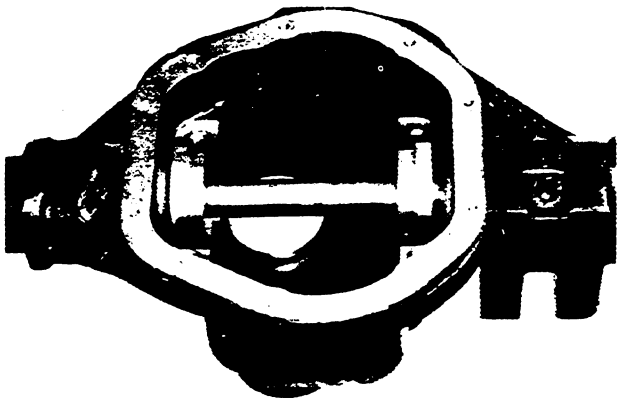


Figure 159 1009-159

Place arbor discs and arbor into cross bores of the carrier as shown.

Tools—#D-115-3 Arbor, #D-115-4 Arbor discs.

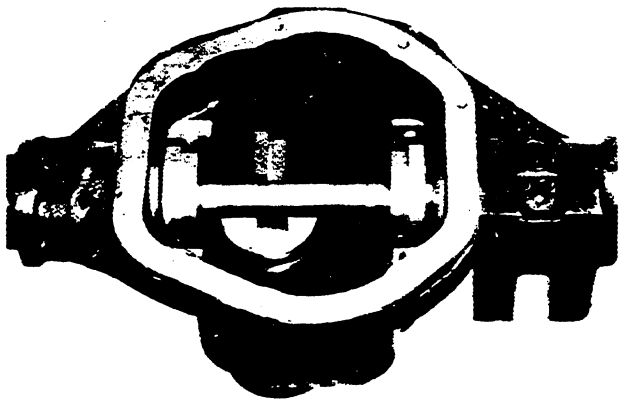


Figure 160 1009-160

Place pinion height block on top of master pinion block, and against arbor as shown.

Tool—#D-115-1 Pinion height block.

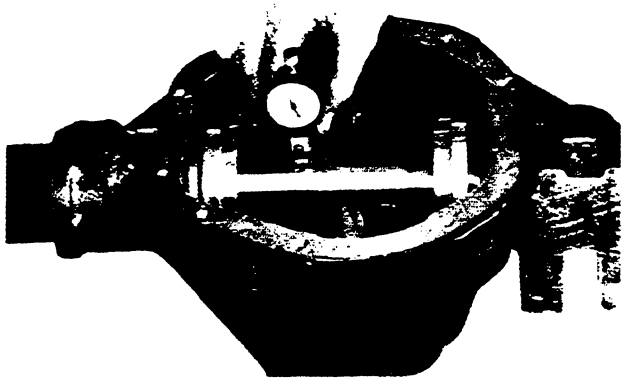


Figure 161 1009-161

Place scooter gage on small step of pinion height block. Apply pressure with fingers making sure the gage is flat on the pinion height block, while pressure is applied, set indicator at zero "0".

Tool—#D-115 Scooter gage.

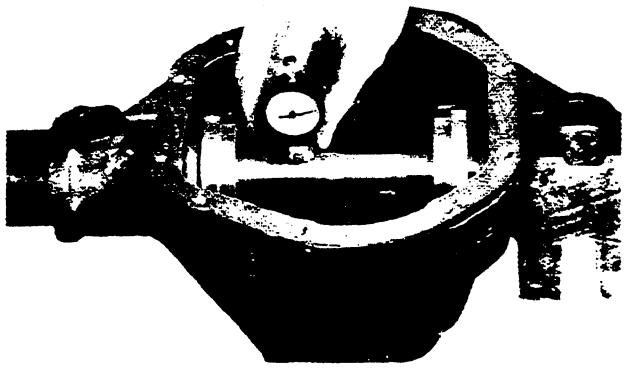


Figure 162 1009-162

Slide scooter gage over arbor. As gage slides over top of arbor, it will travel in a clockwise direction. When indicator is on center of arbor (on top), it will stop traveling in a clockwise direction. If indicator starts to travel in a counterclockwise direction, this means that you have passed the center (top) of the arbor. Record only the reading when the indicator is at the highest point. This reading indicates the amount of shims necessary to obtain the correct shim pack, plus (+) or minus (—) the etching on the bottom end of the pinion. If the etching is zero (0), the shim pack will remain unchanged.

For example: If a pinion is etched +3, this pinion would require .003" less shims than a pinion etched zero "0".

If a pinion is etched —3, we would want to add .003" more shims than would be required if the pinion were etched zero "0".



Figure 163 1009-163

Measure each shim separately with a micrometer and add together to get total shim pack thickness. If baffle is required, it is to be included in the shim pack. If slinger is used between the inner bearing cone and thrust face of pinion, the slinger is also to be measured and included as a part of the total shim pack.

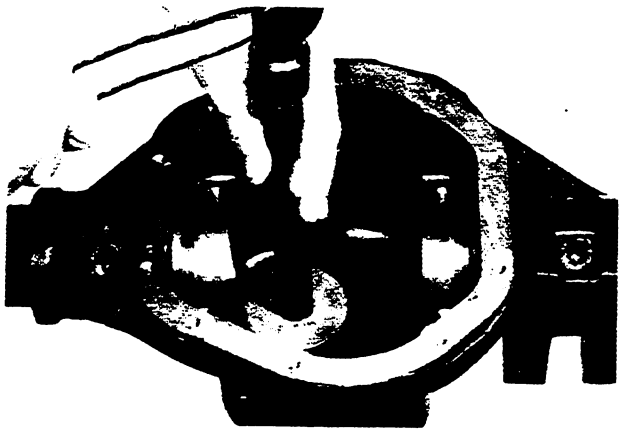


Figure 164 1009-164

Place the required amount of shims (and baffle if used) in the inner bearing bore; drive the inner bearing cup into carrier with tools as shown.

Tools—#D-145 Cup installer, #C-4171 Handle.

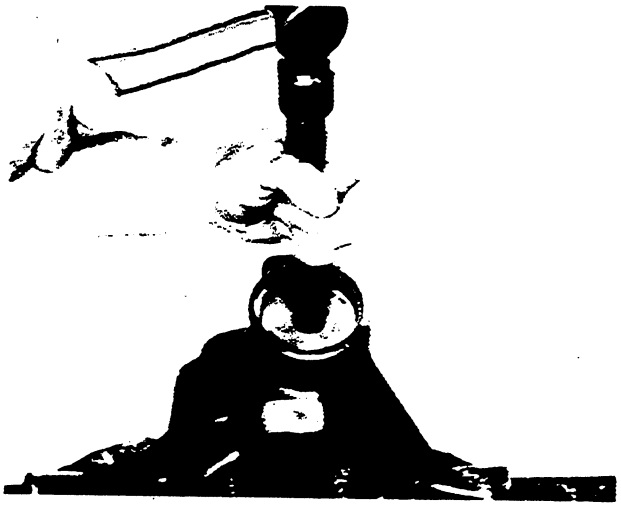


Figure 165 1009-165

Assemble the outer pinion bearing cup into carrier as shown.

Tools—#D-144 Cup installer, #C-4171 Handle.

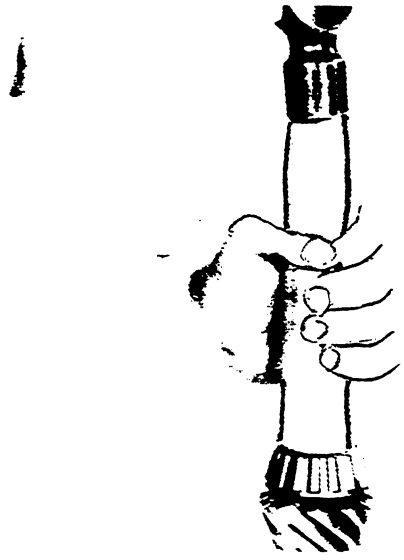


Figure 166 1009-166

Assemble inner bearing cone (and slinger if used) on pinion, place bearing installer over pinion shaft as shown. Drive bearing on shaft until it is completely seated.

Tool—#W-262.

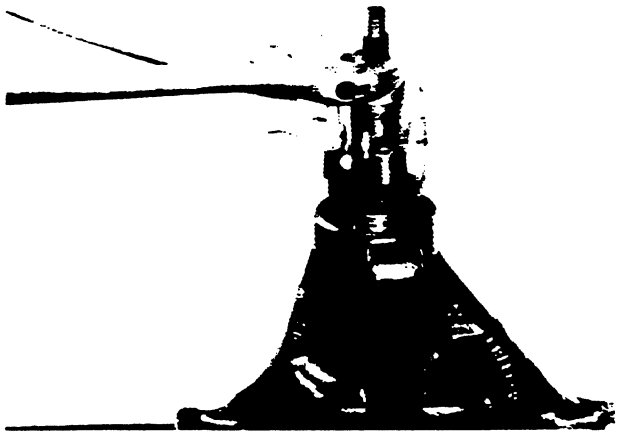


Figure 167 1009-167

Install pinion into carrier.

Assemble outer pinion bearing cone, (slinger if used) and end yoke onto pinion spline.

> **NOTE**
> Do not assemble preload shims or pinion oil seal at this time.

Use yoke installer (as shown) to assemble end yoke onto spline of pinion.

Tools—#W-162 Installer, #C-3281 Holder.



Figure 168 1009-168

Assemble washer and pinion nut. Torque nut until it requires 10 lbs. inch to rotate pinion. Rotate pinion several times before checking pinion position. This is to seat the bearings and assure a more accurate reading of pinion depth setting.

Tool—#C-685-A Inch lb. torque wrench.

> **NOTE**
> The reason for not assembling preload shims and new pinion oil seal at this time is due to the possibility of having to adjust pinion preload or pinion adjustment. It would be necessary to again remove the seal, and as mentioned, whenever seals are removed they are to be discarded because of possible damage.

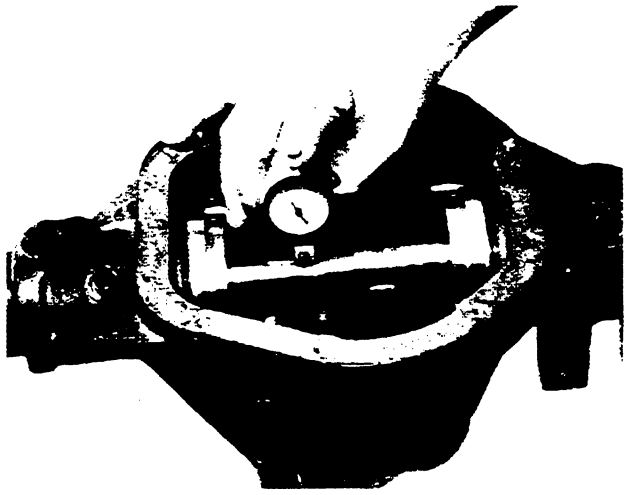


Figure 169 1009-169

Place arbor and arbor discs (small diameter discs for Model 30 axle) into cross bore of carrier. Place pinion height block on button end of pinion. Set dial indicator on zero "0".

Slide scooter gage across or over arbor.

Indicator will read a plus (+) or minus (—) at its highest point, depending on the etching of the pinion.

> **NOTE**
> Indicator reading within .002 of etching is considered acceptable.
> If pinion positioned is found to be within specifications continue with build up. If pinion position is not within specifications, change shim pack thickness under inner bearing cup.

Remove pinion nut, washer, end yoke, slinger, and bearing cone. Assemble preload shims (which were removed during disassembly) onto pinion. Assemble bearing cone, slinger.

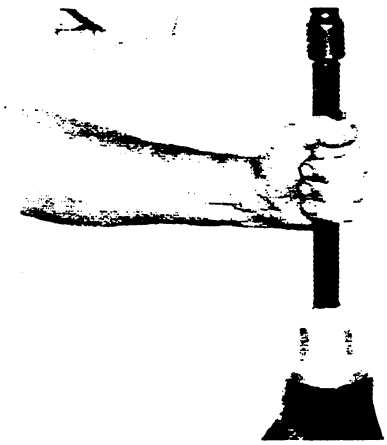


Figure 170 1009-170

Apply a light coat of hypoid lubricant to the lip of the pinion seal and assemble into housing.

Tools—#W-147D Seal installer, #C-4171 Handle.

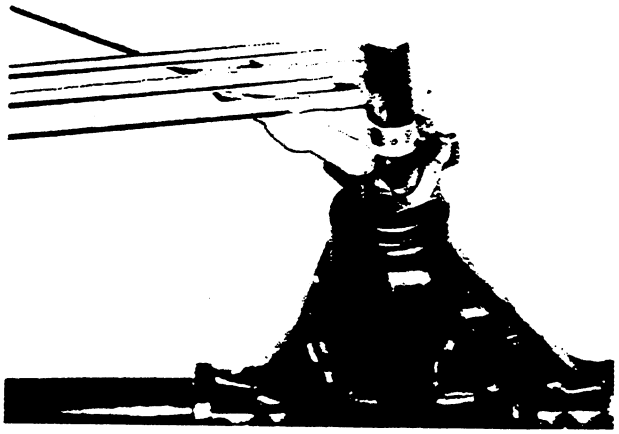


Figure 171 1009-171

Assemble end yoke, washer, and pinion nut. Torque nut to 200-220 lbs. ft.

Tools—#C-4053 Torque wrench, #C-3281 Yoke holder.

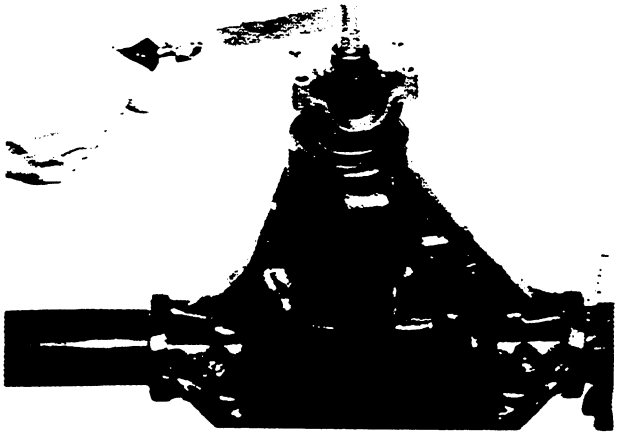


Figure 172 1009-172

Using an inch lb. torque wrench as shown, rotate pinion. Torque of pinion should read between 20-40 lbs. inch.

To increase preload, remove shims; to decrease preload, add shims.

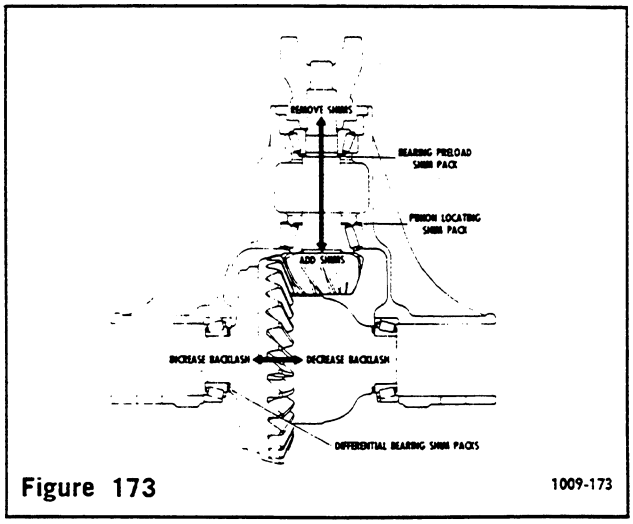


Figure 173 1009-173

L/D Carrier Section.

CARRIER SECTION

The illustration in Figure 1009-173 shows the arrow in the pinion pointing in two directions. The direction of the arrow pointing towards the end yoke indicates that by removing pinion locating shims, the distance from the center line of the axle to pinion button is increased giving a plus reading. The preload shim pack do not affect the pinion depth setting.

Arrows on the ring gear illustrate the method to increase or decrease backlash and differential bearing preload.

ASSEMBLY OF DIFFERENTIAL

Place differential assembly (with pinion assembled) into housing. Differential master bearings should still be installed to differential case.

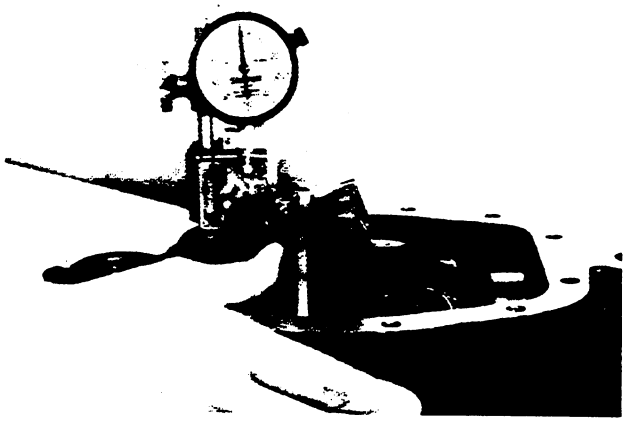


Figure 174 1009-174

Set up dial indicator as shown. Be sure to locate dial indicator on same ring gear screw as shown in Figure 1009-1. Force ring gear to mesh with pinion gear. Rock ring gear to allow the teeth of the gears to mesh. With force still applied to the differential case, set indicator at zero "0".

Tool—#D-128 Indicator.

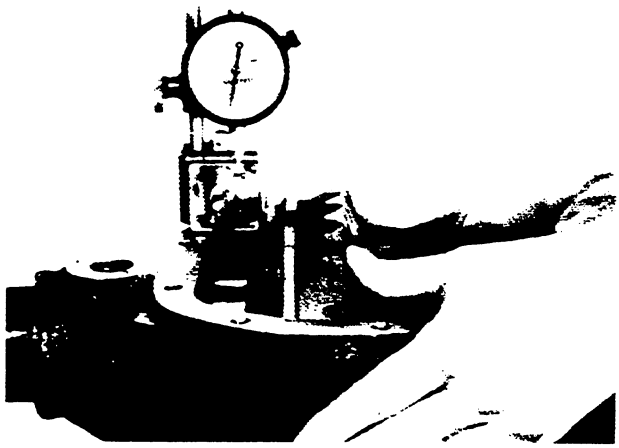


Figure 175 1009-175

Force the differential assembly (ring gear) away from the pinion gear to obtain an indicator reading. Repeat until the same reading is obtained each time. This reading will be the necessary amount of shims between the differential case and differential bearing on the ring gear side. Remove indicator and differential case from the carrier.

Remove master bearings from differential case.

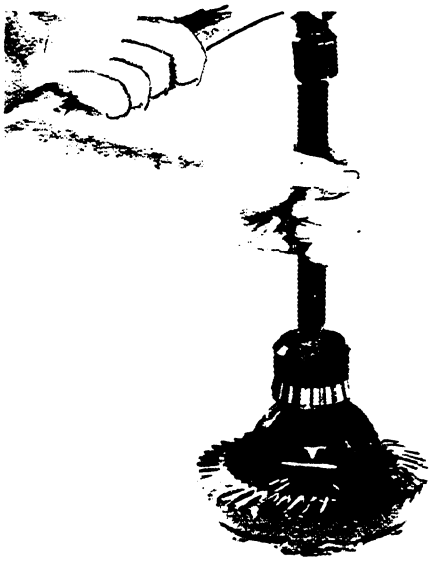


Figure 176 1009-176

Assemble the required amount of shims onto hub (ring gear side) as determined in Figure 1009-175. Place bearing cone on hub of case. Use bearing installer to seat bearing cone as shown.

Tools—#D-156 Installer, #S-4171 Handle.

Assemble the remaining of the total shim pack which was determined in Figure 1009-154 on the opposite side of the differential case. Add an additional .015 of shims on this side to compensate for differential bearing preload. Assemble differential bearing using the same tools as shown in Figure 1009-176.

For example:

In Figure 1009-154 (less pinion) a total of .085 indicator reading was recorded.

In Figure 1009-175 (with pinion) a total of .055 indicator reading was recorded. This leaves a balance .030 of shims for the opposite side and adds up to the .085 which was first recorded.

Add an additional .015 shims on the opposite side for bearing preload and backlash.

Ring gear side—.055

Opposite side—.030

Opposite side preload—.015

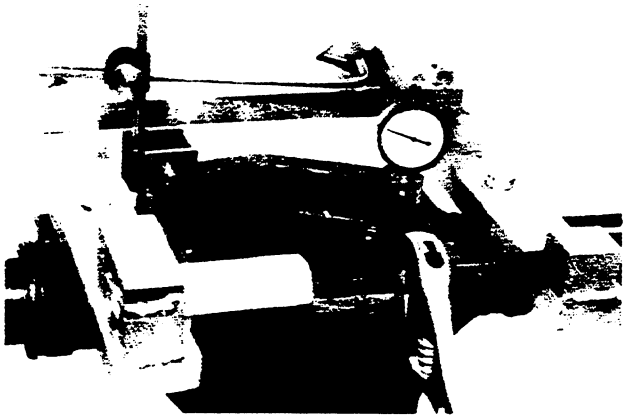


Figure 177 1009-177

Install spreader and indicator to carrier as shown. **Do not spread carrier over .015".**

Remove indicator.

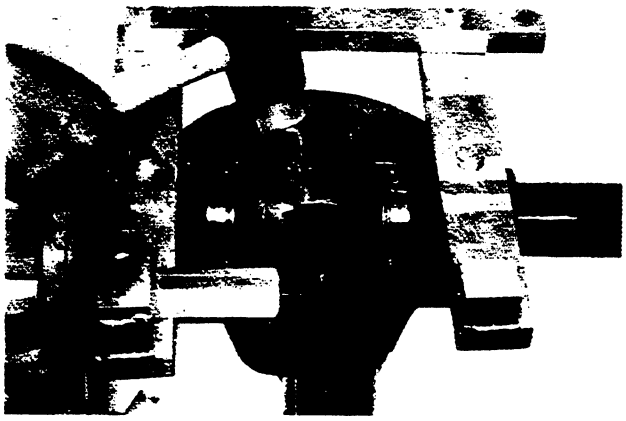


Figure 178 1009-178

Assemble differential bearing cups to differential bearing cones.

Install differential assembly into carrier.

Use a rawhide hammer to seat differential assembly into cross bore of carrier. Care should be taken to avoid nicking the teeth of the ring gear and pinion during assembly.

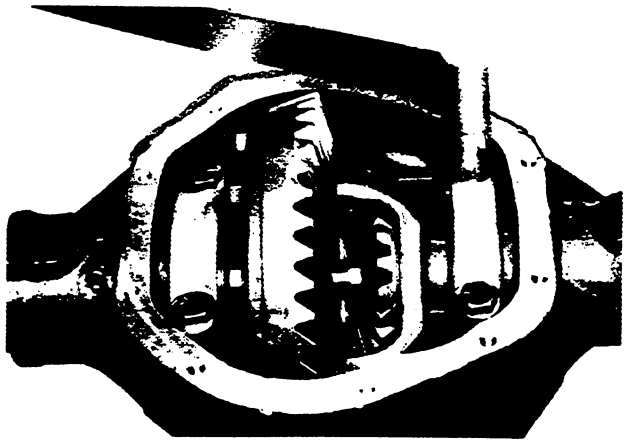


Figure 179 1009-179

Install bearing caps. Make sure the letters stamped on the caps correspond with those on the carrier; torque bearing cap screws to 70-90 lbs. ft.

Tool—#C-524-A Torque wrench.

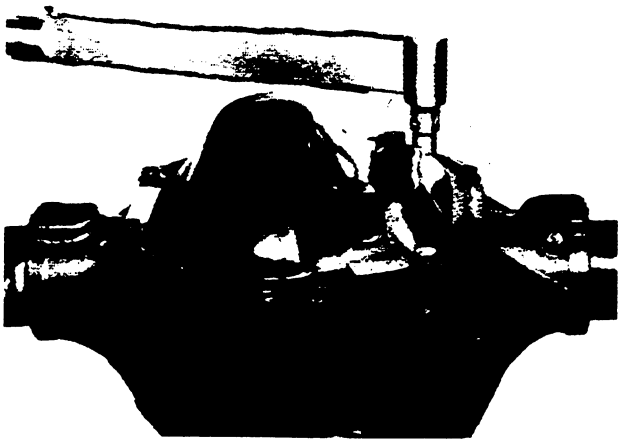


Figure 181 1009-181

Install new cover gasket and install cover plate. Torque screws to 30-40 lbs. ft.

Tool—#C-524-A Torque wrench.

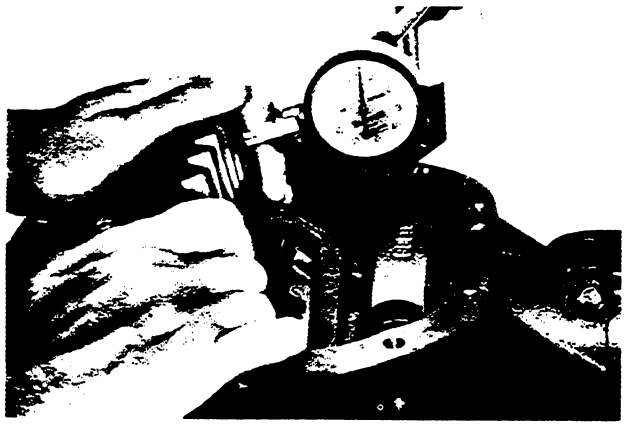


Figure 180 1009-180

Check ring gear and pinion backlash in three equally spaced points with dial indicator as shown.

Backlash tolerance is .005 to .008 and cannot vary more than .002 between points checked.

High backlash is corrected by moving the ring gear closer to the pinion.

Low backlash is corrected by moving the ring gear away from the pinion.

These corrections are made by switching shims from one side of the differential case to the other.

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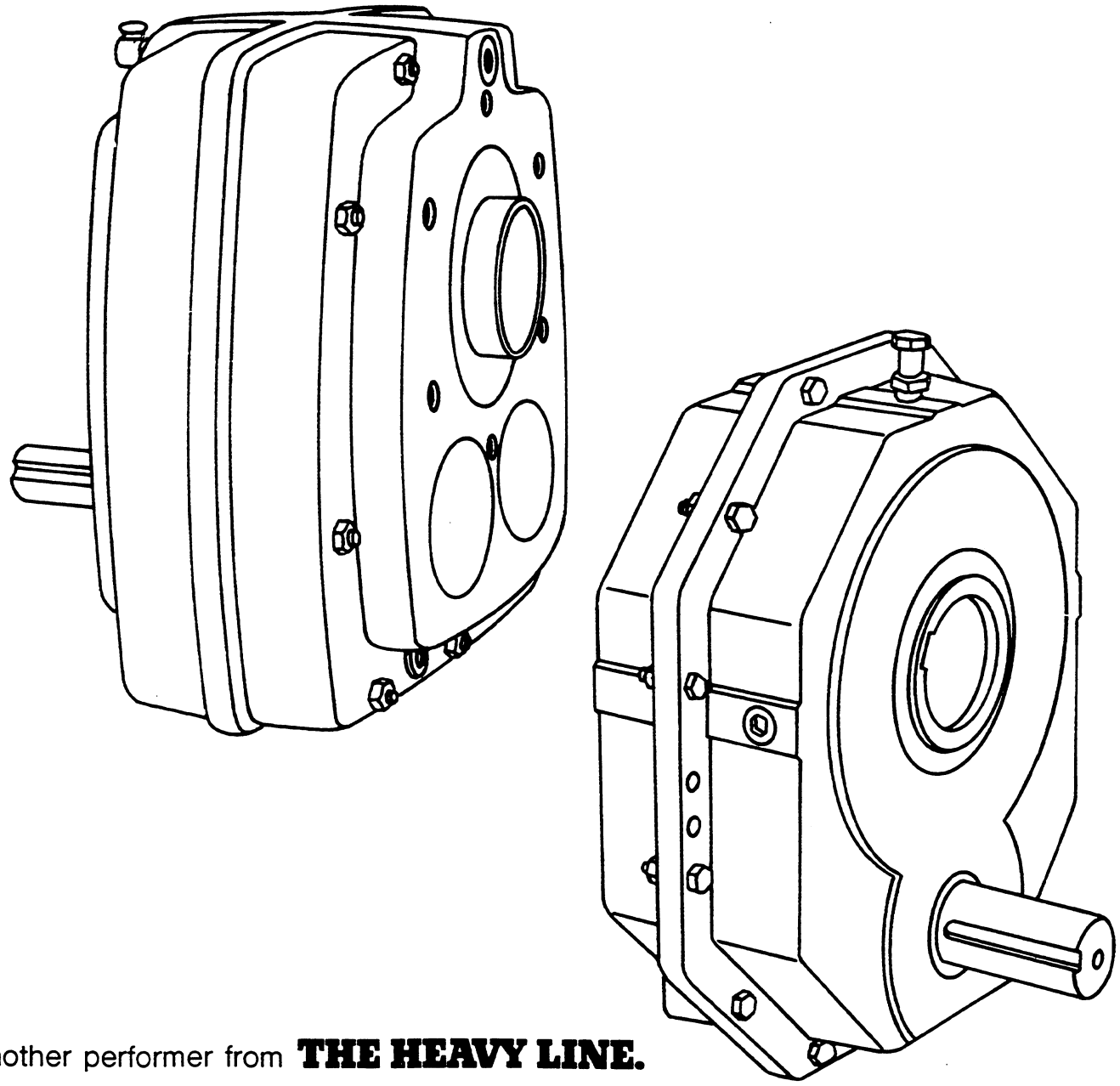
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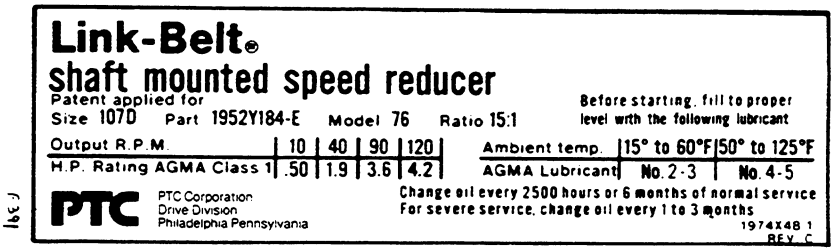
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Maintenance Service Record 16

Installation

Warning:
Safety is the basic factor to consider at all times, in the operation of these drives. Through the use of proper clothing and tools — with proper application and methods of handling, you can prevent serious accidents and injury to yourself and your fellow workers.

Proper installation of the Shaft-Mounted Drive is essential for safety, economical operation, and long life. Consult PTC Drive Division if there are any changes in operating conditions or loading from that for which the drive was sold, or as stamped on the name-plate specifications:



Warning:
Prior to operation at input speeds of 2000 rpm or higher. Consult PTC Drive Division to review application. Under certain conditions, speeds higher than 2000 RPM input could result in property damage or personal injury.

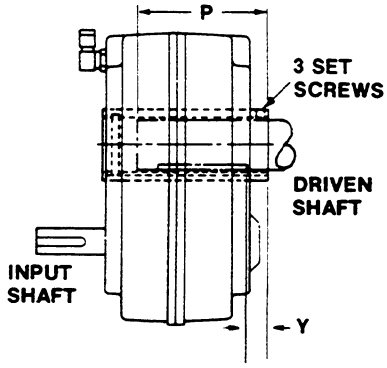
Mounting on Shaft

It is important that the driven shaft, on which the reducer is to be mounted, is clean and free from burrs. Mount reducer on driven shaft using 'P' dimension as the maximum and recommended length of shaft extension into hollow shaft to permit use of wheel puller to remove reducer. Minimum shaft extension to be used in hollow shaft is equal to 'P minus Y' dimension. Dimension 'Y' locates keyseat in driven shaft.

Dimension Chart

Type S Single Reduction			Type D Double Reduction		
Size	P	Y	Size	P	Y
107	4 1/4	3/4	107	4 1/4	3/4
115	4 3/4	3/4	115	4 3/4	3/4
203	5 3/8	1	203	5 3/8	1
207	6 1/8	1	207	6 1/8	1
215	7 1/8	1 1/4	215	7 1/8	1 1/4
307	8	1 1/4	307	8	1 1/4
315	6 3/4	1 1/4	315	9 1/4	1 1/4
			407	11	1 1/4
			415	12	1 1/4
			507	13 1/2	1 1/4
			608	15 1/2	1 1/4

Use a lubricant on the driven shaft to facilitate assembly.



Warning:
For safe handling, use only proper lifting equipment such as crane or hoist, having ample load-carrying capacity. Hand lifting is dangerous. Use lifting lug on reducer, where provided, to lift reducer only. When necessary to lift reducer and attached accessories, use properly placed slings of suitable capacity.

Mounting Assemblies and V-Belt Drive Positions

The reducer may be mounted in any of the assemblies shown. Assembly 1 & 6 are recommended; alternate assemblies can be used where space limitation, motor location or tie rod clevis supports dictate their selection.

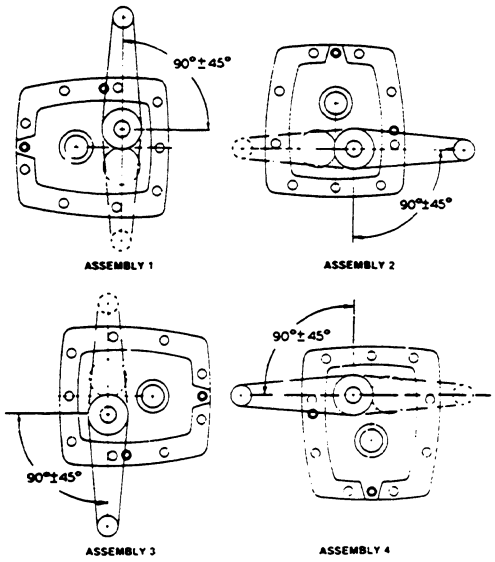
Avoid excessive overhang on both driven shaft and input shaft by mounting reducer as close as possible to bearing support and mounting the center of the V-Belt sheave on the input shaft a distance of no more than 1½ times the shaft diameter away from the reducer.

Caution:
Do not hammer on reducer or sheave when mounting on shafts as damage to bearings may result. Tap lightly with a soft mallet. Tighten the three setscrews to their rated torque value against the driven shaft. Stake keyseat in driven shaft to prevent key from moving.

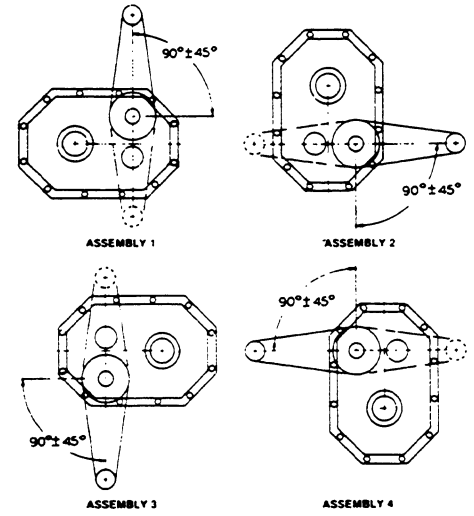
After assembly has been determined, arrange V-Belt drives to provide maximum adjustment to V-Belt drive centers. Variations up to ±45° are permissible.

Warning:
A protective guard meeting OSHA requirements must be mounted around the V-Belt in any installation where personnel could possibly come in contact with the drive or serious personal injury might result.

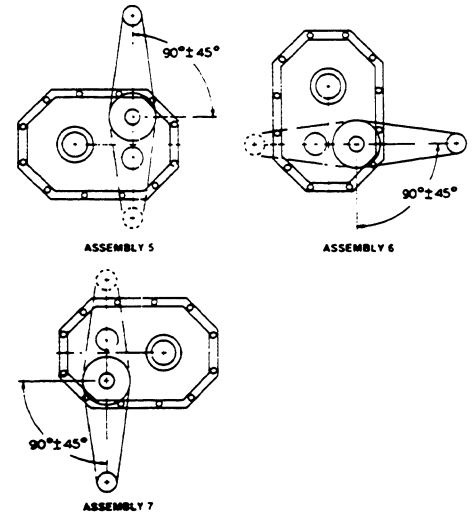
SINGLE AND DOUBLE REDUCTION SIZES 107 THRU 307



SINGLE AND DOUBLE REDUCTION SIZE 315



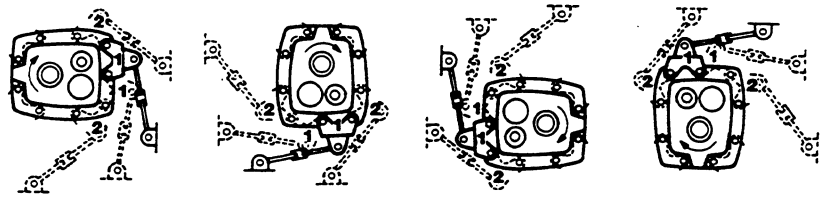
DOUBLE REDUCTION SIZES 407 THRU 608



Tie Rod and Tie Rod Plate Locations

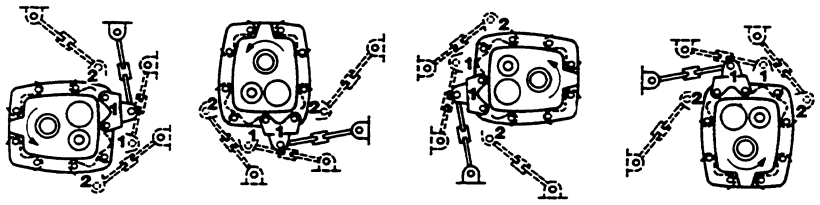
SINGLE AND DOUBLE REDUCTION SIZES 107 THRU 307

CLOCKWISE ROTATION OF HOLLOW SHAFT



ASSEMBLY 1 ASSEMBLY 2 ASSEMBLY 3 ASSEMBLY 4

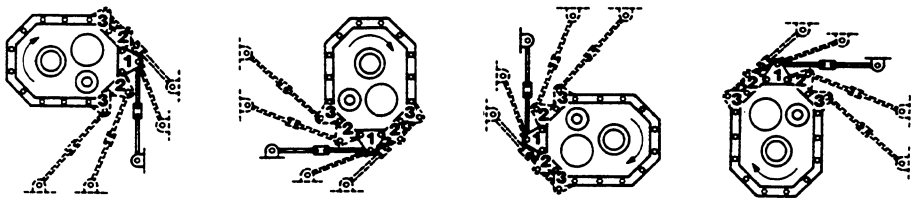
COUNTER-CLOCKWISE ROTATION OF HOLLOW SHAFT



ASSEMBLY 1 ASSEMBLY 2 ASSEMBLY 3 ASSEMBLY 4

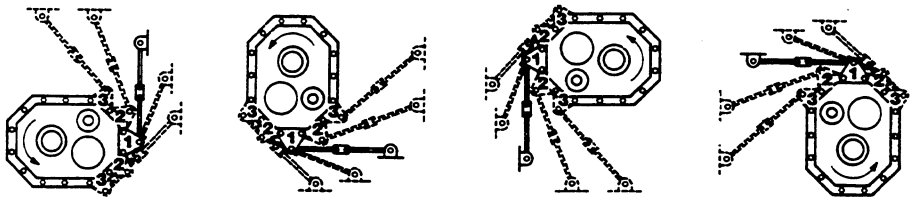
SINGLE AND DOUBLE REDUCTION SIZE 315

CLOCKWISE ROTATION OF HOLLOW SHAFT



ASSEMBLY 1 ASSEMBLY 2 ASSEMBLY 3 ASSEMBLY 4

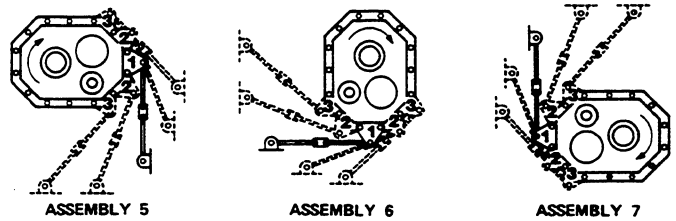
COUNTER-CLOCKWISE ROTATION OF HOLLOW SHAFT



ASSEMBLY 1 ASSEMBLY 2 ASSEMBLY 3 ASSEMBLY 4

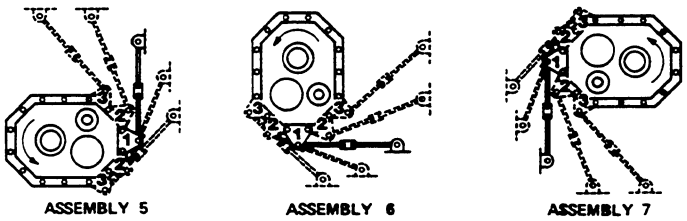
DOUBLE REDUCTION SIZES 407 THRU 608

CLOCKWISE ROTATION OF HOLLOW SHAFT



ASSEMBLY 5 ASSEMBLY 6 ASSEMBLY 7

COUNTER-CLOCKWISE ROTATION OF HOLLOW SHAFT



ASSEMBLY 5 ASSEMBLY 6 ASSEMBLY 7

Caution:
Tie Rod must be mounted only in one of the positions shown, or property damage may result. If any other position is desired — consult PTC Drive Division.

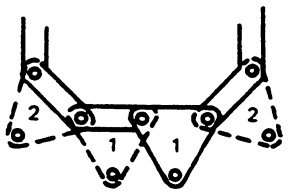
Installation

Locate tie rod and tie rod plate with relation to rotation of the driven shaft. Assemble tie rod plate onto housing with two bolts furnished with tie rod. Bolt into location selected on housing by removing standard bolts in housing.

Tie rod plate location 1, for each assembly, is preferred. Alternates are given in order of preferred positions. Position clevis support so that the tie rod is at approximate right angle to the centerline through the hollow shaft and tie rod mounting plate. Variation from position shown is permissible in tie rod up to 15° towards — or 30° away from housing. Use tierod turnbuckle to adjust V-Belt tension. Use jam nut to lock turnbuckle.

Warning:
The Rod must be connected with bolts properly torqued, and mounted to a solid base. If tie rod breaks loose, serious injury might result.

SIZE 608



Lubrication

Caution:
Shaft-Mounted Reducers are shipped **without oil.**

The reducer is lubricated by an oil reservoir in the housing. The correct amount of oil is important to the proper operation of the speed reducer. Excessive oil may cause leakage or overheating; insufficient oil may cause overheating or damage to rotating parts.

Fill oil reservoir to proper level with correct grade of oil, per table:—

Table below shows recommended lubricants and change periods. **Do not use lubricants of the extreme pressure (E.P.) type or those containing slippery additives when reducer is equipped with a backstop.**

AGMA NUMBER			Oil Change Per Hours	
Ambient Temperature				
Below 15°F	15° to 60°F	50° to 150°F	Initial	Periodic
Consult Drive Division	2-3	4-5	150	2500

Typical Oils Meeting AGMA Recommendations

LUBRICANT MANUFACTURER	AGMA OIL GRADE			
	2	3	4	5
AMOCO	AMERICAN INDUST. #31	AMERICAN INDUST. #51	AMERICAN INDUST. #75	AMERICAN INDUST. #95
ARCO	DURO S-315	DURO S-465	DURO S-700	DURO S-1000
CHEVRON	O.C. TURBINE 68	O.C. TURBINE 100	O.C. TURBINE 150	O.C. TURBINE 220
CITGO	PACEMAKER 30	PACEMAKER 60	PACEMAKER 80	—
EXXON	TERESSTIC 68	TERESSTIC 100	TERESSTIC 150	NUTO 220
GULF	HARMONY 53	HARMONY 61	HARMONY 75	HARMONY 88
KEYSTONE	543	49 LIGHT	432	1790
MOBIL	D.T.E. HEAVY MEDIUM	D.T.E. HEAVY	D.T.E. EXTRA HEAVY	D.T.E. BB
SHELL	TURBO 33	TURBO 41	TURBO 69	TELLUS 71
SUNOCO	SUNVIS 31	SUNVIS 51	SUNVIS 75	SUNVIS 99
TEXACO	REGAL RO-68	REGAL RO-100	REGAL RO-150	REGAL GR & O

The table to the right shows approximate oil capacities for all sizes and assemblies. These capacities are for reference only, and are intended to assist you in the determining how much oil to provide for each reducer. The proper amount of oil for each specific reducer can be determined only by filling the reservoir to the level of the plug.

Warning:
Do not loosen or remove lubrication plugs while reducer is operating, or personal injury might result.

Drain and flush gear housing after first 150 hours of operation, and every 2500 hours thereafter. Check oil level occasionally when unit is not operating, and add oil if necessary. Keep breather holes clean at all times to prevent pressure build-up in reducer.

Approximate Oil Capacities

Reducer Size	Horizontal Assemblies			
	1	2	3	4
	Capacity, U.S. Quarts			
107S,107D	1½	1⅜	1⅝	1½
115S,115D	1¾	1⅝	1⅞	1¾
203S,203D	3⅛	3	3¼	3⅜
207S,207D	4½	4¼	4¾	4⅝
215S,215D	5⅝	5¼	5⅞	6¼
307S,307D	8¼	7½	8¾	9⅜
315S	4⅞	5⅜	4⅞	6⅛
315D	16¼	6	16⅞	11¾

Reducer Size	Horizontal Assemblies		
	5	6	7
	Capacity, U.S. Quarts		
407D	6	11½	6
415D	6	12	6½
507D	10½	21	8¾
608D	34	24¼	35

Horizontal Mounting—Oil Levels

Face input shaft side when determining assembly. All Shaft-Mounted speed reducers are furnished with oil level, drain and breather plugs arranged for horizontal mounting as in Assembly 1 or 6. The user can reposition plugs for other assemblies.

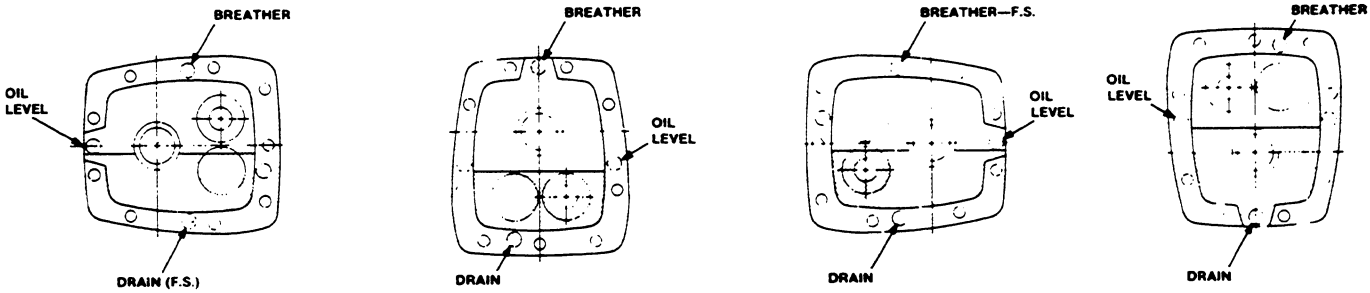
Standard speed reducers may be mounted with input shaft inclined upward or downward from horizontal, to a maximum of 20°, without modification. If reducer is to be installed at an angle greater than 20° upward or downward, consult PTC Drive Division.

Vertical Mounting—Oil Levels

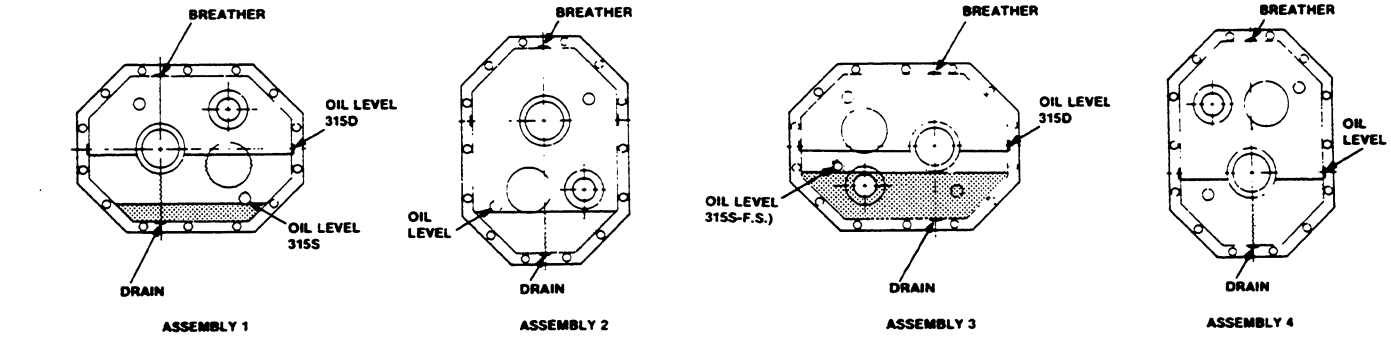
Standard shaft-mounted speed reducers can be supplied with minor modifications for either input shaft up or input shaft down. Consult PTC Drive Division.

Oil Levels

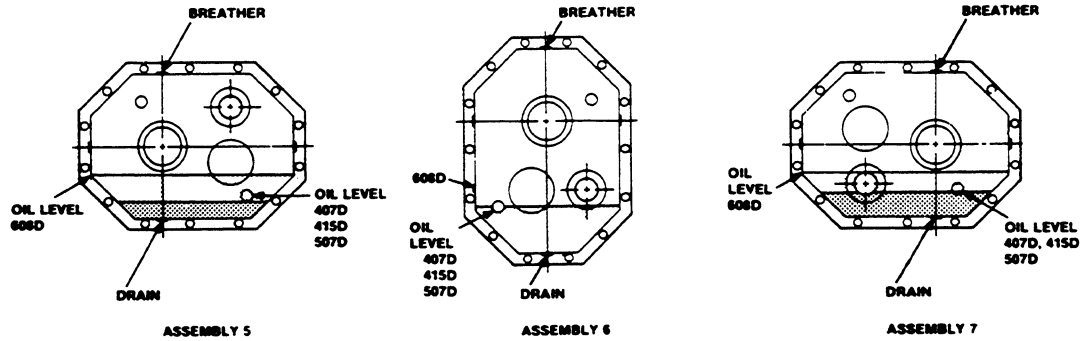
SINGLE AND DOUBLE REDUCTION SIZES 107 THRU 307



SINGLE AND DOUBLE REDUCTION SIZE 315



DOUBLE REDUCTION SIZES 407 THRU 608



Safety First

In the maintenance and operation of mechanical equipment, SAFETY is the basic factor which must be considered at all times. Through the use of the proper clothes, tools and methods of handling, serious accidents causing injury to you or your fellow worker can be prevented.

Warning:
Before proceeding with any installation or maintenance work, put the motor starter in a locked out position so that the motor cannot be started accidentally.

Disassembly and Reassembly

To service the reducer, disconnect the V-belt and remove the sheave from the input shaft. Disconnect the tie rod by removing the two bolts in the tie rod plate. Loosen the three (3) set screws in the hollow shaft. Remove the reducer from the driven shaft with an internal wheel puller by inserting the jaws into the internal groove in the hollow shaft or by using a Link-Belt Shaft-Mounted Reducer Puller.

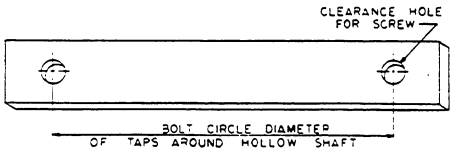
Warning:
Before pulling reducer from driven shaft, support weight of reducer with hoist and properly placed slings having ample load-carrying capacity to prevent personal injury or property damage.

Drain oil from reducer before proceeding further.

Refer to parts drawings and parts lists.

Size 107 through 307

1. Place unit on blocks with input shaft down.
2. Remove nuts, washers and bolts at housing-cover joint.
3. Using two pieces of key stock — or a bar as shown below — across the hollow shaft, tighten two screws into the tapped holes in the cover to separate the housing and the cover. Alternately turn screws and use a **soft** hammer around perimeter of joint.

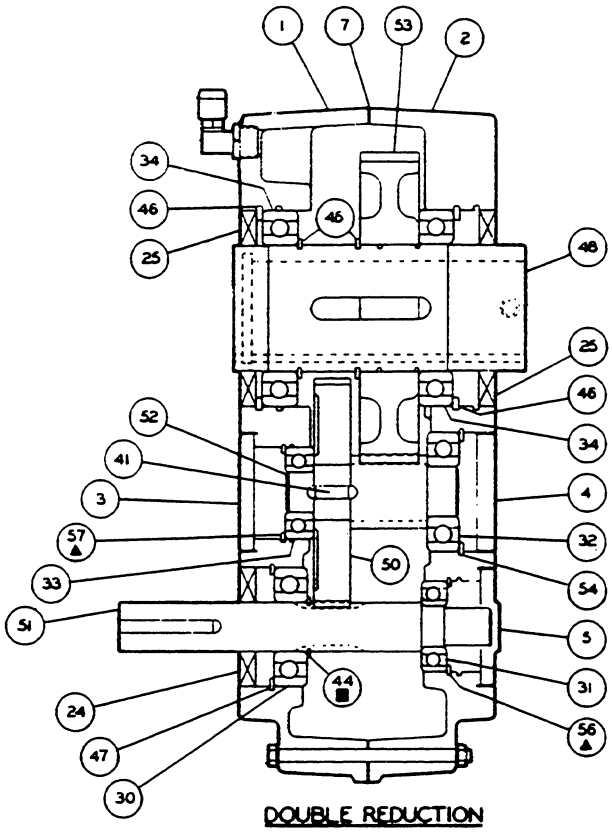


4. Lift cover free of housing and internal assembly.
5. Lift shaft and gear assemblies from housing.
6. On any shaft and gear assemblies (low speed, intermediate speed or high speed) where parts are to be replaced, remove retaining rings and press off bearings and gears.
7. Remove oil seals from housing and cover.
8. Flush and clean all internal assemblies, housing and cover with a clean solvent.
9. Reassemble in the reverse order, replacing worn parts as required. Use new joint gasket.
10. When replacing seals, use extreme caution to avoid damage when sliding over keyway in input shaft and set screw holes in hollow shaft. Use thin shim stock or mylar to cover these areas until seals have been tapped into place, flush with housing.

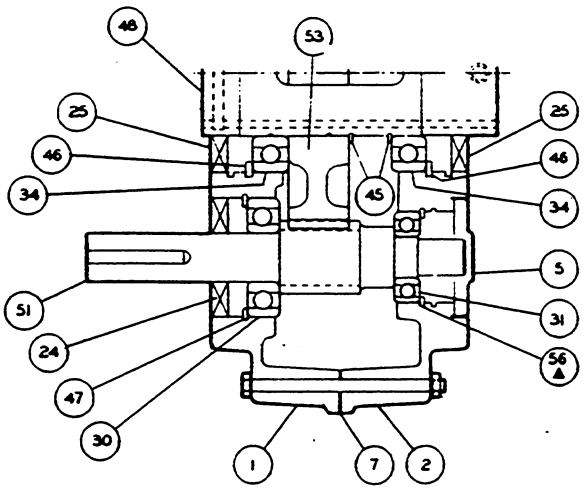
Size 315 through 608

1. Place unit on blocks with input shaft up. (size 608 with input shaft down)
2. Remove nuts, washers and bolts at housing-cover joint.
3. Use two bolts in tapped holes of housing flange for jack-screw operation to separate housing and cover. Turn bolts evenly to prevent cocking and damage to internal parts.
4. Proceed as in steps 4 through 10 under "Size 107 through 307"

Parts Drawing and Parts List Size 107 through 307



DOUBLE REDUCTION

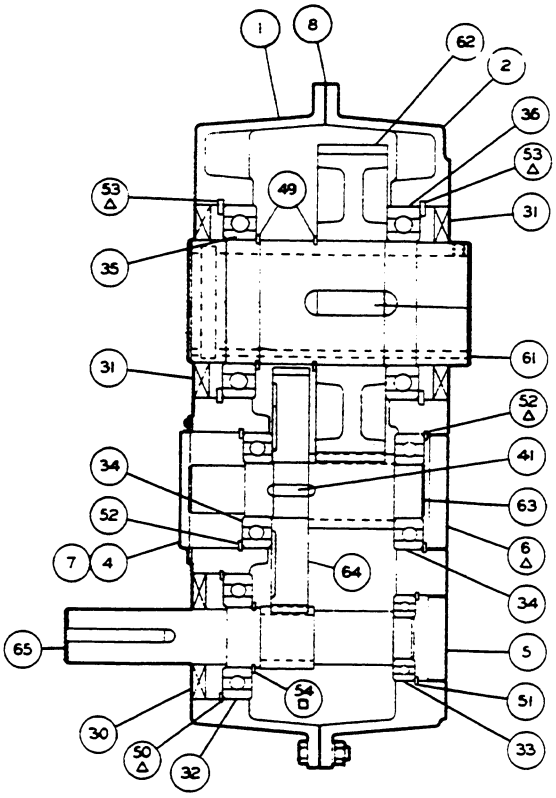


SINGLE REDUCTION

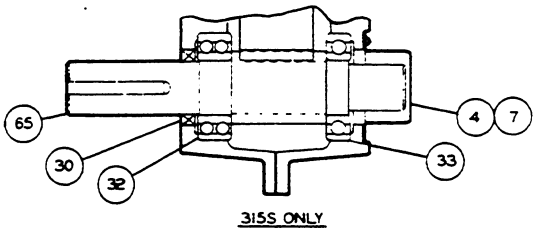
Locator Number	Name of Part	Quantity Per Reducer
1	Housing	1
2	Housing Cover	1
3	Closure	1
4	Closure	1
5	Closure	1
7	Gasket	1
24	Oil Seal	1
25	Oil Seal	2
30	Ball Bearing	1
31	Ball Bearing	1
32	Ball Bearing	1
33	Ball Bearing	1
34	Ball Bearing	2
41	Key	1
44■	Retaining Ring	1
45	Retaining Ring	2
46	Retaining Ring	2
47	Retaining Ring	1
54	Retaining Ring	1
56▲	Retaining Ring	1
57▲	Retaining Ring	1
48	Low Speed Shaft	1
50	High Speed Gear	1
51	High Speed Pinion	1
52	Low Speed Pinion	1
53	Low Speed Gear	1

■ Ratio 24 to 1 only ▲ 203, 215 and 307

Parts Drawing and Parts List Size 315 and 407



△ 315D ONLY
□ RATIO 24:1 ONLY

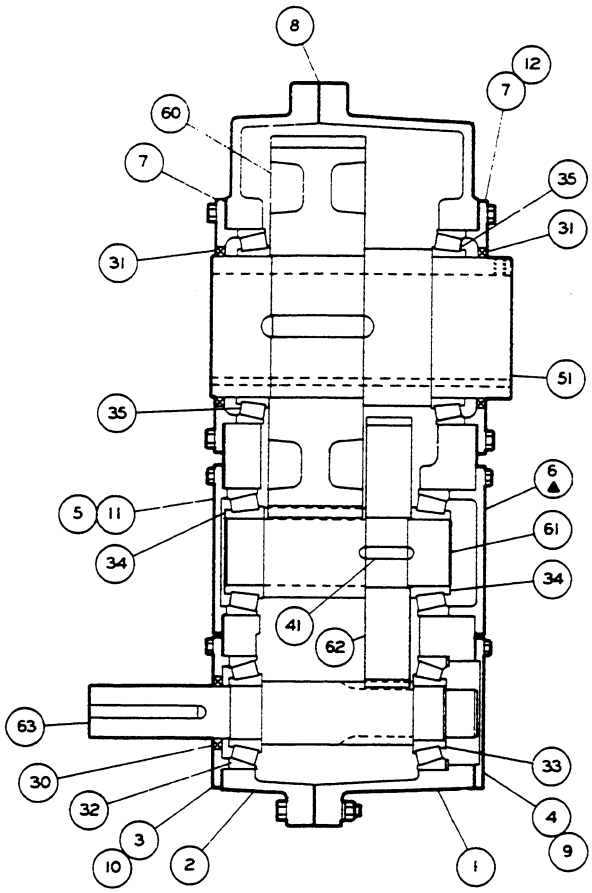


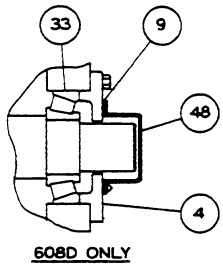
315S ONLY

Locator Number	Name of Part	Quantity Per Reducer
1	Housing	1
2	Housing Cover	1
4	Retainer	1
5	Retainer	1
6△	Retainer	1
7	Gasket	1
8	Gasket	1
30	Oil Seal	1
31	Oil Seal	2
32	Ball Bearing	1
33	Ball Bearing	1
34	Ball Bearing	2
35	Ball Bearing	2
41	Key	1
49	Retaining Ring	2
50△	Retaining Ring	1
51	Retaining Ring	1
52	Retaining Ring	2 (315) 1 (407)
53△	Retaining Ring	2
54□	Retaining Ring	1
61	Low Speed Shaft	1
62	Low Speed Gear	1
63	Low Speed Pinion	1
64	High Speed Gear	1
65	High Speed Pinion	1

△315 Only □ Ratio 24 to 1 only

Parts Drawing and Parts List Size 415 through 608





608D ONLY

Locator Number	Name of Part	Quantity Per Reducer
1	Housing	1
2	Housing Cover	1
3	Bearing Retainer	1
4	Bearing Retainer	1
5	Bearing Retainer	1
6▲	Bearing Retainer	1
7	Bearing Retainer	2
8	Gasket	1
9	Gasket	1
10	Shim Set	1
11	Shim Set	1
12	Shim Set	2
30	Oil Seal	1
31	Oil Seal	2
32	Roller Bearing	1
33	Roller Bearing	1
34	Roller Bearing	2
35	Roller Bearing	2
48▲	Cover	1
51	Low Speed Shaft	1
60	Low Speed Gear	1
61	Low Speed Pinion	1
62	High Speed Gear	1
63	High Speed Pinion	1

▲ 608 Only

Recommended Spare Parts

One set of spare parts is usually adequate for 1 to 5 identical reducers operating in the same general area, under average conditions, where a possible breakdown will affect only one reducer. Where continued operation is extremely vital and/or type of service is unusually severe, consideration should be given to carrying additional sets of spare parts.

For installations having 5 to 10 identical reducers where continued operation is extremely vital, and/or where type of service is unusually severe, some customers carry a complete spare reducer, in addition to spare parts.

For installations having more than 10 identical reducers, or for large quantities of same size reducers regardless whether identical or not, consult Link-Belt for spare parts recommendations. State the exact nature of the application, it's importance regarding continued operation, and any other factors which will aid us in making proper recommendations.

One set of spare parts for a Link-Belt shaft-mounted speed reducer consists of:

One high speed pinion
One high speed gear
One set high speed bearings
One housing joint gasket
One set oil seals

Ordering Instructions

Parts may be obtained for any Link-Belt shaft-mounted speed reducer by submitting the following data:

Data required from speed reducer nameplate:

1. Part Number
2. Reducer Size and Model Number
3. Ratio

Data required from parts drawings and parts lists:

1. Locator number
2. Name of part

With the above information, any Link-Belt reducer or reducer part can be correctly identified from complete factory records maintained by the PTC Drive Division.

Trouble Shooting

An analysis of trouble shooting procedure appears in the table below, showing possible irregularities of performance, details of their causes and remedies.

- Trouble shooting and repair.

	Causes		Remedy
Over-heating	Overloading	Load exceeds drive capacity.	Check rated capacity of drive. Replace with drive of sufficient capacity or reduce load.
	Improper lubrication	Insufficient oil.	Check oil level. Adjust to level indicated.
		Too much oil in the drive causes churning, and excessive heat is generated by the fluid friction of the churning oil.	
		Wrong grade of oil.	Flush and refill to indicated oil level with grade specified on drive nameplate. Typical oils are listed on page 4.
Noise and vibration	Tie rod support.	Improper installation.	Check mounting bolts and tighten. Check clevis support for rigidity and strengthen if necessary.
	Failing bearings	Wear, evident by dullness of balls and raceways. Wear of bearings is caused by abrasives in oil.	Replace worn bearings. Clean and flush drive and replace oil.
		Spalling or flaking-out of metal in raceways usually indicates overloading.	Replace worn bearings. Check and remedy bearing clearances, loading of drive, and overhung loads.
		Bearing cage failure usually indicates overloading.	
	Excessively worn gears	Overloading causes pitting of tooth face.	Determine if load exceeds nameplate rating If overloaded reduce load or replace with reducer of sufficient capacity.
	Insufficient oil	A low oil level reduces the muffling effect of the oil.	Check oil level. Fill to level indicated.
	Loose parts	Excessive shock loads or improper connection with other machinery.	Inspect drive for broken parts, loose bolts, nuts and screws. Check all keys for proper size and fit.
	Excessively high speeds		Check recommended speed range. Reduce speed or install drive with sufficient speed range.
Excessive shaft end play	Worn bearings	Bearing exposure to an abrasive causes wear in the balls and raceways.	Worn bearing balls and raceways have a dulled appearance. Replace worn bearings. Clean and flush drive and replace oil.
Excessive backlash	Worn gears or loose parts	Worn gears and keys or loose screws cause backlash. Backlash increases with the number of gear sets; therefore, backlash is normally greater in double reduction drives.	Replace worn gears and keys. Tighten loose screws.
Oil leakage		Excessive oil.	Check oil level and drain to indicated level.
		Clogged breather.	Clean or replace breather. Clean breather hole with pipe cleaner and a suitable non-flammable solvent.

Backstops for Link-Belt® Shaft-Mounted Speed Reducers

Backstops can be installed on shaft-mounted speed reducers to prevent reverse rotation. Applications that could require backstops include elevators, inclined conveyors and pumps.

This device operates on the overrunning clutch principle, automatically preventing reverse rotation of driven shaft resulting from power stoppages or other causes.

Locking action occurs through an infinite number of gripping positions.

On each speed reducer, provision is made for mounting backstop. A keyway in the housing bore matches the keyseat in the outside diameter of the backstop.

This backstop kit is used for shaft-mounted speed reducers Type S single reduction, and Type D double reduction. Since certain parts will not be required (see parts list) — after assembly is completed and operation of the backstop checked, the extra parts may be discarded.

Installation

Warning: Before installing backstop
Disconnect motor from power source so that motor cannot be started accidentally. Establish correct direction of rotation of input shaft for desired rotation of hollow shaft. (Refer to sketches — "Rotation of Hollow Shaft")

Establish motor wiring arrangement, which will result in correct rotation of input shaft. **Do not** wire motor using reversible type starting switch.

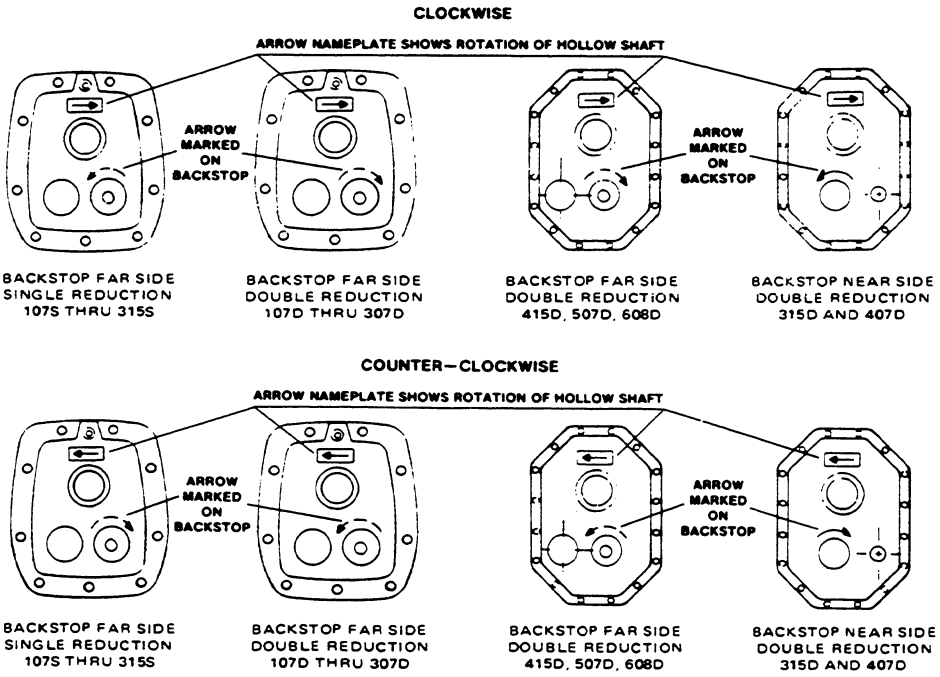
Failure to perform any of the above steps could result in personal injury or machine damage — or both.

It is also necessary to determine assembly **Style 1 or Style 2,** by comparing with drawing Page 13.

1. Drain oil from housing. On Style 1 units, pry out steel cover at opposite end of high speed shaft, and discard. On Style 2 units, remove screws and washers, steel cover and gasket.

   Note: On sizes 315D and 407D, backstop is installed on intermediate speed shaft on same side as input shaft.

Rotation of Hollow Shaft - When Viewed from Input Shaft Side



2. Thoroughly clean suitable surface area on housing, on input side above hollow shaft, and firmly attach self-sticking arrow nameplate to reducer to correctly indicate proper hollow shaft rotation.

   Never install backstop until desired direction of output shaft has been established.

3. On Size 315D, insert retaining ring in unit.

4. Check housing bore. Backstop should slide into housing bore easily if bore is clean and free of burrs.

   CAUTION: Use only hand pressure when installing backstop, as hammer blows can cause damage. Arrows marked on either side of backstop indicate the direction of free rotation of shaft permitted by backstop.

Installation (continued)

5. Install backstop with arrow pointing in proper direction. See diagrams above. (See special instructions for size 415, 507 and 608 — model '79)
6. A temporary cardboard internal collar is furnished to facilitate assembly. With backstop in proper relationship to reducer for required shaft rotation draw collar approximately half way out of backstop bore. Position backstop on end of shaft and push into housing bore and onto shaft with a turning motion in a direction opposite to arrow until it is fully seated and keyways are aligned. Shaft will force temporary collar from backstop bore.
7. Insert key between backstop O.D. and housing bore. **WARNING!** It is vitally important to use the key with this backstop. USE ONLY THE KEY FURNISHED with kit, or serious injury could result. Use only finger pressure and fit if necessary.
8. For Style 1 units, install new cover from Backstop Kit. For Style 2 units, install original cover, screws, washers and new gasket.
9. Thoroughly clean suitable surface area in conspicuous location on reducer, and firmly attach self-sticking "Caution" nameplate.
10. Refill housing with oil.
11. Recheck for proper direction of rotation, by turning input shaft by hand before connecting motor and/or belts.

Size 415, 507 and 608 Model '79

Backstops for these reducers are complete with an integral inner race. The backstop for the Size 415 mounts directly into the housing high speed bore. The backstop for the Size 507 and Size 608 mounts into a cartridge.

The Size 507 cartridge is furnished as part of the kit and must be assembled to the reducer housing. The Size 608 cartridge is integral with the bearing retainer Loc. 4.

6-1. Insert the backstop body (less inner race) into the housing or cartridge bore to check the fit. If the backstop enters fully, remove it. If the backstop will not enter fully, remove it, file burrs and recheck the fit.

6-2. Assemble the inner race with key onto the shaft. Light force may be needed to assemble this part. Assemble the retaining ring into the shaft groove. Start the backstop onto the inner race and into the housing or cartridge bore and continue pushing with a turning motion in a direction opposite to the arrow until the backstop is fully seated and keyways aligned.

Continue installation from step number 7.

Name of Part	Number Per Reducer	
	Style 1	Style 2
cover	1	1*
gasket	none	1
nameplate (overhollow shaft)	1	1
backstop	1	1
screw	none	4*
key	1	1
"caution" nameplate	1	1
retaining ring	none	1▲
washer	none	4*

*Not in backstop kit because already on reducer

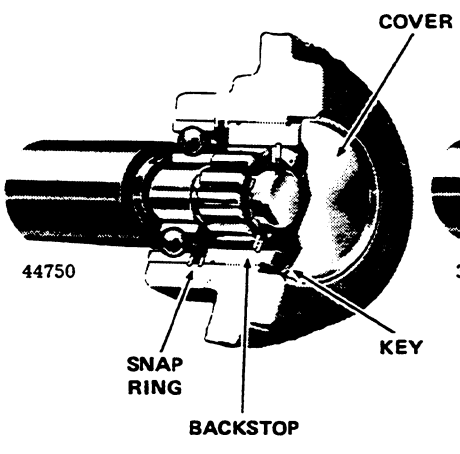
▲On Size 315D only

Caution:
The backstop is lubricated by oil from a reservoir located in the speed reducer housing. Do Not use lubricants of the extreme pressure (EP) type, or those containing slippery additives.

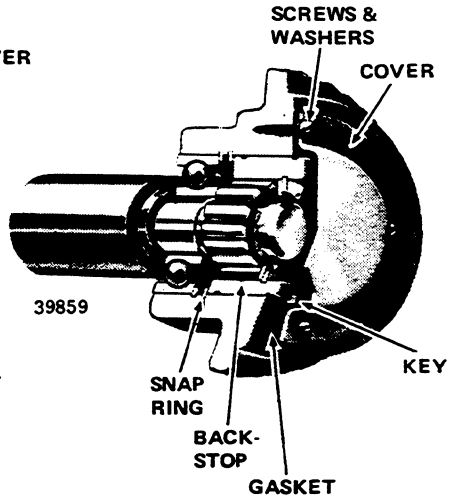
Removal

Warning:

1. Disconnect motor from power source so that motor cannot be started accidentally.
2. Drain oil from housing. For Style 1 units, pry out cover. For Style 2 units, remove screws, washers, cover and gasket.
3. Insert suitable tool in groove in outside diameter of backstop and, with equal pressure around the outside diameter, pry backstop from housing.



STYLE 1
Type S Model 62



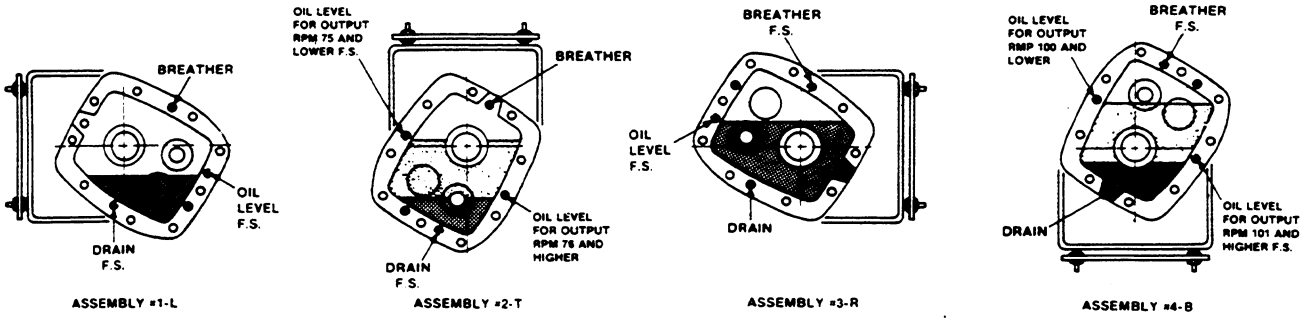
STYLE 2
Types S and D Model 58

Motor Bracket for Link®-Belt Shaft-Mounted Speed Reducer Model 76

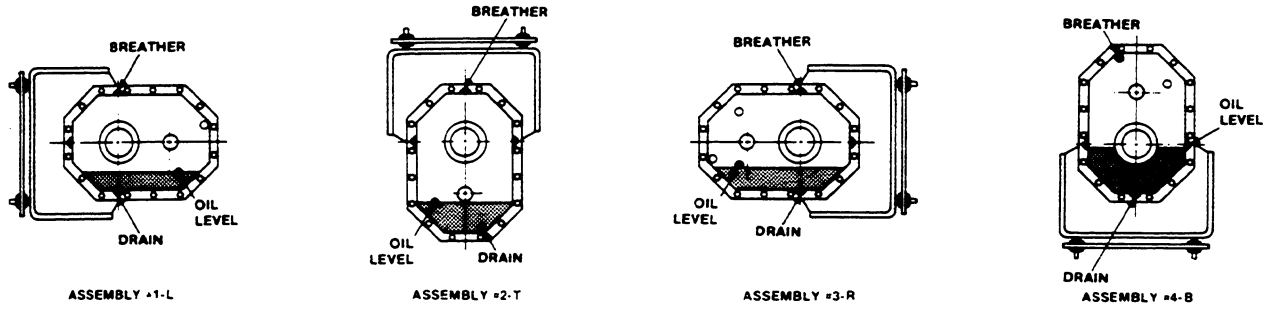
The Shaft-Mounted Reducer, sizes as shown, can be mounted with a motor bracket in any of the positions shown below:

Warning: When mounting a motor on this drive, belts, sheaves, chains, etc., must be covered by a safety guard meeting requirements of OSHA and local safety codes, in order to prevent personal injury or property damage.

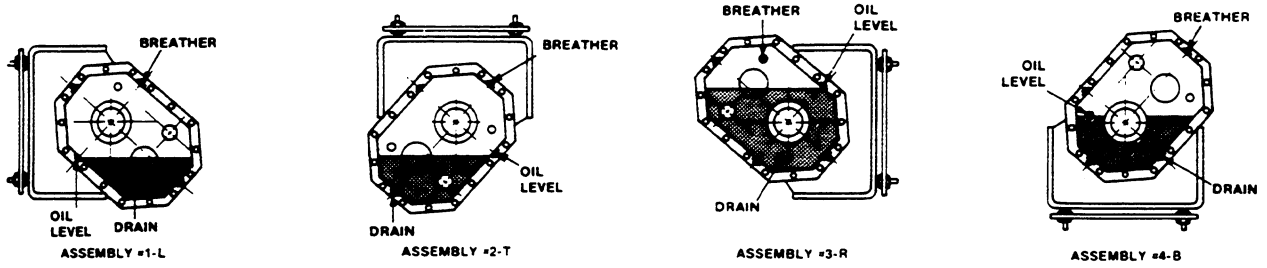
Motor Bracket Mountings—Oil Levels Sizes 107 Thru 307 Single & Double Reduction



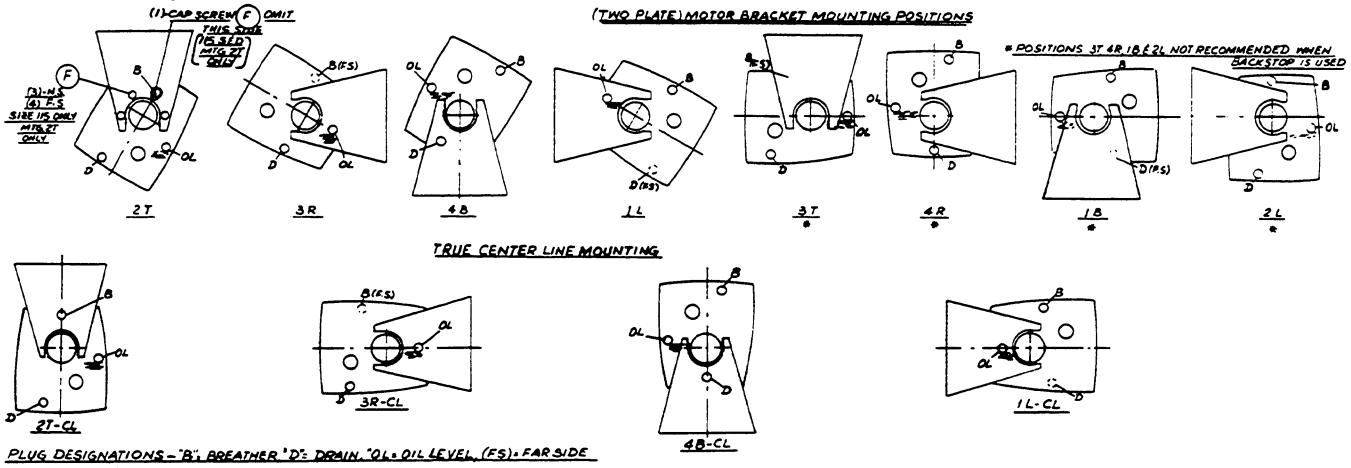
Motor Bracket Mounting—Oil Levels—Size 315 Single Reduction



Motor Bracket Mounting—Oil Levels—Size 315 Double Reduction



Motor Bracket Mounting (Two Plate)—Size 107 Thru 203 Single & Double Reduction



Assembly Procedure

1. Mount motor bracket (98) with label toward reducer (1).

   Attach bracket to reducer with four cap screws (87), furnished in parts bag.

   Brackets for reducers 107 through 407 mount directly at tapped holes in reducer cover.

   Brackets for reducers 415 and 507 mount to low speed bearing retainer. Replace four retainer cap screws with cap screws (87), furnished in parts bag.

2. Remove top four nuts (100) and run four bottom nuts all the way down. Place motor plate (99) on jackscrews, then replace the four top nuts.

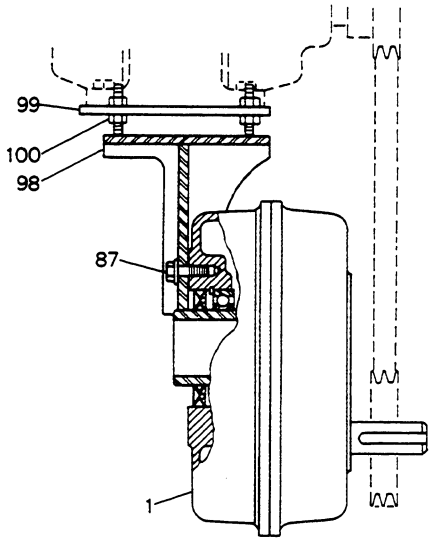
3. Mount motor to motor plate (99) with capscrews, nuts and lockwashers (furnished by user).

4. Assemble V-Belt Drive, raise plate (99) by moving nuts (100) until proper belt tension is obtained. Nuts also provide for leveling of the motor.

Caution: Do not overtighten belts, or damage to input shaft bearings could result.

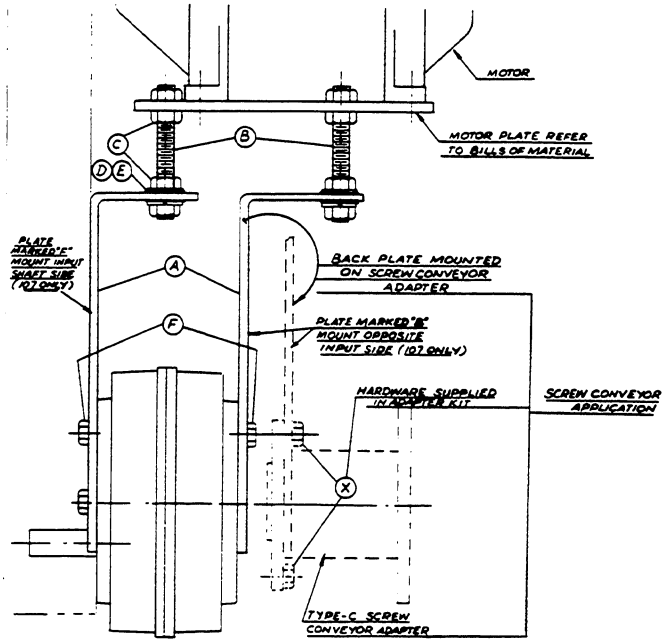
Welded Steel Bracket

Loc. No.	Name of Part	Qty. Per Drive
1	Reducer	1
87	Capscrew	4
98	Bracket	1
99	Plate	1
100	Nut	8



Two Piece Steel Bracket

Loc. Sym.	Name of Part	Qty. Per Drive
A	Brackets	2
B	Threaded Stud	4
C	Nut	16
D	Washer	8
E	Lockwasher	8
F	Cap Screw	8



MAINTENANCE SERVICE RECORD

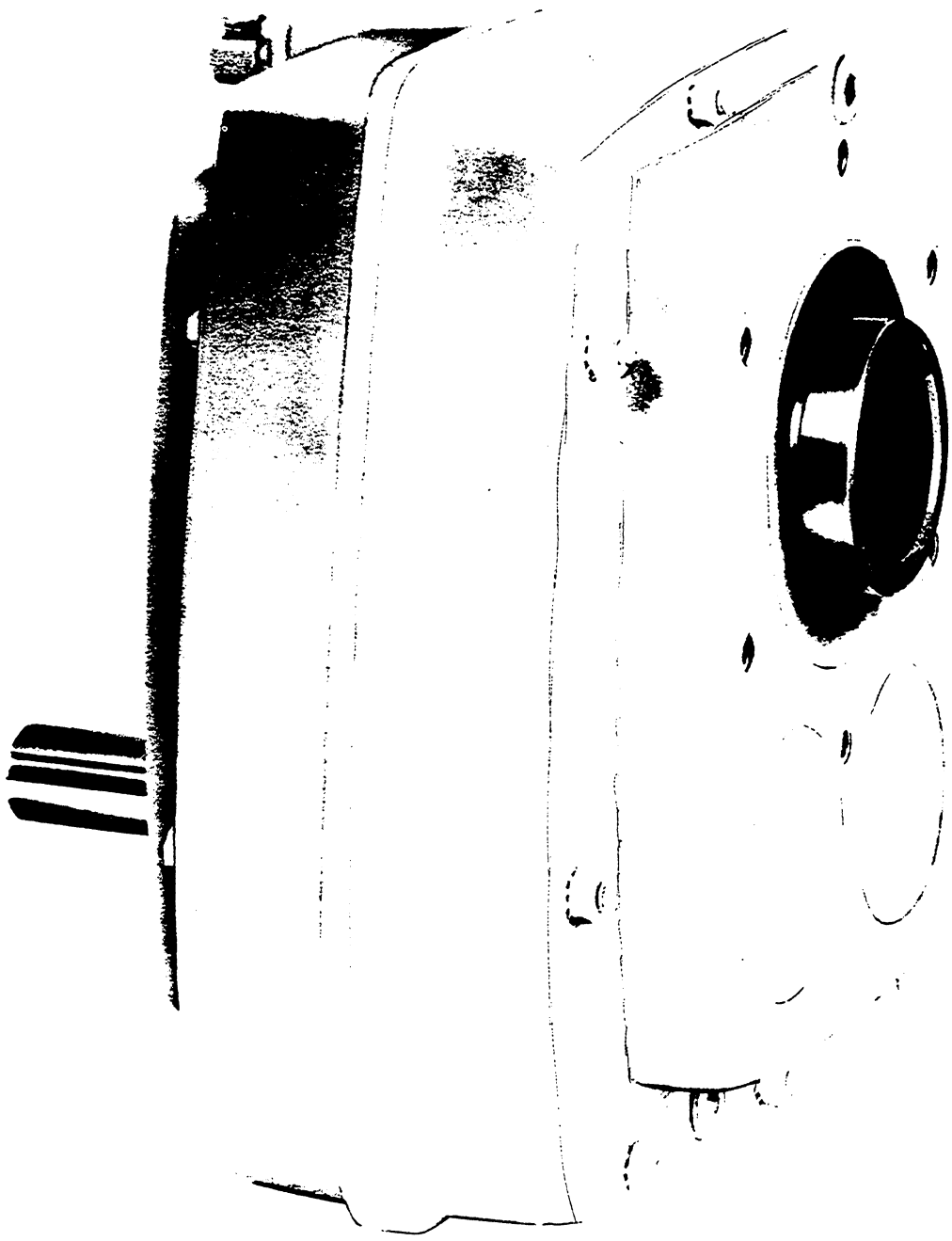
The following maintenance record form is for your convenience and should be kept up to date and made part of your permanent maintenance records.

MAINTENANCE RECORD

Reducer Type & Size _____ **Model No.** _____

Serial No. _____ **Ratio** _____

DATE	MAINTENANCE TO BE PERFORMED	HOURS OF OPERATION	REMARKS
	FILL WITH PROPER GRADE OIL AND CHECK FOR CORRECT OIL LEVEL	START UP	SEE PAGES 4 AND 5
	INITIAL OIL CHANGE	150	
	FIRST PERIODIC OIL CHANGE	2500	
	SECOND PERIODIC OIL CHANGE	5000	
	THIRD PERIODIC OIL CHANGE	7500	
	FOURTH PERIODIC OIL CHANGE	10,000	
	FIFTH PERIODIC OIL CHANGE	12,500	
	SIXTH PERIODIC OIL CHANGE	15,000	
	SEVENTH PERIODIC OIL CHANGE	17,500	



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Springs 1560 Transvaal • Republic of South
Africa • 56-1411

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5-69-23-22

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3118 Rev. 9/82
LPI 7.5M

⚠ LOOK FOR THIS SYMBOL TO POINT OUT SAFETY PRECAUTIONS. IT MEANS BECOME ALERT - YOUR SAFETY IS INVOLVED. IF YOU DO NOT FOLLOW THESE SAFETY INSTRUCTIONS INJURY OR PROPERTY DAMAGE CAN OCCUR.

INTRODUCTION

The Lestronic II battery charger is designed to recharge deep-cycle, lead-acid batteries. A ferroresonant transformer is used to provide a highly reliable, line compensating unit with a minimum of moving parts, designed for long trouble-free service. A patented electronic timer turns the charger on and off automatically. This electonic timer determines full charge of the batteries by measuring the rate at which the battery voltage increases during charge. When the voltage stops rising, the battery is fully charged and the charger turns off.

INITIAL INSTALLATION

The circuit breaker or fuse protection in the AC line to which the charger is to be connected should allow at least 15 amps per charger. The use of an extension cord with the charger should be avoided. The use of an improper extension cord could result in a risk of a fire or electric shock. If an extension cord must be used. use a three conductor No. 12 AWG cord with ground, properly wired, in good electrical condition and keep it as short as possible. Make sure that the pins on the plug of the extension cord are the same number, size, and shape as that of the plug on the battery charger. Locate all cords so that they will not be stepped on, tripped over, or otherwise subjected to damage or stress.

Do not operate this charger with a damaged cord or plug. Do not operate this charger if it has received a sharp blow, was dropped or otherwise damaged in any manner; refer to a qualified serviceman.

Provide adequate ventilation for the batteries and charger. The convection-cooled design requires an unobstructed flow of cooling air for proper operation. Keep all charger ventilation openings at least two (2) inches (5 cm) away from walls and other objects. Do not allow clothing, blankets, or other material to cover the charger.

⚠ WARNING: Chargers can ignite flammable materials and vapors. Do not use near fuels. grain dust, solvents, thinners, or other flammables.

⚠ WARNING: Keep Dry - Do not expose to rain. For storage keep in a building. Replace worn, cut, or damaged power cords or wires immediately.

GROUNDING INSTRUCTIONS

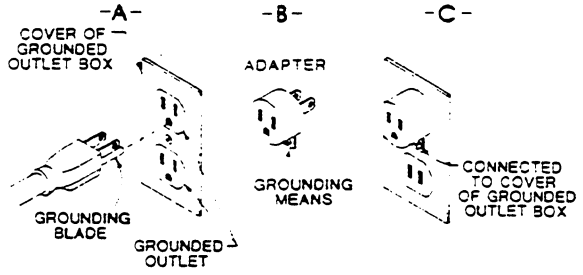
This battery charger must be grounded to reduce the risk of electric shock. This charger is equipped with an electric cord having an equipment-grounding conductor and a grounding type plug and is for use on a nominal 115 Volt, 60 Hertz circuit. This plug must be connected to an appropriate receptacle that is properly installed and grounded in accordance with the National Electrical Code and all local codes and ordinances.

⚠ DANGER: Improper connection of the equipment- grounding conductor can result in a risk of an electric shock.

The conductor with insulation having an outer surface that is green with or without yellow stripes is the equipment-grounding conductor. If repair or replacement of the electric cord or plug is necessary, do not connect the equipment-grounding connector to a live terminal.

A temporary adapter, as illustrated in Figures B and C, may be used to connect this plug to a two-pole outlet as shown in Figure C if a properly grounded outlet is not available. The temporary adapter should be used only until a properly grounded outlet can be installed by a qualified electrician. The green-colored rigid ear or lug extending from the adapter must be connected to a permanent ground such as a properly grounded outlet box.

GROUNDING METHODS



NOTE: The use of the adapter shown in Figures B and C is not permitted in Canada.

NORMAL OPERATION

The instructions printed on the cover of the charger are for daily reference.

1. With the charger DC output cord disconnected from the batteries, connect the power supply cord to a 115 Volt, 60 Hertz outlet.

⚠ WARNING: Connect only to a properly grounded single phase (3 wire) outlet. Refer to grounding instructions.

⚠ CAUTION: Make sure the battery pack is a 36 volt, 18 cell, series connected, lead-acid system with a capacity of 75 to 110 minutes (BCI rating) and finish on-charge voltage of 2.5 Volts per cell. Use otherwise may damage the charger and/or batteries.

⚠ DANGER: To prevent electric shock do not touch any uninsulated parts of the charger DC output connector, battery connector, or battery terminals. Make sure the charger and battery connectors are in good working condition. Do not use connectors that are cracked, corroded, or do not make adequate electrical contact. Overheating and possible property damage can result if a defective connector is used.

2. Connect the charger DC output connector to the battery connector. The charger turns on automatically two to five seconds after the DC output cord is connected.

3. Monitor the ammeter for the correct charge rate. The initial charge rate will vary from 20 to 29 amps depending upon the condition and depth of discharge of the batteries.

Slight variations in the initial charge rate may also result from AC input line voltages which are higher or lower than 115 Volts. Higher line voltages increase the initial charge rate while lower line voltages reduce the charge rate.

If the batteries are heavily discharged and the AC input line voltage is higher than 115 Volts, the initial charge rate may exceed 30 amps and the ammeter needle will be pegged at 30 amps. Under normal conditions the charge rate will taper to less than 30 amps within 30 minutes. If the ammeter still reads 30 amps after 30 minutes, turn the charger off by disconnecting the power supply cord from its outlet. Refer to Section 3 of the Trouble Shooting and Repair Guide in this manual for test procedures.

⚠ CAUTION: To prevent overheating damage to the charger, do not allow the charger to operate for more than 30 minutes with the ammeter reading 30 amps.

During charge the battery voltage increases gradually which causes the charge rate to decrease. Good battery cells should each rise to approximately 2.5 volts DC which will allow the charge rate to taper to less than 8 amps. Since each cell accepts charge at a slightly different rate. normal charging with the ammeter reading in the 5 to 10 amps area for the last few hours of charge is important to achieve equalization of all battery cells every time the batteries are charged.

The charger turns off automatically when the batteries are fully charged. The required charge time varies with battery size and depth of discharge. Allow 9 hours when charging 75 to 90 minute batteries and up to 14 hours for 110 minute batteries. Up to 18 hours may be required to properly charge batteries that have been severely discharged. New or cold batteries also require more time to achieve full charge. Do not leave the charger unattended for more than two consecutive days. Severe overcharging and possible damage to the batteries will result if the charger should fail to turn off.

As batteries age, individual cells may weaken resulting in a lower than normal finish voltage. As the finish charge voltage decreases, the charge rate will not taper into the 5 to 10 amps area on the ammeter. The electronic timer will, however, still determine when the batteries have reached full charge and turn the charger off. Even though they are properly charged, older batteries will gradually lose capacity, and should be replaced when they will no longer perform as required.

4. After the charger has turned off, disconnect the DC output connector from the battery connector.

⚠ WARNING: Lead-acid batteries generate gasses which can be explosive. To prevent arcing or burning near the batteries do not disconnect the DC output connector from the batteries while the charger is operating. If the charge cycle must be interrupted, first disconnect the power supply cord from its outlet, then disconnect the DC output connector from the battery connector. Keep sparks and flame away from the batteries. NO SMOKING!

⚠ CAUTION: To avoid damage to the charger cord and battery connector, disconnect by grasping the plug and pulling it straight out of the battery connector. DO NOT pull on the charger cord. DO NOT twist, rock. or pull the plug sideways.

STORAGE

When the machine is not in use, charge the batteries once each week.

PROPER CARE OF MOTIVE POWER BATTERIES

Motive power batteries are subjected to severe deep cycle duty on a daily basis. Although these batteries are designed to withstand such duty the following precautions must be observed to obtain good performance and maximum cycle life.

⚠CAUTION: Always wear protective eye shields and clothing when working with batteries. Batteries contain acids which can cause bodily harm. Do not put wrenches or other metal objects across the battery terminal or battery top. Arcing or explosion of the battery can result.

1. When installing new batteries be sure the polarity of each battery and overall battery pack is correct. Due to the electrical characteristics of this charger it is possible to improperly hook up the batteries and not blow the fuse when charging. Battery and/or charger damage can result.

2. New batteries should be given a full charge before their first use because it is difficult to know how long the batteries have been stored.

3. Limit the use of new batteries for the first five cycles. New batteries are not capable of their rated output until they have been discharged and charged a number of times.

4. Do not excessively discharge the batteries. Excessive discharge can cause polarity reversal of individual cells resulting in complete failure shortly thereafter. Limited use of new batteries will minimize the risk of cell reversals.

5. Maintain the proper electrolyte level by adding water when necessary. Never allow the electrolyte to fall below the top of the battery plates. Electrolyte levels fall during discharge and rise during charge. Therefore, to prevent the overflow of electrolyte when charging, it is mandatory that water be added to cells AFTER they have been fully charged. DO NOT OVERFILL. Old batteries require more frequent additions of water than do new batteries.

6. When the temperature falls below 65 degrees F, the batteries should be placed on charge as soon after use as possible.

7. The tops of the batteries and battery hold-downs must be kept clean and dry at all times to prevent excessive self discharge and flow of current between the battery posts and frame.

8. Follow all operating instructions, cautions, and warnings as specified in this manual and on the charger case.

TROUBLE SHOOTING AND REPAIR GUIDE

⚠ CAUTION: REPAIRS BY QUALIFIED PERSONNEL ONLY. NOTE: Modifying this charger for use other than that for which it was intended, repairs by persons not qualified, or not using original equipment replacement parts will void the warranty and Lester liability.

⚠ CAUTION: ALWAYS UNPLUG THE ELECTRICAL CORDS FROM THE AC OUTLET AND THE BATTERIES BEFORE ATTEMPTING ANY REPAIRS TO THE CHARGER.

⚠ DANGER: HIGH VOLTAGE - With the charger on, the internal charger capacitor voltage is approximately 650 volts.

The Lestronic II battery charger is a reliable, automatic charger designed for long, trouble-free service. If a malfunction should develop, identify the symptom and follow the associated test procedures.

SECTION	MALFUNCTION SYMPTOM
1	CHARGER DOES NOT TURN ON
	A. Relay does not Close, No Transformer Hum and Ammeter Does Not Register.
	B. Relay Closes But No Transformer Hum and Ammeter Does Not Register.
	C. Relay Closes and Transformer Hums But Ammeter Does Not Register.
2	CHARGER FUSE BLOWS
	A. Single Fuse Link Blows
	B. Both Fuse Links Blow
3	AMMETER READS 30 AMPS FOR MORE THAN 30 MINUTES
4	CHARGER OUTPUT IS LOW
5	CHARGER DOES NOT TURN OFF
6	ELECTRONIC TIMER KIT REPLACEMENT
7	AC LINE FUSE OR CIRCUIT BREAKER BLOWS
8	TRANSFORMER SHORT OR BURN-OUT

SECTION 1 - CHARGER DOES NOT TURN ON

In normal operation the charger DC output connector must be connected to the batteries in order to turn the charger on. A time delay of 2 to 5 seconds is provided to allow adequate time to make a secure connection before the charger turns on. After this time delay the power relay closes and an audible "click" should be heard. When the relay closes, AC power is supplied to the transformer primary coil. If operating properly the transformer should hum and the ammeter should indicate the charge rate. If the charger does not turn on properly refer to Part A, B or C for specific test procedures.

PART A - RELAY DOES NOT CLOSE, NO TRANSFORMER HUM AND AMMETER DOES NOT REGISTER.

Check to be sure both the power supply cord and DC output connector are securely connected. If so, disconnect the power supply cord from its outlet. Measure the DC voltage at the battery connector using a suitable DC voltmeter.

The voltage reading should be the same as the battery terminal voltage and must be between 20 and 50 volts DC in order to close the relay. If the DC voltage is within the above limits, remove the charger cover and verify that the charger is properly wired. (Refer to the wiring diagram in Figure 7.) If the charger is wired correctly, a malfunction in the Electronic Timer Kit has probably occurred. Due to its complexity, do not attempt to make field repairs to any part of the Electronic Timer Kit. If a malfunction exists, simply remove the entire Electronic Timer Kit and replace it with a new one. Refer to Section 6 - "Electronic Timer Kit Replacement" for correct procedures.

The Electronic Timer Kit may be bypassed in order to verify that a malfunction exists. First disconnect the charger power supply cord from its outlet and the DC output connector from the battery connector. Place a jumper wire between terminals #1 and #3 to bypass the Electronic Timer Kit as shown in Figure 1.

The power supply cord is now connected directly to the primary transformer coil and the transformer should hum when the power supply cord is connected to a live outlet. The charger operation may be checked by connecting the DC output connector to the battery connector, and then connecting the power supply cord to an outlet. If normal charging current is indicated on the ammeter the Electronic Timer Kit is defective and must be replaced.

⚠ CAUTION: DO NOT charge batteries with the Electronic Timer Kit bypassed. The charger will remain on as long as the power supply cord is connected to an outlet. Severe overcharging and eventual damage to batteries will result.

If the transformer does not hum and the ammeter still does not register with the Electronic Timer Kit bypassed, a continuity check of the charger AC circuit is necessary. Disconnect the power supply cord from its outlet and the DC output connector from the battery connector and, with a suitable continuity tester, check the circuit across the power supply cord prongs as shown in Figure 1. With the Electronic Timer Kit bypassed, the CIRCUIT SHOULD BE COMPLETE. If the circuit is not complete, individually check the continuity of the power supply cord, primary transformer coil and all connections.



FIGURE 1
Charger AC Circuit Continuity Test

PART B - RELAY CLOSES BUT NO TRANSFORMER HUM AND AMMETER DOES NOT REGISTER

Check to be sure the power supply cord is securely connected to a live AC outlet. When three-prong to two-prong adapters are used, they tend to work loose resulting in a poor connection. Check the AC line fuse or circuit breaker and. if possible, measure the AC line voltage at the outlet to be sure AC power is present. If necessary connect a functioning charger, utility light. or other electrical appliance to the outlet to verify the presence of AC power.

If AC power is present, disconnect the power supply cord from its outlet and the DC output connector from the battery connector. Bypass the Electronic Timer Kit as described in Section 1 Part A, and with a suitable continuity tester check the circuit across the power supply cord prongs as shown in Figure 1. With the Electronic Timer Kit bypassed, the CIRCUIT SHOULD BE COMPLETE. If th circuit is complete, refer to the wiring diagram in Figure 7, and check the relay wiring and all connections. If the circuit is not complete, check the wiring of the power supply cord. transformer primary coil leads and the Electronic Timer Kit. If the charger is wired correctly, individually check the continuity of the power supply cord. transformer primary coil and relay.

PART C - RELAY CLOSES AND TRANSFORMER HUMS BUT AMMETER DOES NOT REGISTER

If the relay closes and the transformer hums, the charger AC circuit and Electronic Timer Kit are functioning properly. If the ammeter does not register, a fault in the charger DC circuit exists and a continuity check must be performed. Disconnect the power supply cord from its outlet and the DC output connector from the battery connector, and check the charger fuse. If a fuse link is blown, refer to Section 2 - "Charger Fuse Blows" for further tests. If the fuse checks good. use a low voltage continuity tester to perform the following tests:

1. Connect the tester leads to the charger DC output connector as shown in Figure 2, and note the reading. Reverse the tester leads and check the output connector again. The circuit should be complete in only one direction. If the circuit does not conduct in either direction and the fuse is good. Individually check the continuity of the DC output cord, ammeter, diodes. and all connections. If the circuit conducts in both directions, a "short" exists in the charger DC circuit. First check the DC output cord for a "short" between the two wires. It is more likely that one or both diodes have "shorted". Refer to Section 2 - "Charger Fuse Blows" for continuity test of diodes.

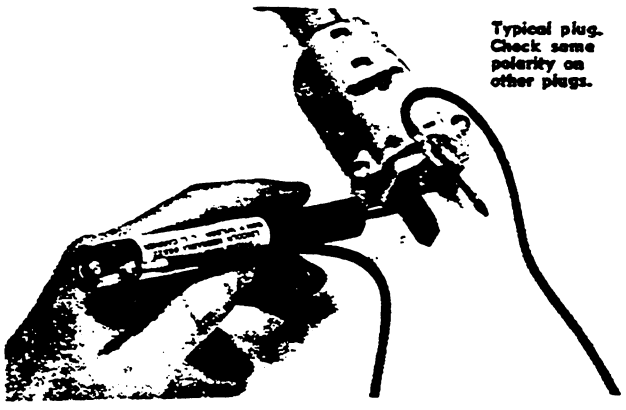


FIGURE 2
Charger DC Continuity Test

2. If the charger DC circuit test is good, a check of the capacitor is necessary. Disconnect the power supply cord from its outlet and the DC output connector from the battery connector. Then disconnect both transformer coil leads from the capacitor terminals. Use care when disconnecting the capacitor leads so the wires do not break. Using an ohmmeter, set the scale to R X 10K ohms and test the capacitor as follows:

GOOD CAPACITOR - When the ohmmeter leads are connected to the capacitor terminals, the meter needle jumps to mid-scale and rapidly moves to high resistance (∞).

OPEN CAPACITOR - When the ohmmeter leads are connected to the capacitor terminals, the meter needle does not move and stays at high resistance (∞). A bulge in the top of the capacitor may be visible if the capacitor has failed "Open".

SHORTED CAPACITOR - When the ohmmeter leads are connected to the capacitor terminals, the meter needle jumps immediately to zero ohms and remains there.

If the capacitor is "Open" or "Shorted" it must be replaced.

⚠ CAUTION: Use only a 6 Mfd, 660 volt AC rated capacitor for replacement (Part No. 02390S). The use of a different value capacitor may result in improper charging, capacitor failure, transformer burn-out. and/or battery damage.

3. If the charger DC circuit and capacitor check good, a test of the transformer is necessary. Refer to Section 8 - "Transformer Short or Burn-Out" for test procedures.

SECTION 2 - CHARGER FUSE BLOWS

The charger fuse consists of two fusible links mounted in a single assembly on the charger front panel. Each fuse link is electrically connected in series with one diode to provide protection for the transformer in the event of a diode failure. Visually check the fuse to determine if one or both fuse links are blown and refer to Part A or B for appropriate test procedures. Note: Replace the complete fuse assembly (Part No. 08776S) if the fuse is blown. Do not attempt to repair the fuse link as inadequate charger protection may result.

PART A - SINGLE FUSE LINK BLOWS

This condition is normally caused by a short circuit failure of one diode. The fuse link will blow when the charger DC output connector is connected to the battery connector, regardless of whether the power supply cord is connected to an outlet. To check the diodes, disconnect the power supply cord from its outlet and the DC output connector from the battery connector, and then disconnect one transformer secondary coil lead from the diode terminal. Using a low voltage continuity tester, connect one tester lead to the diode mounting plate and the other tester lead to a diode terminal as shown in Figure 3.

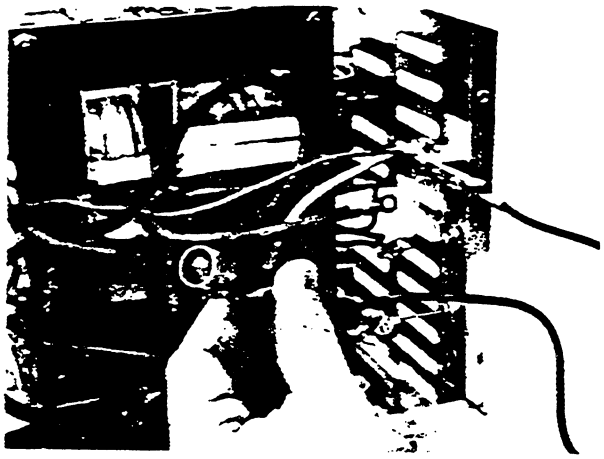


FIGURE 3
Diode Continuity Test

Note the reading and then reverse the tester leads and check each diode again. If a diode conducts current in both directions, it is "shorted" and the complete Heat Sink Assembly with Diodes (Part No. 09653S) must be replaced.

On rare occasions a single fuse link may melt due to excessive heat. This can be caused by a loose internal fuse connection. Check all three fuse connections inside the charger to be sure they are clean and tight. The proper torque on the fuse connector nuts is 20 Inch-Pounds (23 Cm-Kg).

PART B - BOTH FUSE LINKS BLOW

This is normally caused by a reverse polarity connection between the charger DC output connector and the battery connector. Check the battery pack and battery connector to be sure they are wired in the correct polarity. If possible check the voltage and polarity at the battery connector with a DC voltmeter. Also, check the charger DC output connector for the correct polarity. The white wire should be connected to the positive (+) blade, and the black wire to the negative (-) blade. If a reverse polarity connection is made between the charger and batteries, both fuse links will blow regardless of whether the power supply cord is connected to an outlet.

Another cause for both fuse links blowing is the short circuit failure of both diodes. Although this is rare, it may occur as the result of a lightning strike at the charging location. Excessive heat due to a loose connection may also cause both fuse links to melt. Refer to Part A - "Single Fuse Link Blows" for trouble-shooting procedures.

SECTION 3 - AMMETER READS 30 AMPS FOR MORE THAN 30 MINUTES

This condition normally results if the charger is connected to a battery system which is less than 36 volts. If connected to a 12, 18, 24, or 30 volt battery system the charge rate will not taper below 30 amps within 30 minutes. Check to be sure all batteries are correctly wired. and also check the battery pack voltage at the battery connector using a DC voltmeter. For a 36 volt battery system the measured voltage when charging should be 34 to 38 volts DC.

⚠ CAUTION: DO NOT connect the charger to battery packs which are not 36 volt systems. Overheating and transformer burn-out will result.

SECTION 4 - CHARGER OUTPUT IS LOW

The most probable cause of low output is a single fuse link blowing as the result of a short circuit failure of one diode. Refer to Section 2 - "Charger Fuse Blows" for trouble-shooting procedures. On rare occasions a short circuit failure of the transformer coils may cause the output to be low. Refer to Section 8 - "Transformer Short or Burn-Out" for test procedures.

⚠ CAUTION: Do not use the charger if the output is low. Batteries will not reach full charge, thereby increasing the possibility of a harmful deep discharge during their next use.

SECTION 5 - CHARGER DOES NOT TURN OFF

The Electronic Timer Kit turns the charger both on and off. Proper charge time is determined by many factors but the main elements are: (1) Battery size. (2) Depth of battery discharge, and (3) Finish charge rate. Larger, severely discharged batteries require more time to reach full charge than do smaller, lightly discharged batteries.

Since the charge rate is controlled by the rising battery voltage during charge, the finish charge rate depends on how high the battery voltage rises. New batteries with all good cells should rise to at least 2.5 volts per cell. This will allow the finish charge rate to taper below 8 amperes. As batteries age individual cells may weaken and these cells may not reach 2.5 volts. This will result in finish charge rates greater than 8 amperes, and less time will be required for the batteries to reach full charge. At a finish charge rate of 8 amperes or less the charge time should not exceed 18 hours. At a finish charge rate greater than 8 amperes the charge time should not exceed 14 hours.

If the charger remains on longer than the maximum time specified, verify that the green wire from the Electronic Timer Kit and the secondary transformer coil lead are securely connected to the diode lead. The charger will NOT turn off if the green wire is loose or disconnected. If the green wire is securely connected, the Electronic Timer has malfunctioned and the complete Electronic Timer Kit must be replaced. Refer to Section 6 - "Electronic Timer Kit Replacement" for correct procedures.

If a precision digital type DC voltmeter is available, a test to verify that the Electronic Timer has malfunctioned can be made. Connect the charger to the batteries and allow to charge normally. After the charge rate has tapered to its lowest point, measure the battery terminal voltage using a DC voltmeter capable of reading in increments of .001 volts. Continue charging and check the battery voltage reading every hour. If the battery voltage increases less than .012 volts, or if the battery voltage decreases between successive hourly readings, the charger should turn off. If the charger does not turn off, the Electronic Timer has malfunctioned and the complete Electronic Timer Kit must be replaced.

SECTION 6 - ELECTRONIC TIMER KIT REPLACEMENT

The Electronic Timer Kit should always be replaced as a complete assembly. The tools required are a Phillips head screwdriver, 3/8" and 11/32" wrenches, and pliers. No soldering is required. To replace the kit follow the step-by-step procedures listed below.

1. Disconnect the charger power supply cord from its outlet and the DC output connector from the battery connector, and remove the charger cover.

2. Disconnect the green, black, and red wires of the Electronic Timer Kit as shown in Figure 4. Then remove the black and white leads of the power supply cord and both primary transformer coil leads from the Electronic Timer Kit terminal tabs. The Kit can be removed by removing the three mounting screws on the charger front panel. Save all hardware for reassembly.

3. Install the replacement Electronic Timer Kit by reversing the disassembly procedures described in Step 2. When reconnecting the wires to the Electronic Timer Kit terminal tabs support the terminal board to prevent damage to the electronic circuit board. Connect either transformer primary lead to terminal #2, and the remaining primary lead to terminal #3.

   Connect the black lead of the power supply cord to terminal #1 on the Electronic Timer Kit and the white lead of the power supply cord to terminal #2.

   Connect the red wire of the Electronic Timer Kit along with the white lead of the DC cord to the Heat Sink Assembly. Connect the black wire of the Electronic Timer Kit along with the black lead of the DC cord to the ammeter post. Do not allow the ammeter post to turn when tightening the nut. Reconnect the green wire of the Electronic Timer Kit along with the transformer secondary lead to the diode lead terminal.

⚠ CAUTION: Be sure all connections are clean and tight. Also check to be sure all wires and terminals are positioned so they do not short together or to the charger case.

4. Replace the charger cover and check the Electronic Timer Kit for proper operation as follows:

   a. With the DC output connector disconnected from the battery connector, insert the power supply cord into an outlet. The relay on the Electronic Timer Kit should not close. A DC voltmeter connected across the DC output connector should indicate zero volts.

   b. Disconnect the power supply cord from its outlet and connect the DC output connector to the battery connector. The relay on the Electronic Timer Kit should close with an audible "click" after a two to five second delay.

   c. If the Electronic Timer Kit does not operate as (a) and (b) above, refer to the appropriate wiring diagram in Figure 7 and check to be sure the charger is wired correctly. If the Electronic Timer Kit operates properly, the charger is ready for use. Always monitor the first charge cycle to verify that the charger is turning off properly.

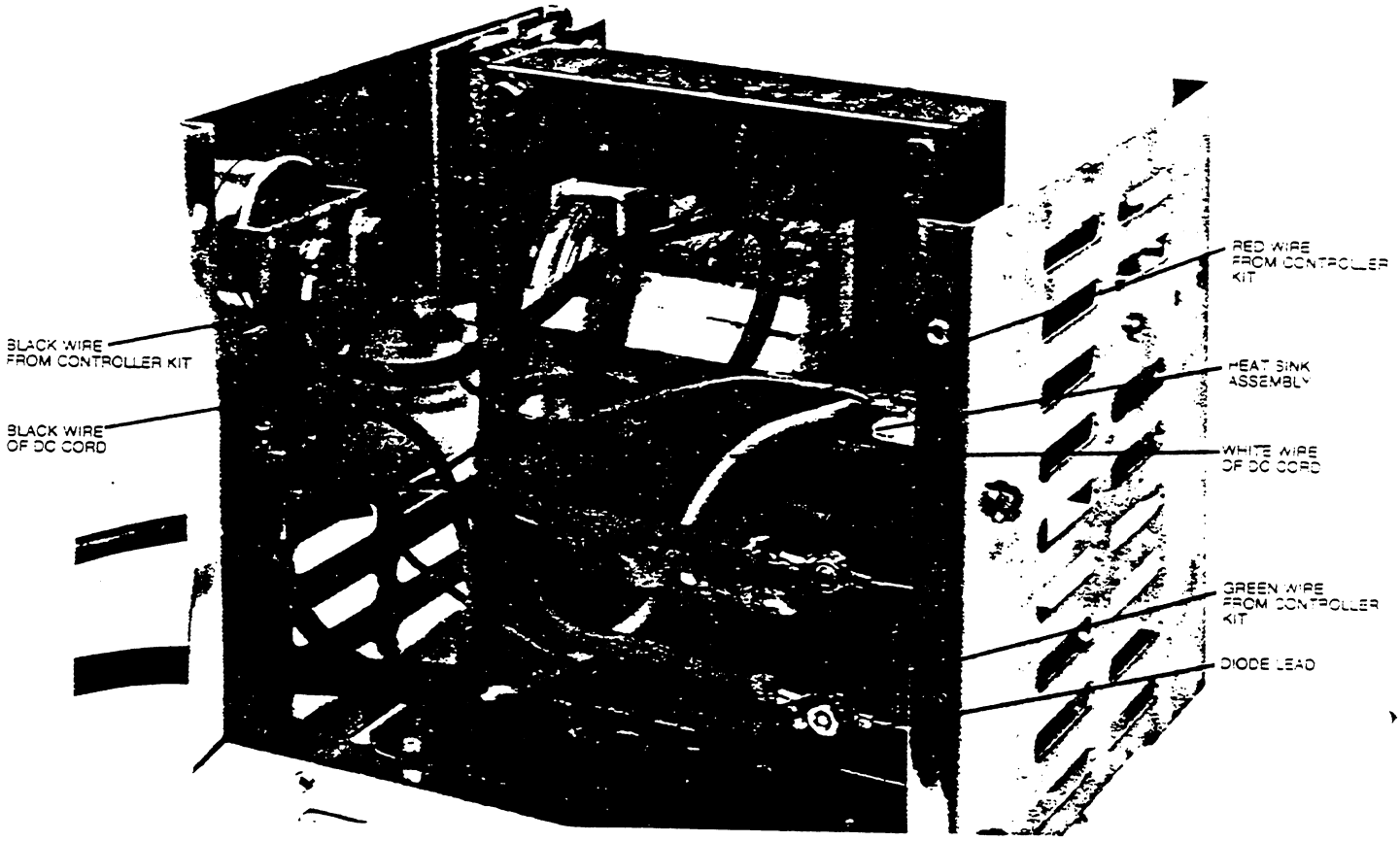


FIGURE 4
Electronic Timer Kit Wiring

SECTION 7 - AC LINE FUSE OR CIRCUIT BREAKER BLOWS

If this occurs when the charger power supply cord is connected to an outlet, without the DC output connector connected to the battery connector, the charger power supply cord may be shorted. Disconnect the power supply cord from its outlet and the DC output connector from the battery connector, then check to be sure the Electronic Timer Kit is NOT bypassed. With a suitable continuity tester check the circuit across the power supply cord prongs as shown in Figure 1. THE CIRCUIT SHOULD NOT BE COMPLETE. IF the circuit is complete, check the relay contacts to be sure they are open and have not welded closed. If the relay contacts are open, the power supply cord is shorted and must be replaced.

If the power supply cord checks good the transformer coils may be shorted. Refer to Section 8 - "Transformer Short or Burn-Out" for test procedures.

SECTION 8 - TRANSFORMER SHORT OR BURN-OUT

Failure of the transformer may be caused by natural aging or premature shorting of adjacent coil turns. A low or complete lack of output would be

observed on the ammeter, however the transformer may hum or the AC line fuse or circuit breaker may blow when the charger is turned on. To test the transformer, disconnect the power supply cord from its outlet and the DC output connector from the battery connector. Then disconnect the transformer secondary coil leads #1 and #4 from the diode terminals and disconnect the transformer capacitor coil leads from the capacitor terminals. Use care when disconnecting the capacitor leads so the wires do not break.

⚠ DANGER - HIGH VOLTAGE: With the charger operating, the charger capacitor voltage is approximately 650 volts AC. Use extreme caution when working near the capacitor terminals.

In order to apply AC power directly to the transformer primary coil the Electronic Timer Kit must be bypassed. Refer to Section 1, Part A for bypass procedures. With the Electronic Timer Kit bypassed and taking care for personal safety, connect the power supply cord to an outlet. If the AC line fuse or circuit breaker blows, the transformer is shorted internally and must be replaced. If this does not occur, check the transformer secondary and capacitor coil voltages as shown in Figure 5, using a suitable AC voltmeter. If the measured voltages are substantially lower than those shown, the transformer is shorted internally and must be replaced.

If the transformer output voltages check good, disconnect the power supply cord from its outlet. Check the capacitor to be sure its rating is 6 Mfd, 660 volts AC. and then carefully reconnect the capacitor coil leads to the capacitor terminals. Then, taking care for personal safety, reconnect the power supply cord to an outlet and measure the transformer secondary and capacitor coil voltages again. The correct voltage readings are shown in Figure 6. If the voltage readings are the same as those shown in Figure 5, the capacitor may be defective or the capacitor coil leads may not be making proper electrical contact. Refer to Section 1, Part C, Item 2 for capacitor test procedures. If the voltage readings are correct, both the transformer and capacitor are good. Refer to Section 1. Part C, Item 1 for further tests of the DC circuit.

If it should become necessary to replace a terminal on one of the transformer leads, the new terminal must be crimped AND soldered. NOTE: Some transformer leads may be aluminum wire and a solder must be used on these wires that is intended for use on aluminum, such as Alcoa #807 solder with Alcoa #69 flux. If these materials are not available locally, contact the Lester factory.

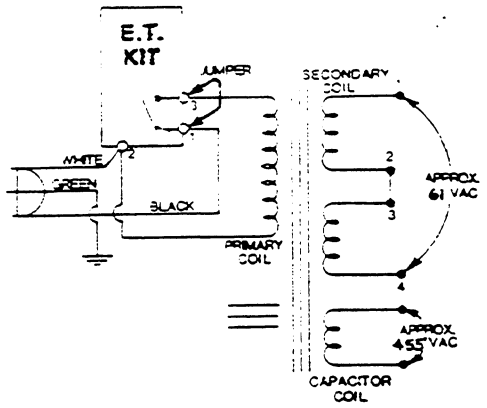


FIGURE 5
Transformer Coil Voltage Test
(without capacitor)

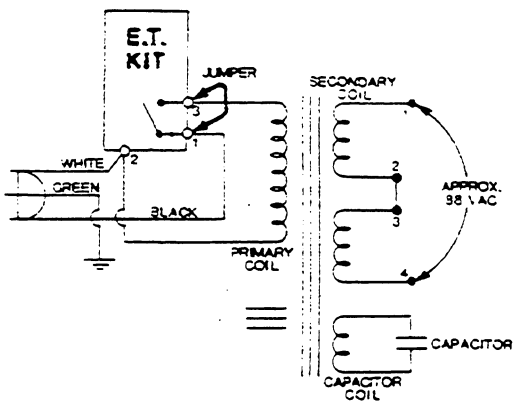


FIGURE 6
Transformer Coil Voltage Test
(with Capacitor)

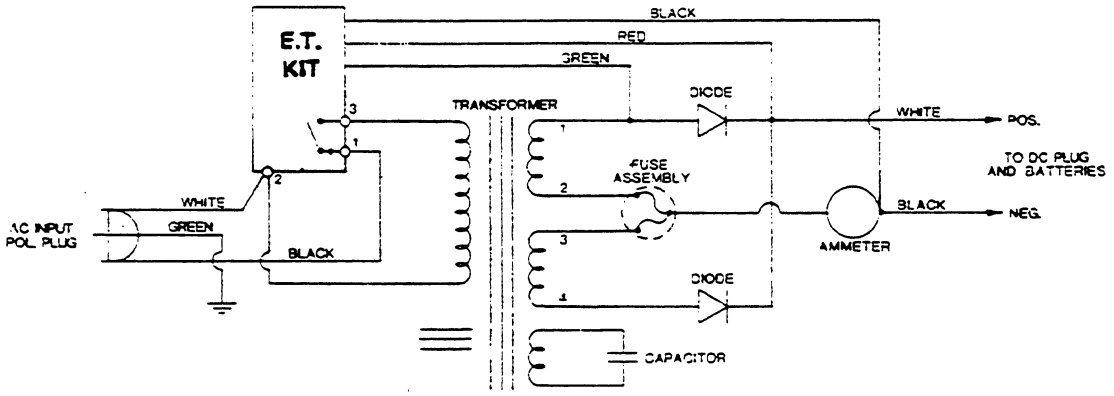
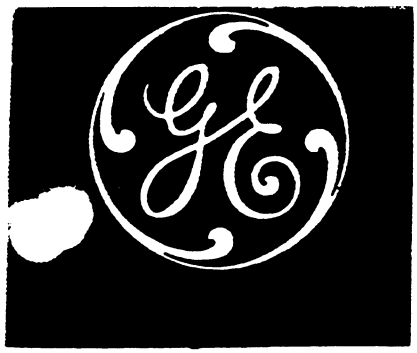


FIGURE 7
Charger Wiring Diagram



GEK-83454

INSTRUCTIONS

MAINTENANCE AND TROUBLESHOOTING FOR THE EV-10* SCR CONTROL

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JANUARY, 1983

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CHAPTER 5
MAINTENANCE AND TROUBLESHOOTING

SECTION 1
GENERAL MAINTENANCE INSTRUCTIONS

The SCR control, like all electrical apparatus, does have some thermal losses. The semiconductor junctions have finite temperature limits above which these devices may be damaged. For these reasons, normal maintenance should guard against any action which exposes the components to excessive heat, such as steam cleaning, or which reduces the heat dissipating ability of the control, such as restricting air flow.

The following DO'S and DON'TS should be observed:

1. Advise the truck manufacturer of any controls that will be used in ambients of 100°F (40°) or over.

2. Use filters on all external components having inductive coils. Refer to the vehicle manufacturer for specifications.

3. Do not steam-clean the control. In dusty areas, use low pressure air to blow off the control. In oily or greasy areas, use a mild solution of detergent, denatured alcohol, or Freon TF degreaser to wash off the control; then blow it completely dry with low pressure air.

4. Mount the SCR panel against the frame of the truck. The truck frame, acting as an additional heat sink, will give improved truck performance by keeping the SCR control package cooler. Add Silicone Grease (Dow Corning No. 342 or equivalent) between the SCR Control base and the vehicle frame.

5. Keep the terminal boards and other exposed SCR control parts free of dirt and paint which might change the effective resistance between points.

CAUTION

THE TRUCK SHOULD NOT BE PLUGGED IN WHEN IT IS JACKED UP AND THE DRIVE WHEELS ARE IN A FREE-WHEELING POSITION. THIS CAN CREATE EXCESSIVE VOLTAGES THAT CAN BE HARMFUL TO THE CONTROL.

SECTION 2
TROUBLESHOOTING DIAGNOSTIC DIAGRAM

HOW TO USE THE DIAGNOSTIC DIAGRAM

DIAGRAMS ARRANGED BY FAILURE

The diagrams are arranged by failure modes. These modes are described in oval-shaped boxes at the top of each page.

FIND YOUR SYMPTOM AND FOLLOW THE ARROWS

Find the symptom that describes your vehicle's failure mode and proceed to the next step following the arrow.

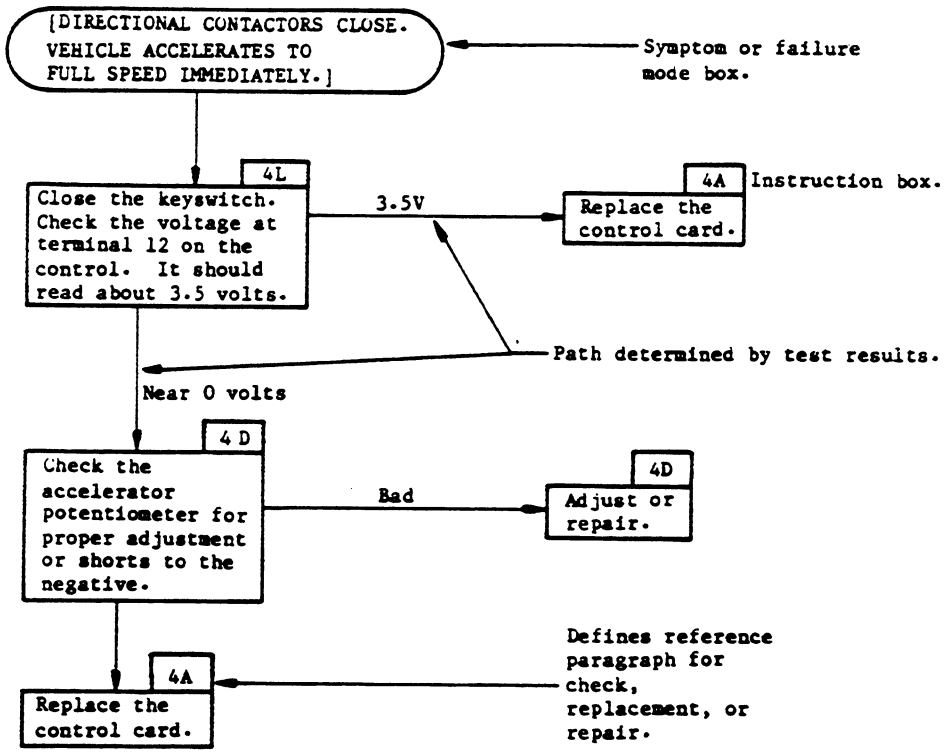
FOLLOW THE INSTRUCTIONS

Follow the instruction described in the box and proceed to the next box along the arrow path which coincides with the result of your action.

NOTE

The numbers and letters (i.e., 4A) enclosed in small boxes in the upper right corner of some instruction boxes correspond to a particular segment in Section 4, Checking Components. Please refer to that segment for more detailed instructions.

EXAMPLE


[DIRECTIONAL CONTACTORS CLOSE. VEHICLE ACCELERATES TO FULL SPEED IMMEDIATELY.]
Symptom or failure mode box.
4L
Close the keyswitch. Check the voltage at terminal 12 on the control. It should read about 3.5 volts.
3.5V
4A
Replace the control card.
Instruction box.
Path determined by test results.
Near 0 volts
4 D
Check the accelerator potentiometer for proper adjustment or shorts to the negative.
Bad
4D
Adjust or repair.
4A
Replace the control card.
Defines reference paragraph for check, replacement, or repair.

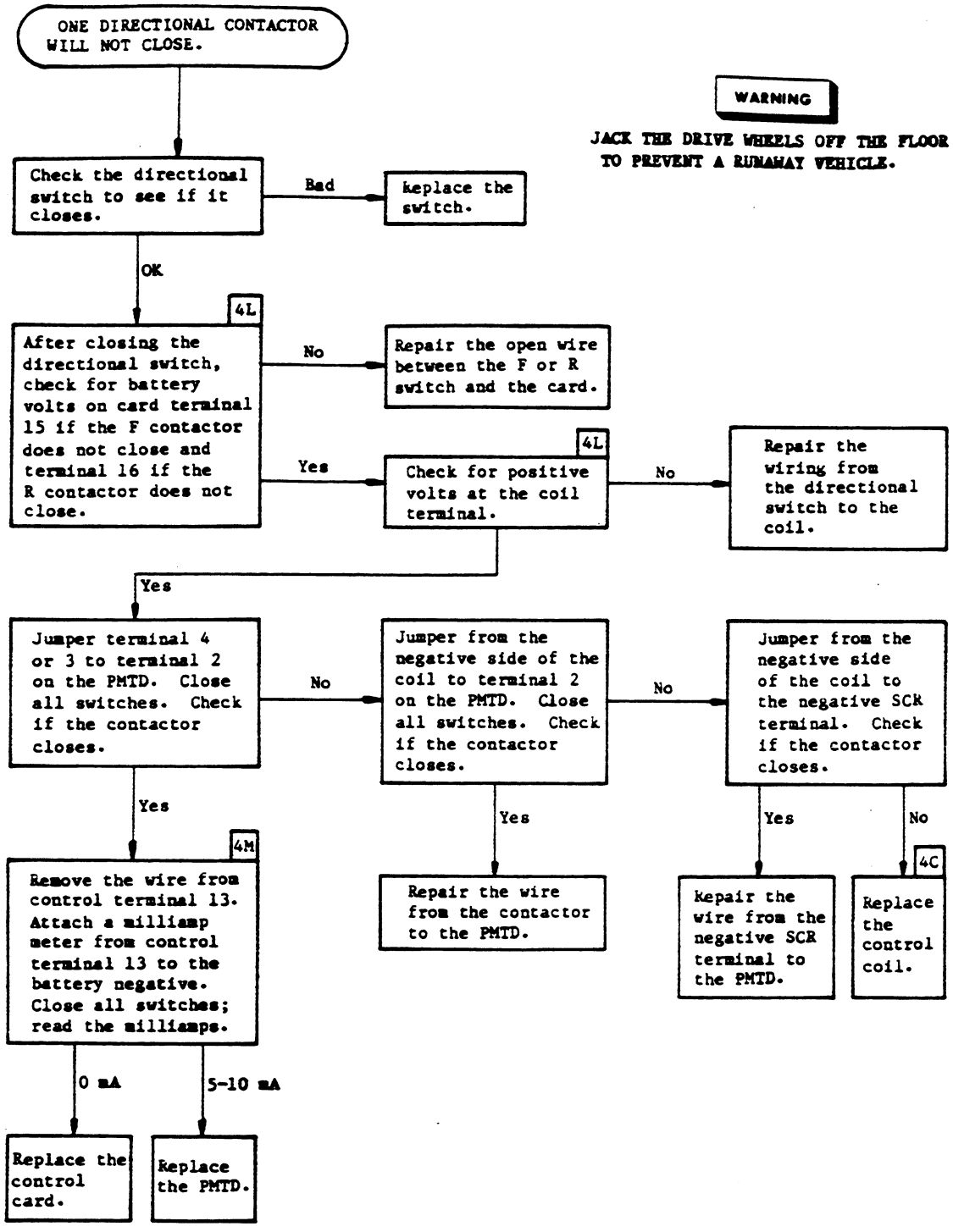


Figure 5.2.1, Sheet 1
TROUBLESHOOTING DIAGNOSTIC DIAGRAM

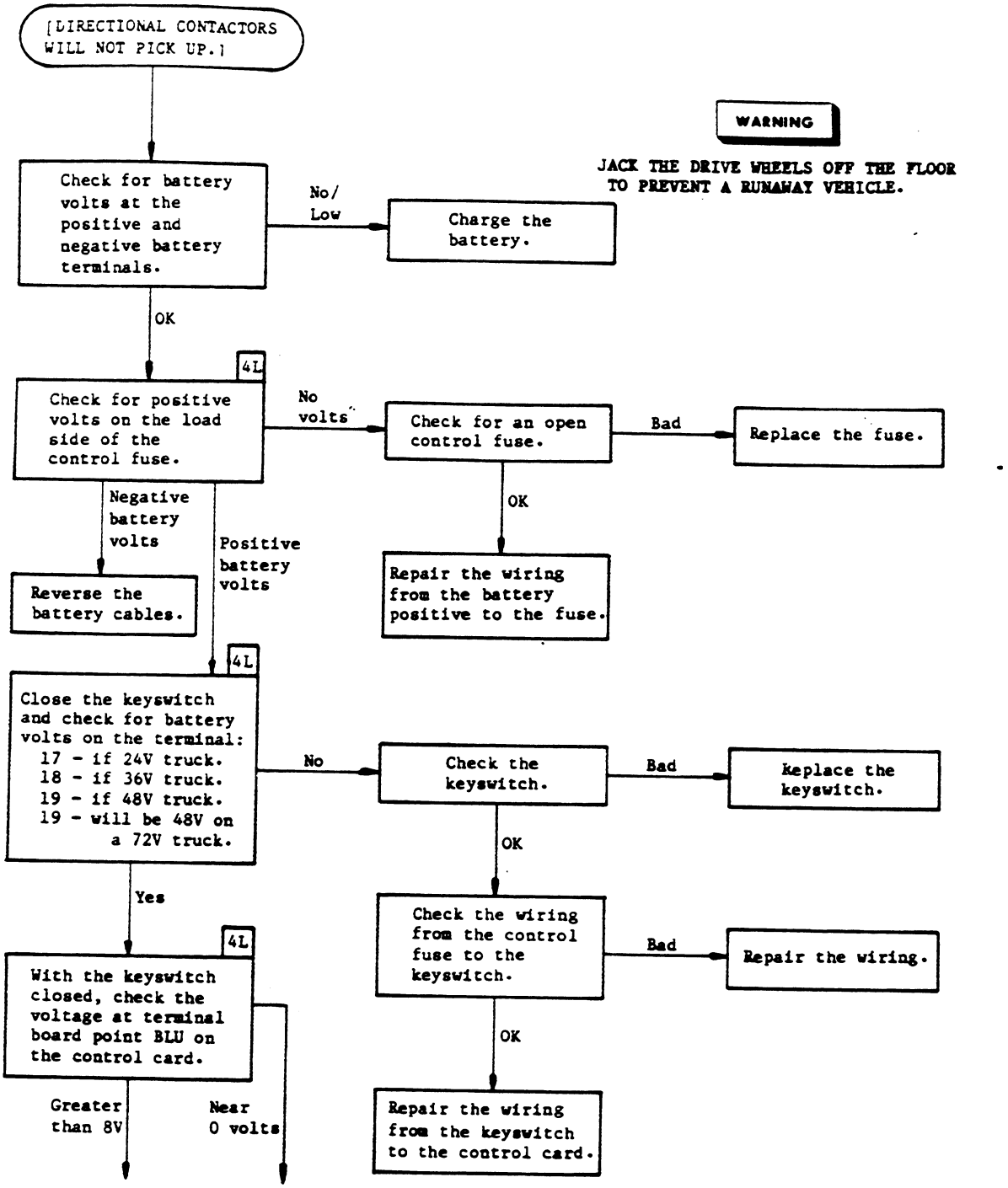


Figure 5.2.1, Sheet 2
TROUBLESHOOTING DIAGNOSTIC DIAGRAM

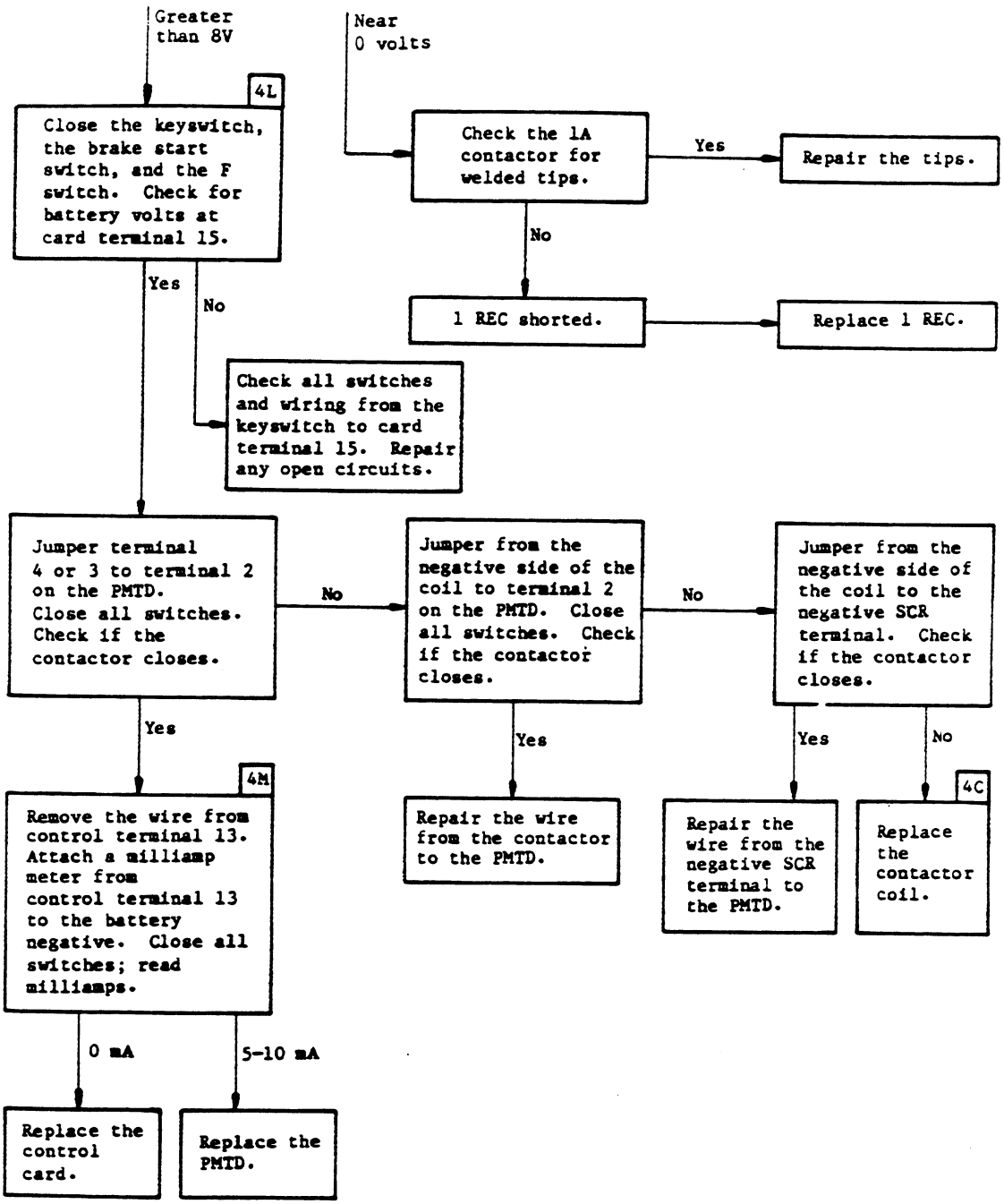


Figure 5.2.1, Sheet 3
TROUBLESHOOTING DIAGNOSTIC DIAGRAM

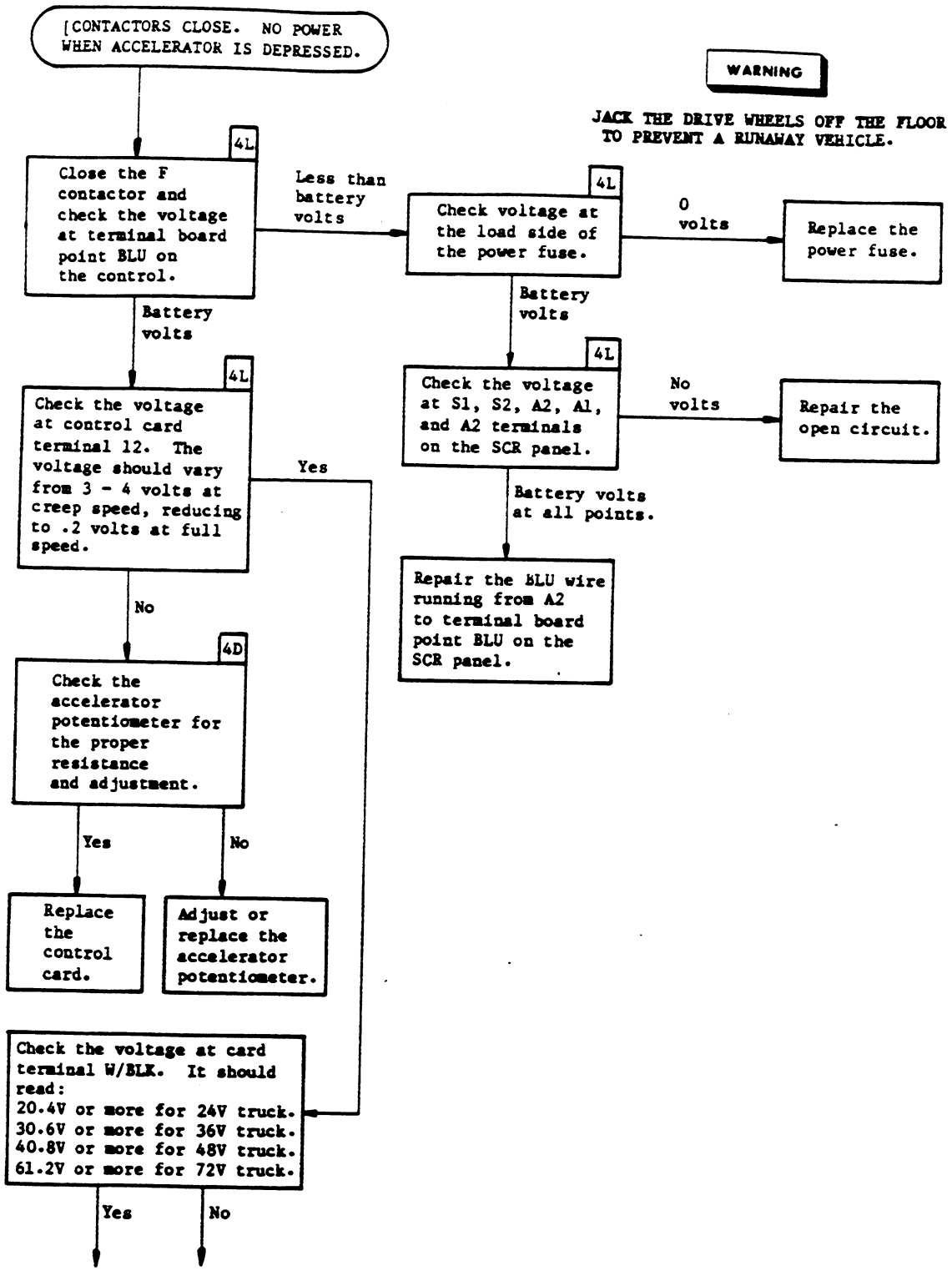


Figure 5.2.1, Sheet 4
TROUBLESHOOTING DIAGNOSTIC DIAGRAM

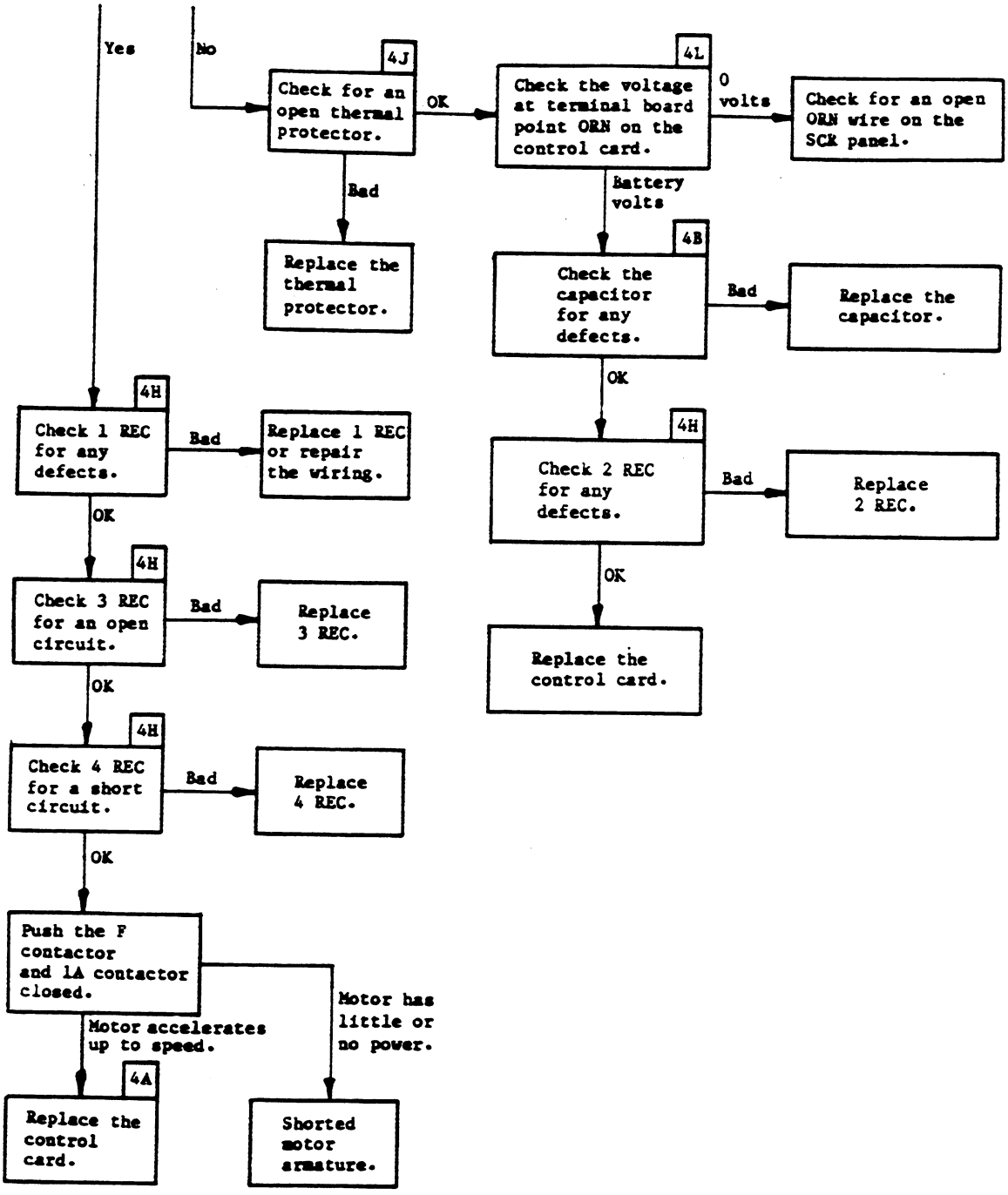


Figure 5.2.1, Sheet 5
TROUBLESHOOTING DIAGNOSTIC DIAGRAM

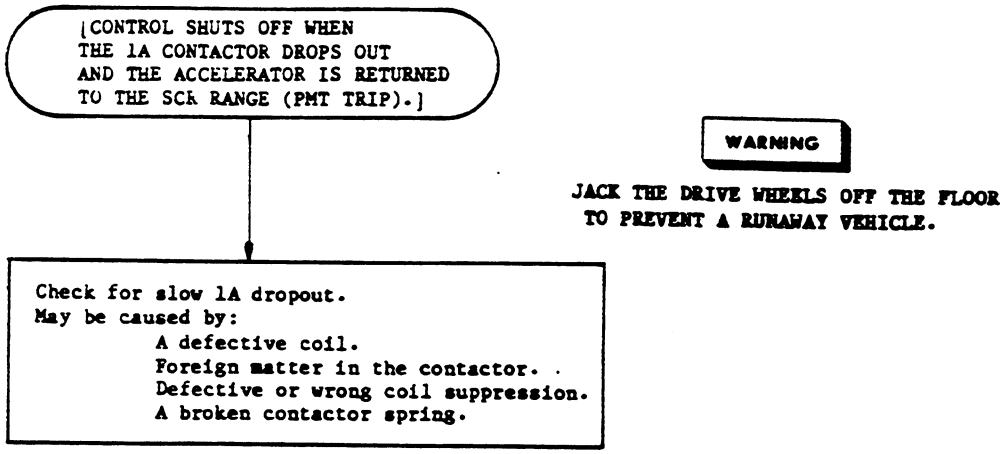


Figure 5.2.1, Sheet 6
TROUBLESHOOTING DIAGNOSTIC DIAGRAM

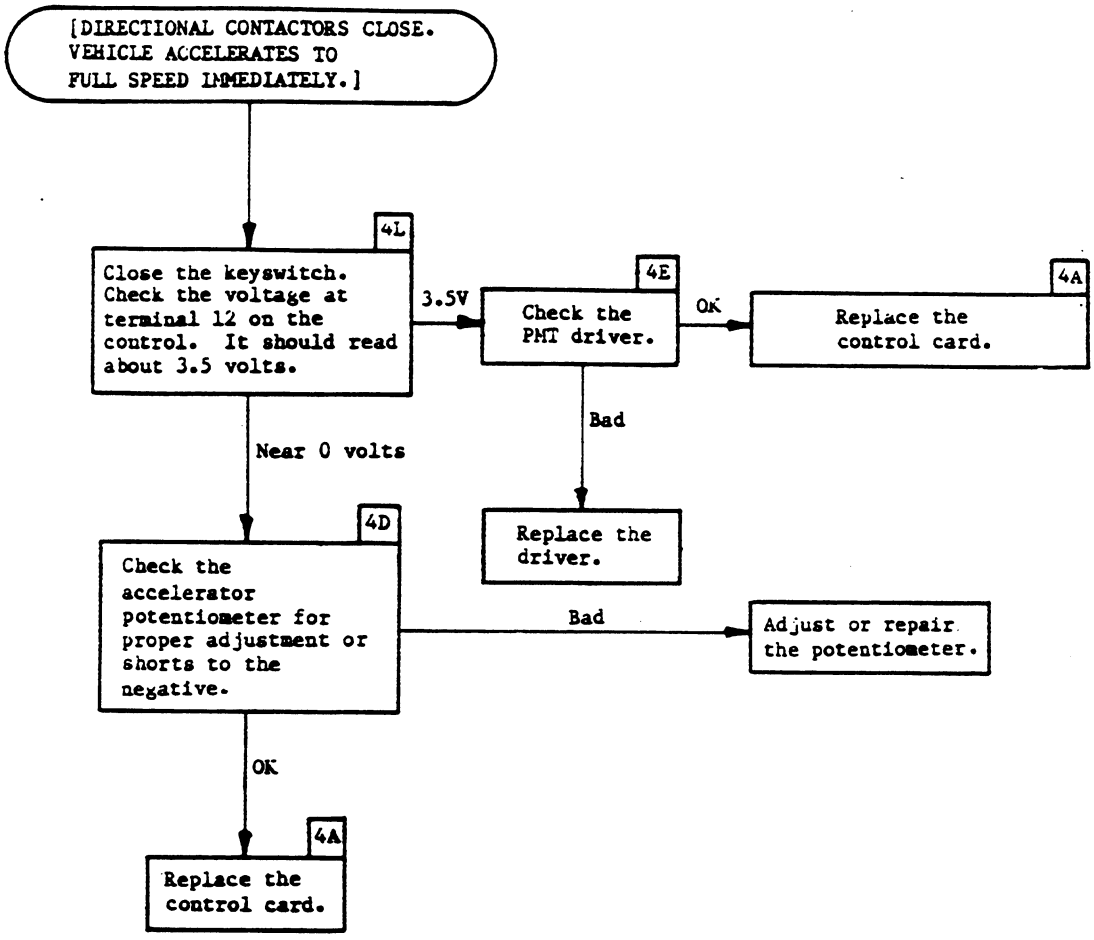


Figure 5.2.1, Sheet 7
TROUBLESHOOTING DIAGNOSTIC DIAGRAM

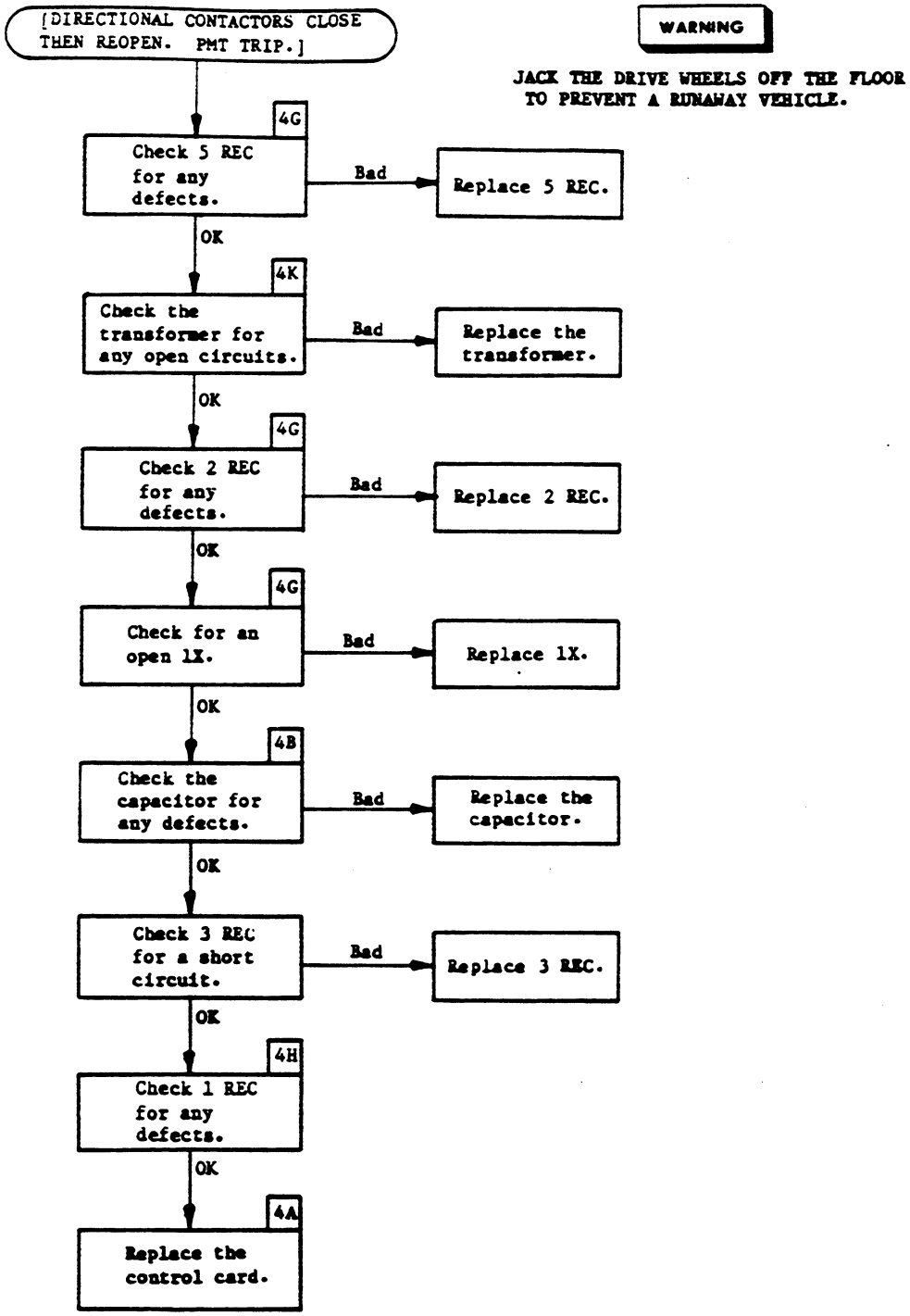


Figure 5.2.1, Sheet 8
TROUBLESHOOTING DIAGNOSTIC DIAGRAM

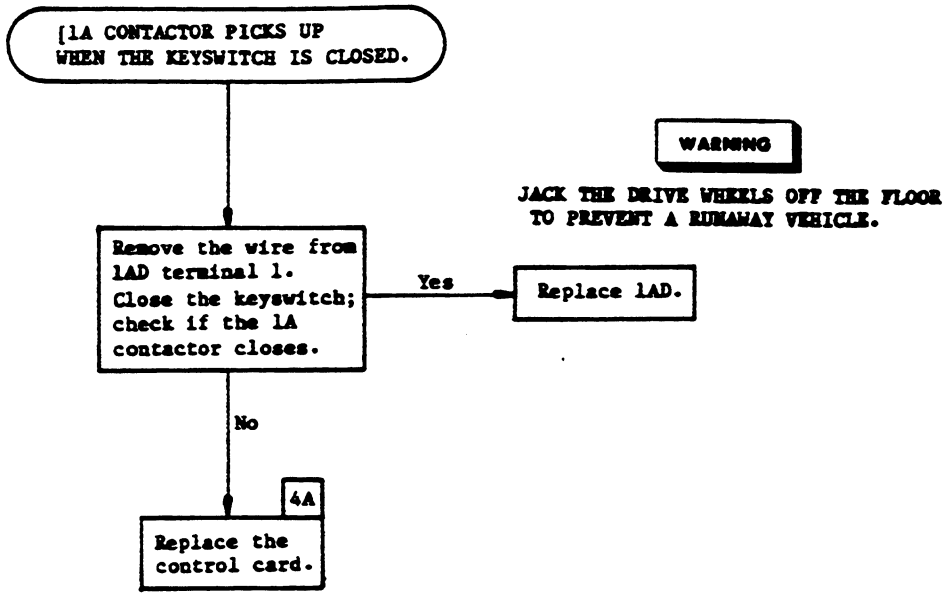


Figure 5.2.1, Sheet 9
TROUBLESHOOTING DIAGNOSTIC DIAGRAM

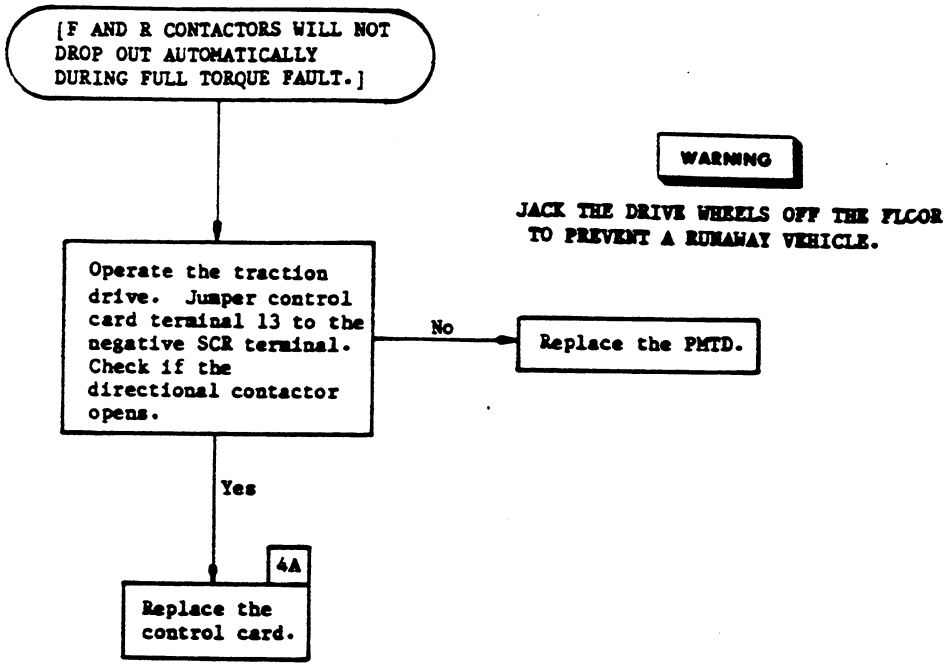


Figure 5.2.1, Sheet 10
TROUBLESHOOTING DIAGNOSTIC DIAGRAM

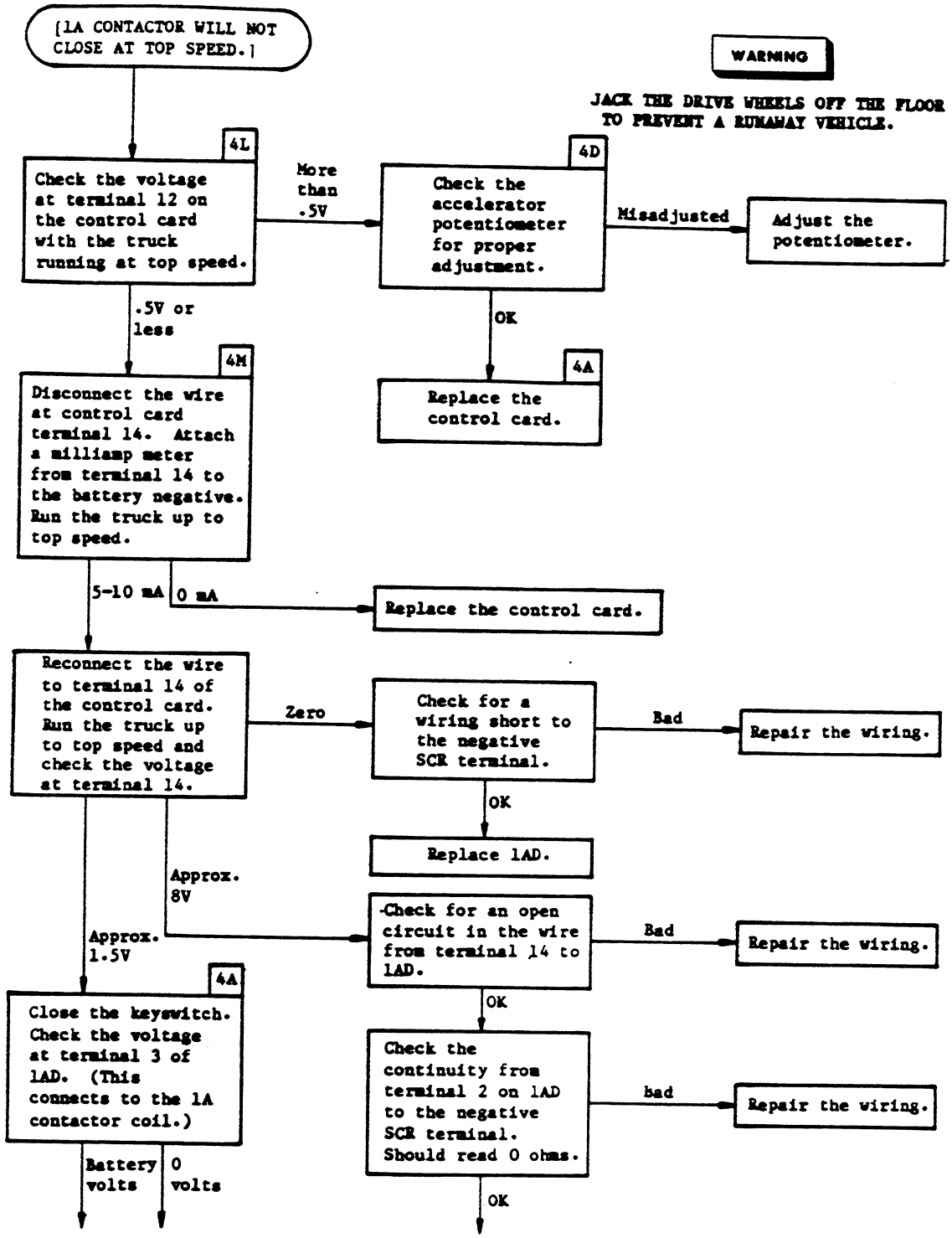


Figure 5.2.1, Sheet 11
TROUBLESHOOTING DIAGNOSTIC DIAGRAM

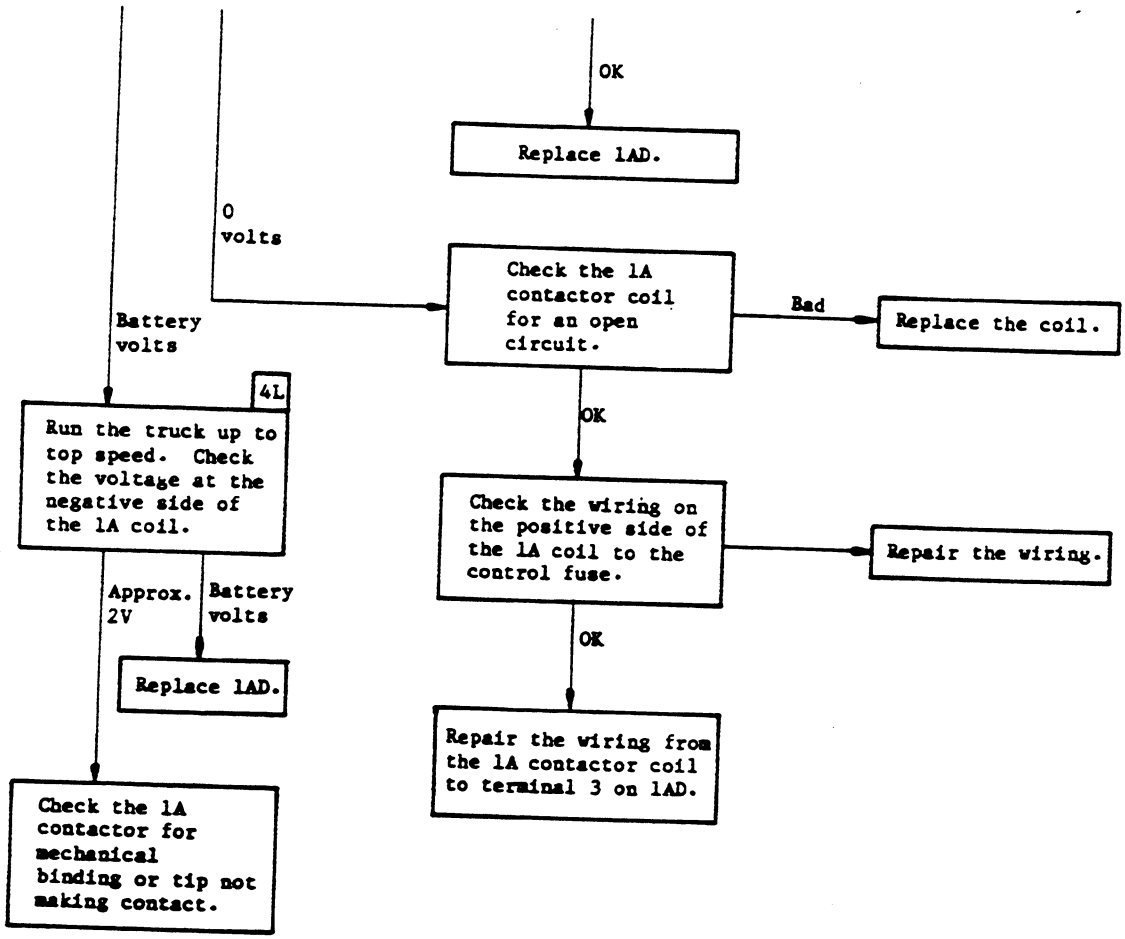


Figure 5.2.1, Sheet 12
TROUBLESHOOTING DIAGNOSTIC DIAGRAM

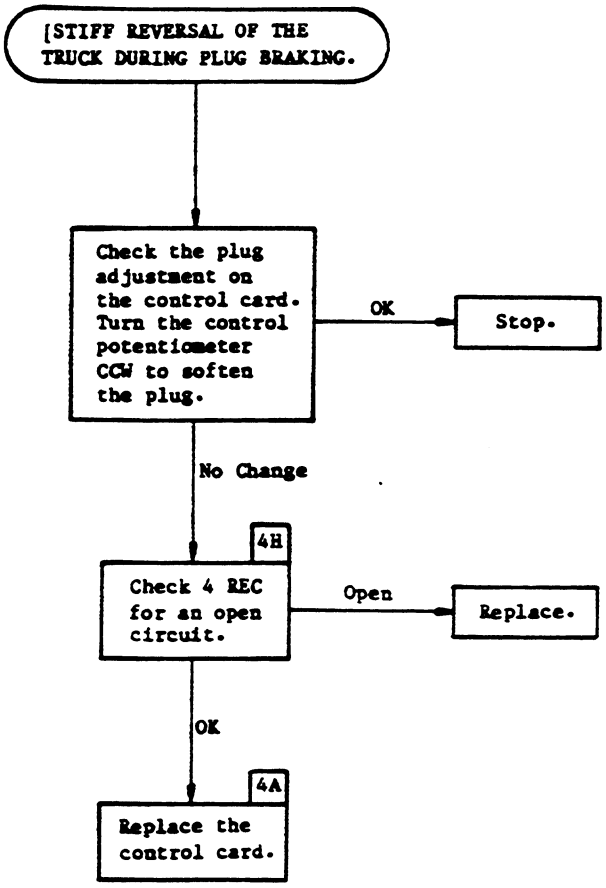


Figure 5.2.1, Sheet 13
TROUBLESHOOTING DIAGNOSTIC DIAGRAM

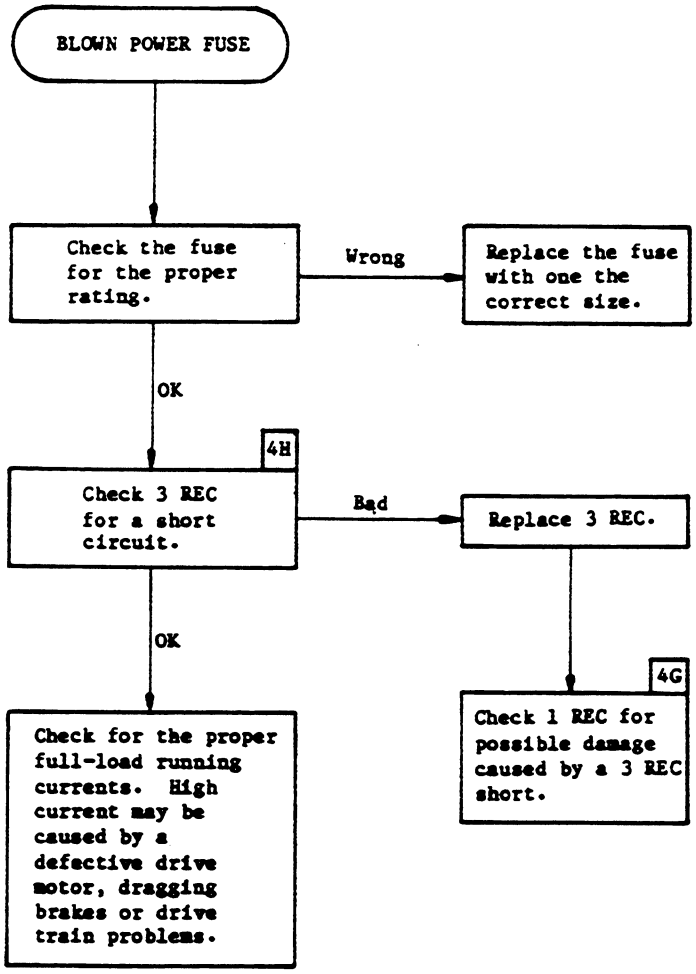


Figure 5.2.1, Sheet 14
TROUBLESHOOTING DIAGNOSTIC DIAGRAM

SECTION 3
DESCRIPTION OF OSCILLATOR CARD INPUTS AND OUTPUTS

INPUTS

Table 5.3.1
OSCILLATOR CARD INPUTS

COLOR	FUNCTION
W/GRN	Plugging input
GRY	Thermal protector input
ORN	Battery volts reference
RED	Gate drive for 5 REC
BRN	Gate loading for 5 REC
W/BLK	Gate loading for 2 REC & capacitor volts
W/RED	Gate drive for 2 REC
BLU	PMT/current limit sense input
WHT	Gate drive for 1 REC
VIO	Gate loading for 1 REC
BLK (2)	Negative card input - 1 wire from negative on transformer and 1 wire from thermal protector.

OUTPUTS

Table 5.3.2
OSCILLATOR CARD OUTPUTS

TERMINAL NUMBER	FUNCTION
19	Battery positive input for 48 volt vehicle
18	Battery positive input for 36 volt vehicle
17	Battery positive input for 24 volt vehicle
16	Reverse directional switch input
15	Forward directional switch input
14	Signal for 1A driver
13	Signal for PMTD or F/R driver
12	Accelerator potentiometer input

SECTION 4
CHECKING COMPONENTS

This section provides step-by-step instructions for checking the components. These instructions include meter readings from the Volt-Ohm-Meter, with the desired reading indicated at the end of that particular step.

MAIN SCR CONTROL CARD (4A)

The troubleshooting diagnostics check all outside devices and eliminate them as the source of the problem. If that does not resolve the problem, then the card must be faulty.

INSTRUCTIONS FOR REMOVAL OF THE CONTROL CARD

WARNING

TO AVOID DAMAGE TO THE CARD, DO NOT REMOVE THE SCR CONTROL CARD FROM ITS METAL TOP AND BOTTOM.

1. Remove all wires from the outside terminal board on the control card.

2. Remove all wires from the inside terminal board on the control card.

3. Remove the 2 screws attaching the control card bottom to the stand-up bracket (near the capacitor).

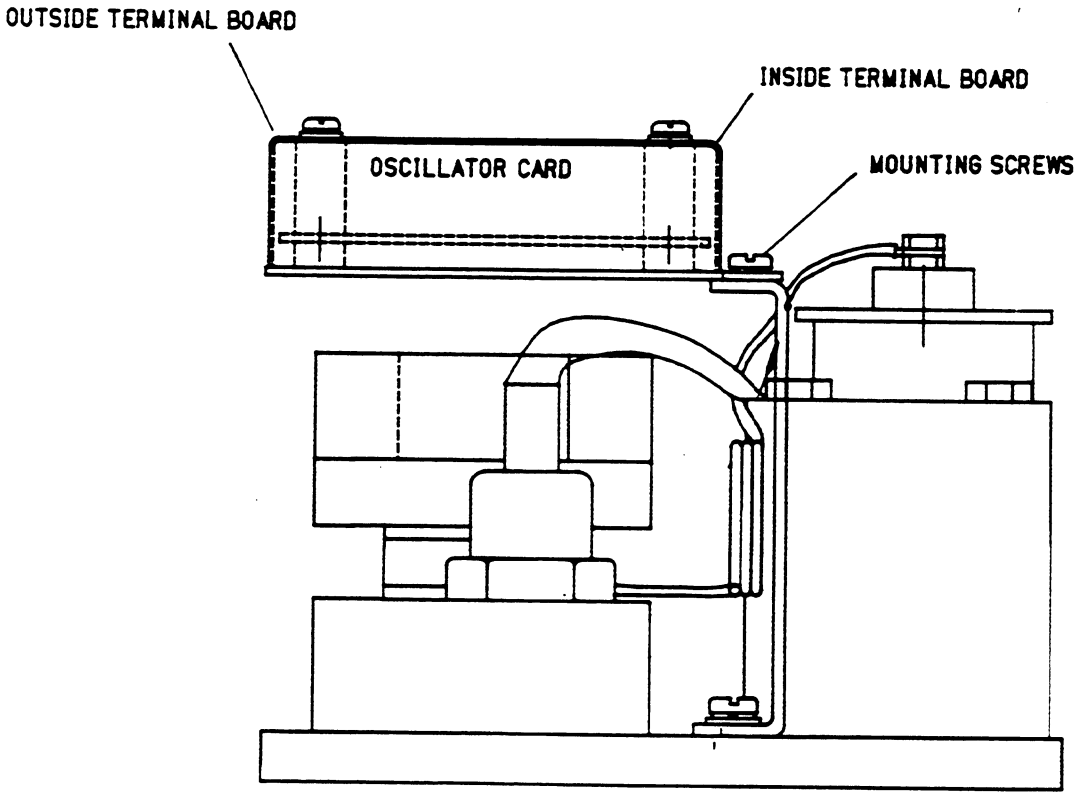


Figure 5.4.1
SCR CONTROL CARD

Ref. 91.TMP.26

CAPACITOR 1C (4B)

WARNING

TO AVOID ELECTRICAL SHOCK OR A RUNAWAY VEHICLE, DISCONNECT THE BATTERY AND DISCHARGE THE CAPACITOR BEFORE DOING ANY TESTING.

USING A VOLT-OHM-METER (VOM) SET TO THE R X 10,000 SCALE:

1. Remove the wires from one of the terminals of the capacitor.
2. Connect the leads from the VOM across the capacitor terminals. The meter should swing to 0 ohms, then gradually swing to above 100,000 ohms.
3. Reverse the leads of the VOM. The meter should swing to 0 ohms, then gradually swing to above 100,000 ohms.
4. Check the resistance from one of the capacitor terminals to its case. Meter reading: 50,000 ohms or more.

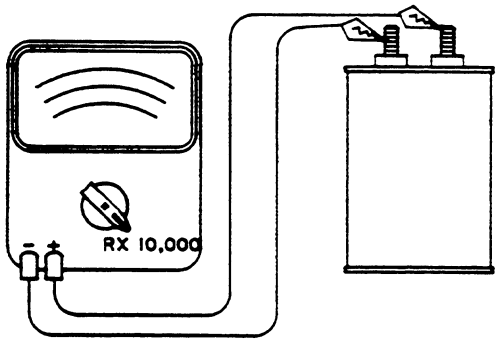


Figure 5.4.2
CAPACITOR CHECK

Ref. 91.TMP.27

CONTACTORS F, R, 1A, and P (4C)

For 150 and 300 amp contactors, refer to GEH-4469 located in Section 7 of this chapter.

For 75 amp contactors, refer to GEH-3099A located in Section 7 of this chapter.

POTENTIOMETER IN ACCELERATOR (4D)

1. Disconnect the battery.

2. Remove the wire from terminal board point 12.

3. Connect a Volt-Ohm-Meter from the wire at terminal board point 12 to the negative on the transformer with the scale set to R X 100.

4. Set the accelerator at creep speed.
   Meter reading: 4800 to 6000 ohms.

5. Move the accelerator to top speed.
   Meter reading: 200 ohms or less.

6. Move the negative VOM lead to the truck frame.
   Meter reading: 1,000,000 ohms or more.

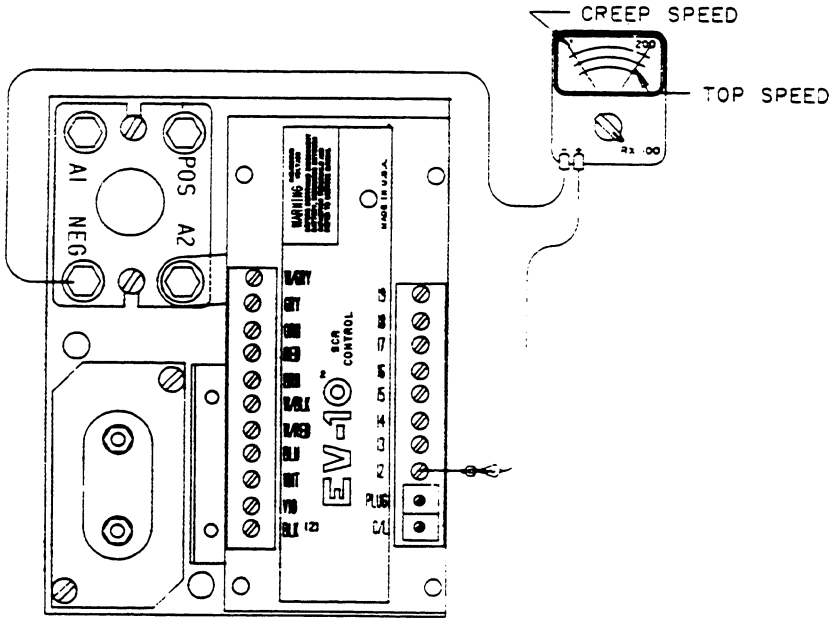


Figure 5.4.3
ACCELERATOR POTENTIOMETER CHECK

Ref. 91.TMP.28

DRIVER MODULE (4E)

Resistor = 8200 ohms 2 watts for 72 volts.
= 4700 ohms 2 watts for 24/36/48 volts.

USING A VOM SET TO THE 50V DC SCALE:

(For 24/36/48V, use a VOM set to a 100V dc scale.)

1. Disconnect the leads.
2. Connect the resistor, coil and switch to terminals 1 and 3 as shown.
3. Connect the battery negative to terminal 2 and the battery positive to the junction of the switch and the resistor.
4. Connect the negative lead of the VOM to terminal 2 and the positive lead of the VOM to terminal 3. Read the battery voltage on the VOM.
5. Close the switch. The VOM meter reading should drop to 2V or less.
6. Move the resistor and the positive meter lead from terminal 3 to terminal 4.
7. Repeat the same test.

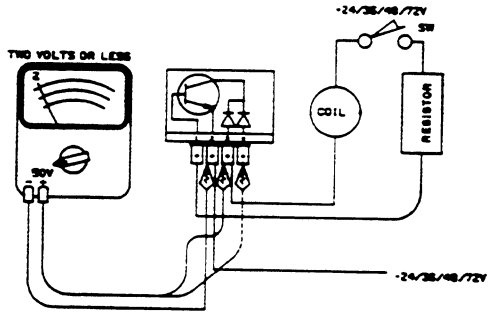


Figure 5.4.4
DRIVER MODULE CHECK

Ref. 91.TMP.29

HOURMETER MODULE (4F)

USING A VOM SET TO THE R X 1 SCALE:

1. Disconnect the lead from terminal 4.

2. Connect the positive lead of the VOM to terminal 3 and the negative lead of the VOM to terminal 4.
   Meter reading: less than 20 ohms.

3. Move the positive lead to terminal 2.
   Meter reading: less than 20 ohms.

4. Move the positive lead to terminal 1.
   Meter reading: less than 20 ohms.

SWITCH THE VOM TO THE R X 10,000 SCALE:

5. Connect the negative lead of the VOM to terminal 3 and the positive lead to terminal 4.
   Meter reading: 50,000 ohms or more.

6. Move the negative lead to terminal 2.
   Meter reading: 50,000 ohms or more.

7. Move the negative lead to terminal 1.
   Meter reading: 50,000 ohms or more.

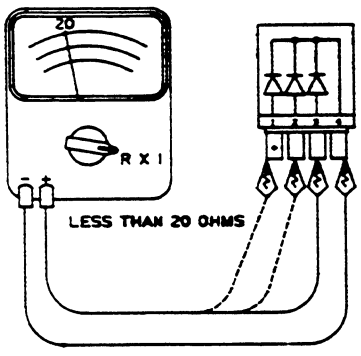


Figure 5.4.5
HOURMETER MODULE CHECK

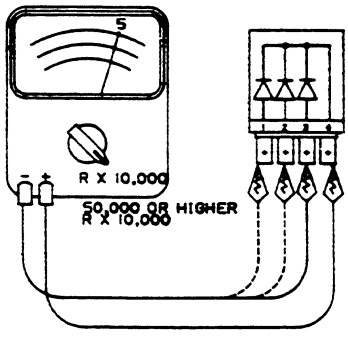


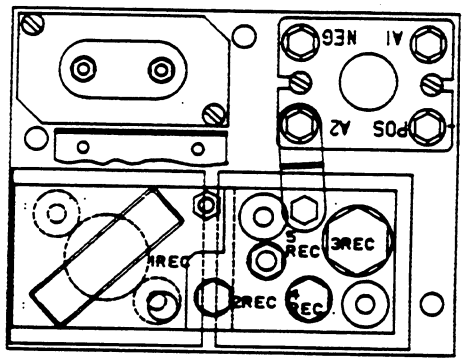
Figure 5.4.6
HOURMETER MODULE CHECK

Ref. 91.TMP.30
Ref. 91.TMP.31

SCR (1 REC, 2 REC, 5 REC) (4G)

WARNING

TO AVOID ELECTRICAL SHOCK OR A RUNAWAY VEHICLE, DISCONNECT THE BATTERY AND DISCHARGE THE CAPACITOR BEFORE DOING ANY TESTING.



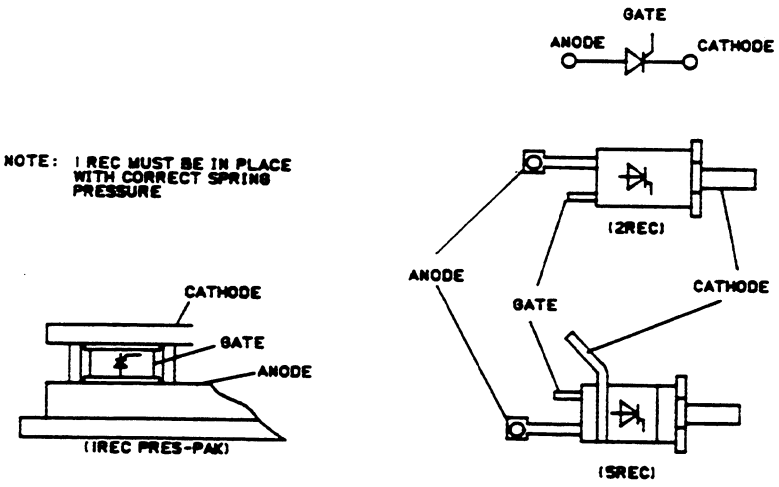


Figure 5.4.7
SCR LOCATIONS

Ref. 91.TMP.32

1 REC

USING A 6V TEST LIGHT, AS SHOWN:

1. Disconnect the WHT wire from the card.

2. Connect the negative lead of the test light to terminal board point VIO (cathode).

3. Connect the positive lead of the test light to terminal board point BLU (anode). If the light comes on, 1 REC has shorted. If the light does not come on, continue testing.

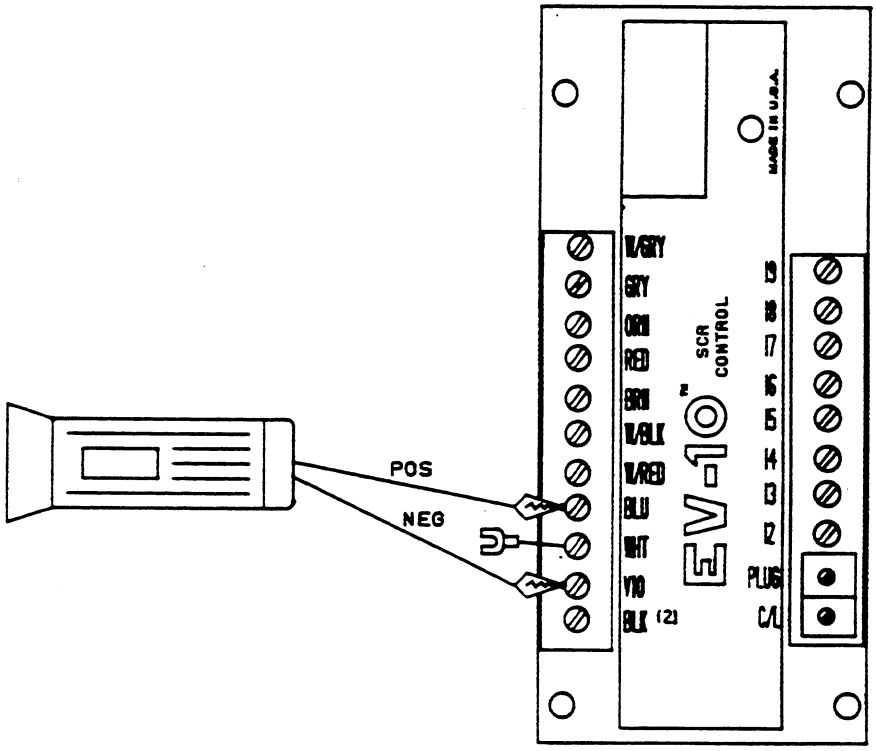


Figure 5.4.8
1 REC TEST LIGHT CHECK

Ref. 91.TMP.33

1 REC (Continued)

4. Touch the WHT (gate) wire to terminal board point BLU. The light should come on. If it does not, 1 REC is open.

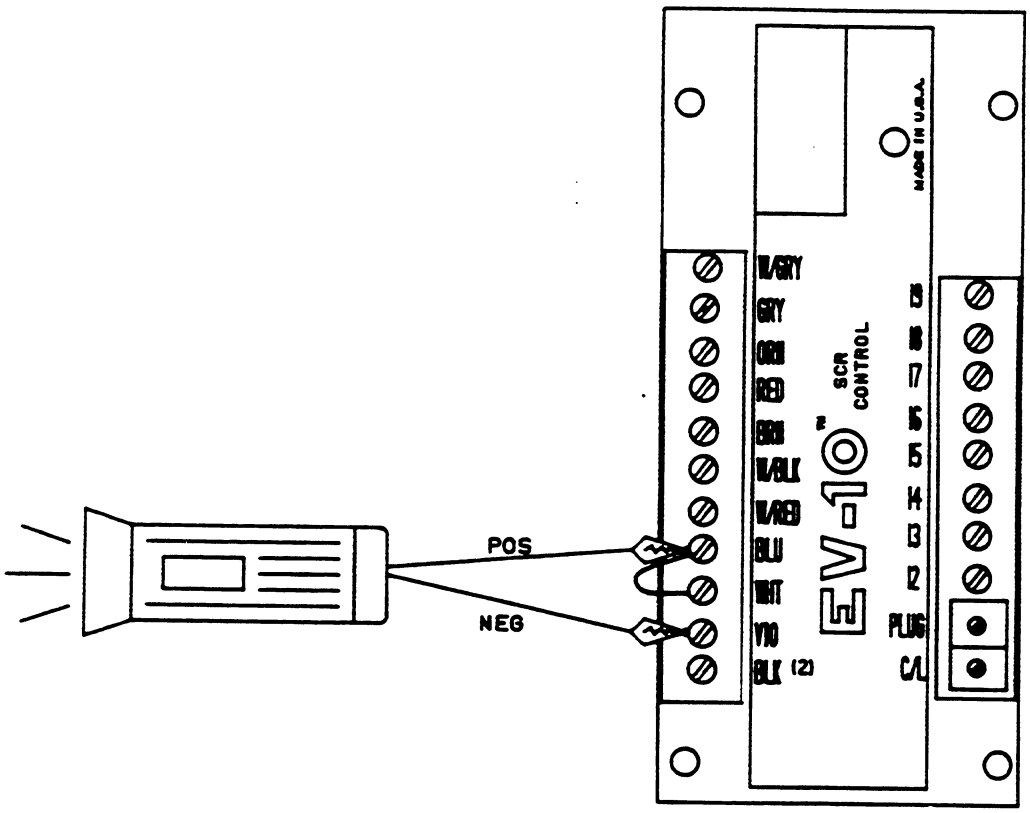


Figure 5.4.9
1 REC TEST LIGHT CHECK

Ref. 91.TMP.34

1 REC (Continued)

USING A VOM SET TO THE R X 1 SCALE:

1. Disconnect the BLU wire from terminal board point BLU.

2. Disconnect the WHT wire from terminal board point WHT.

3. Connect the negative lead of the VOM to the WHT wire (gate).

4. Connect the positive lead of the VOM to terminal board point VI0 (cathode). Replace 1 REC if the reading is either zero or infinity.

5. Reverse the meter leads and check again. Replace 1 REC if the reading is zero or infinity.

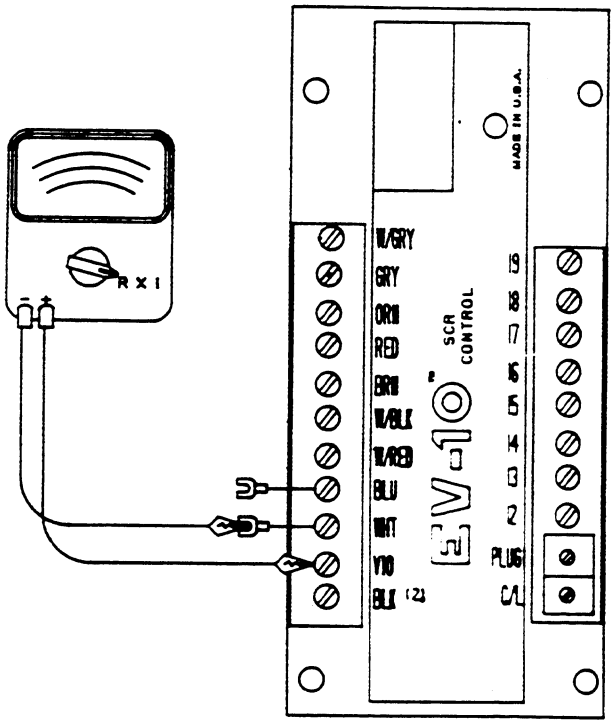


Figure 5.4.10
1 REC VOM CHECK

Ref. 91.TMP.35

1 REC (Continued)

SWITCH THE VOM TO THE R X 100 SCALE:

6. Connect the negative lead of the VOM to the BLU wire (anode).

7. Connect the positive lead of the VOM to terminal board point V10 (cathode). Replace 1 REC if the meter reads zero.

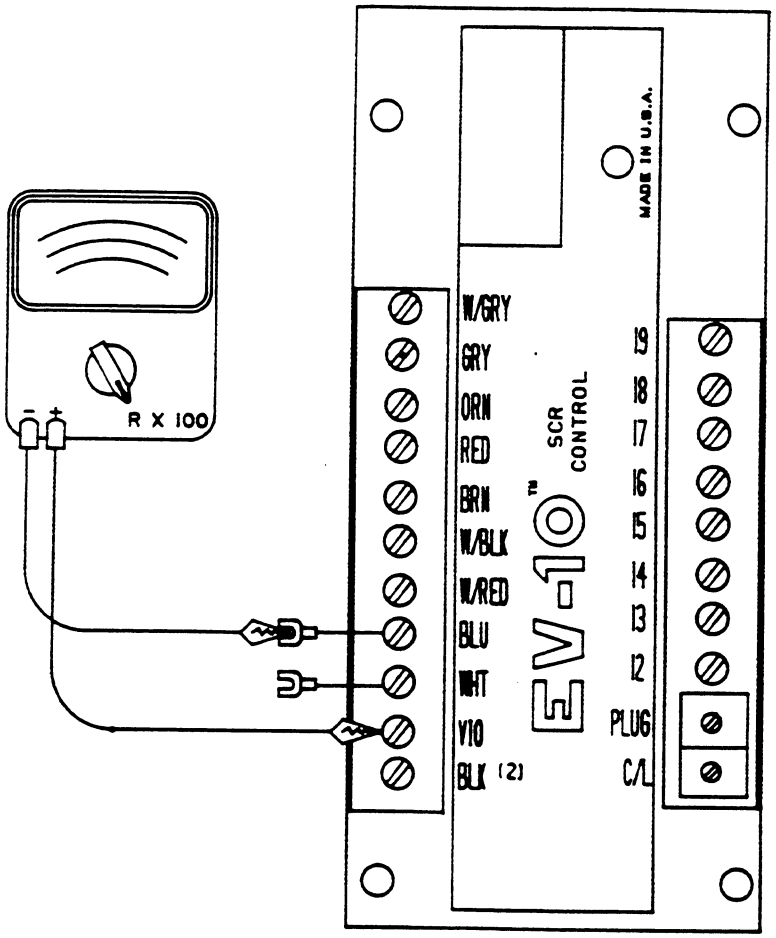


Figure 5.4.11
1 REC VOM CHECK

Ref. 91.TMP.36

2 REC

USING A 6V TEST LIGHT, AS SHOWN:

1. Disconnect the W/RED wire from the card.

2. Connect the negative lead of the test light to terminal board point W/BLK (cathode).

3. Connect the positive lead of the test light to terminal board point BLU (anode). If the light comes on, 1 REC has shorted. If the light does not come on, continue testing.

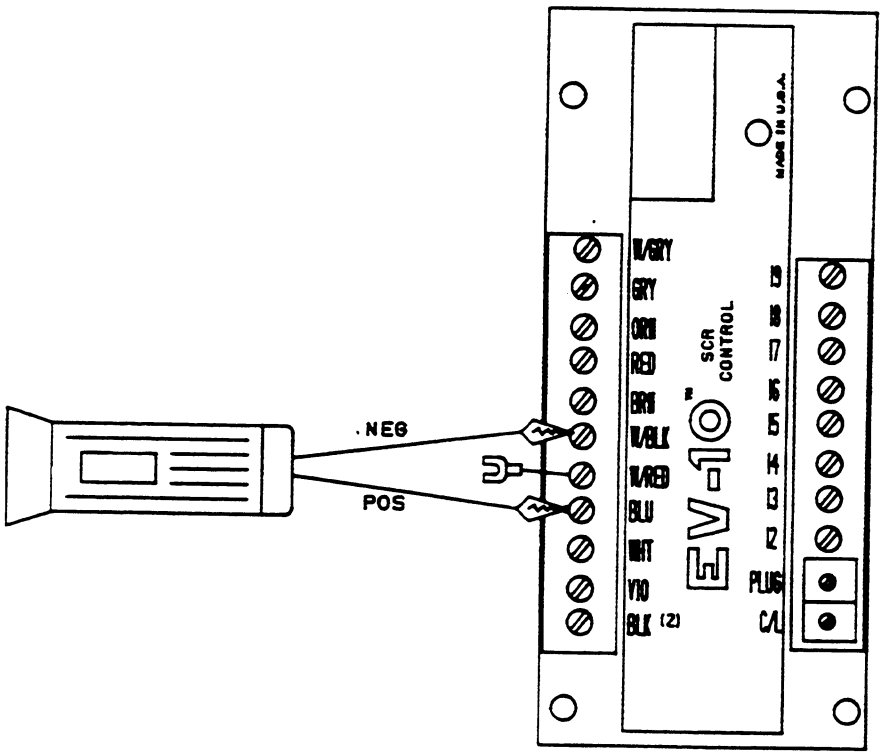


Figure 5.4.12
2 REC TEST LIGHT CHECK

Ref. 91.TMP.37

2 REC (Continued)

4. Touch the W/RED (gate) wire to terminal board point BLU. The light should come on and stay on when the W/RED wire is removed; if not, 2 REC is open.

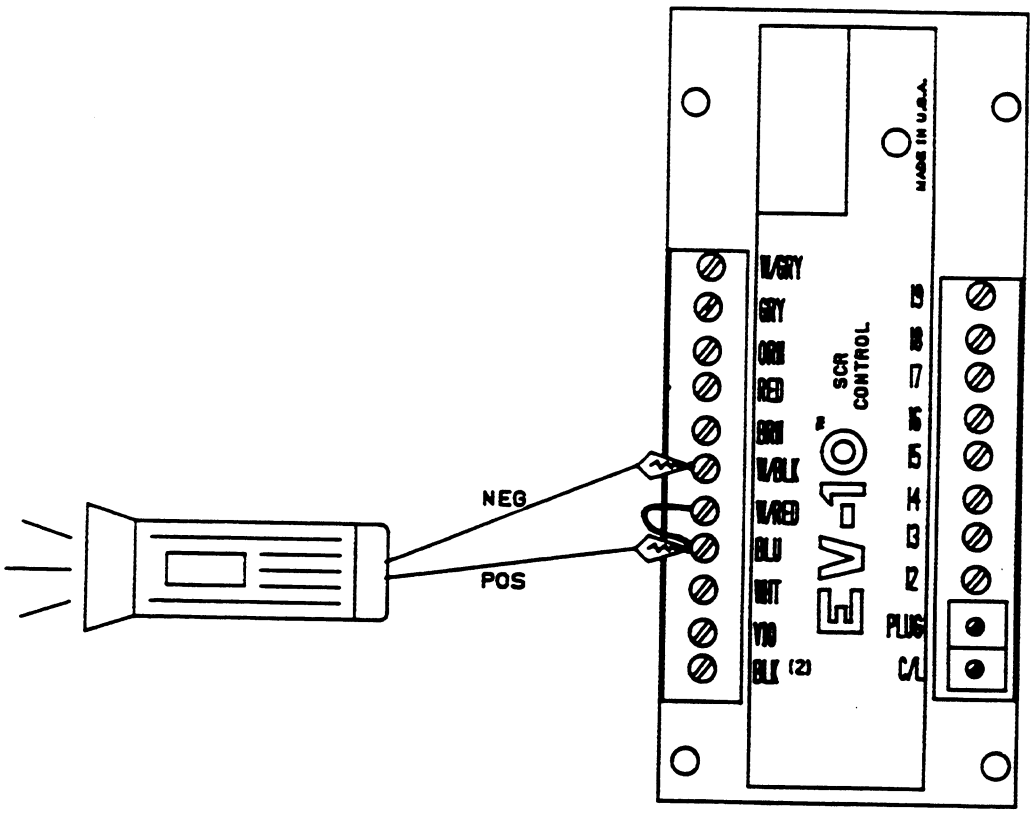


Figure 5.4.13
2 REC TEST LIGHT CHECK

Ref. 91.TMP.38

2 REC (Continued)

USING A VOM SET TO THE R X 1 SCALE:

1. Disconnect the BLU wire from terminal board point BLU.
2. Disconnect the W/RED wire from terminal board point W/RED.
3. Connect the negative lead of the VOM to the W/RED wire (gate).
4. Connect the positive lead of the VOM to terminal board point W/BLK (cathode). Replace 2 REC if the reading is either zero or infinity.
5. Reverse the meter leads and check again. Replace 1 REC if the reading is zero or infinity.

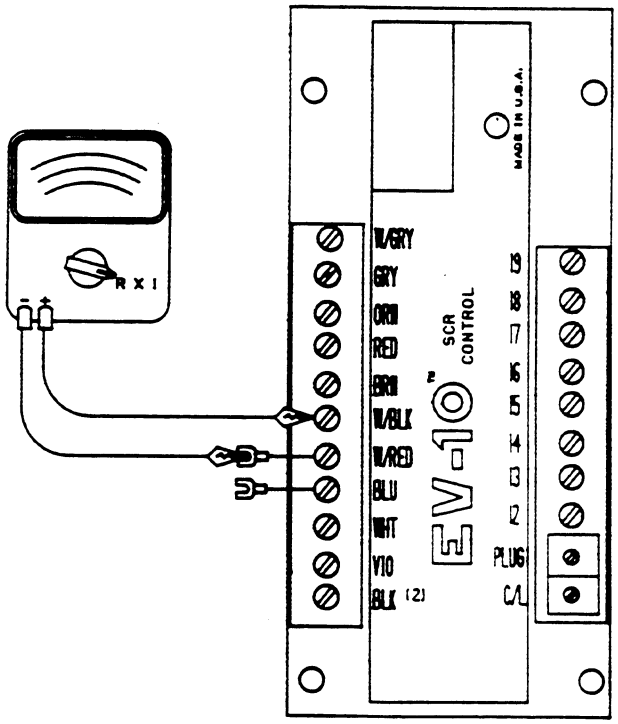


Figure 5.4.14
2 REC VOM CHECK

Ref. 91.TMP.39

2 REC (Continued)

SWITCH THE VOM TO THE R X 100 SCALE:

6. Connect the negative lead of the VOM to the BLU wire (anode).

7. Connect the positive lead of the VOM to terminal board point W/BLK (cathode). Replace 2 REC if the meter reads zero.

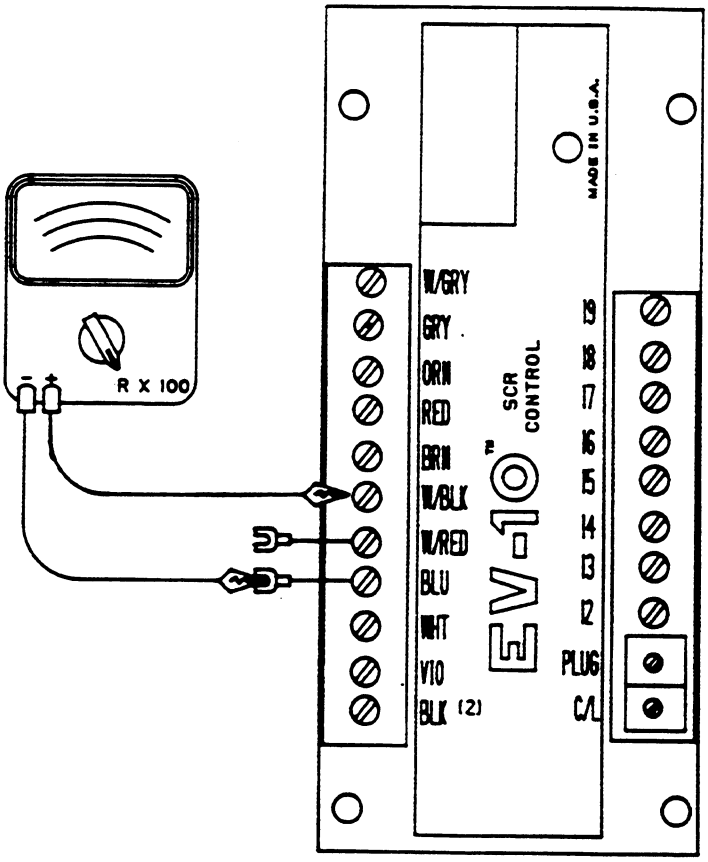


Figure 5.4.15
2 REC VOM CHECK

Ref. 91.TMP.40

5 REC

USING A 6V TEST LIGHT, AS SHOWN:

1. Disconnect the RED wire from the card.

2. Connect the negative lead of the test light to terminal board point BRN (cathode).

3. Connect the positive lead of the test light to terminal board point W/BLK (anode). If the light comes on, 1 REC has shorted. If the light does not come on, continue testing.

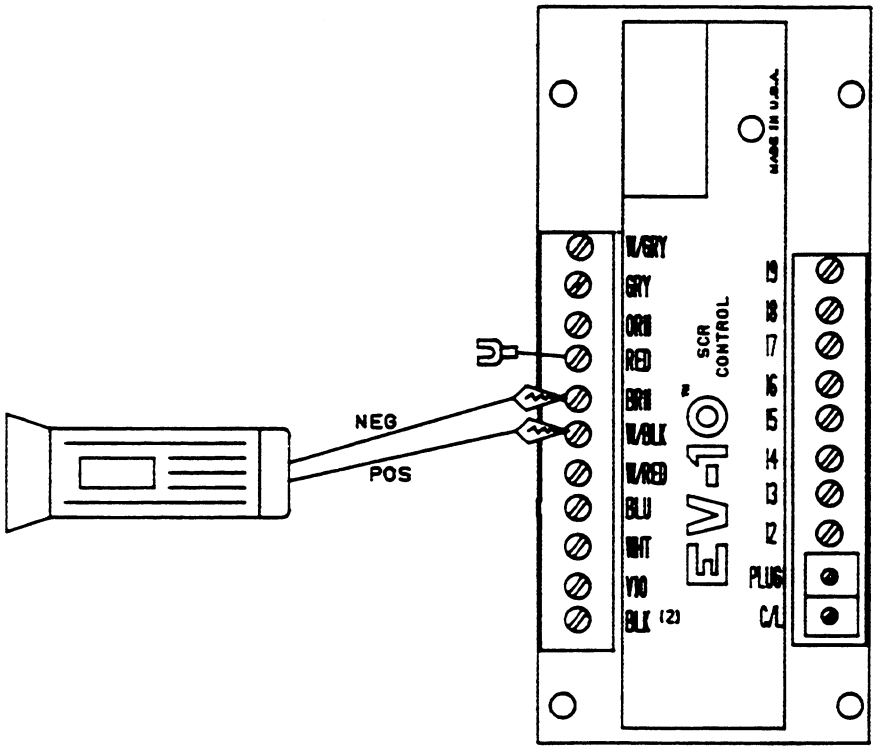


Figure 5.4.16
5 REC TEST LIGHT CHECK

Ref. 91.TMP.41

5 REC (Continued)

4. Touch the RED (gate) wire to terminal board point W/BLK. The light should come on and stay on when the RED wire is removed; if not, 5 REC is open.

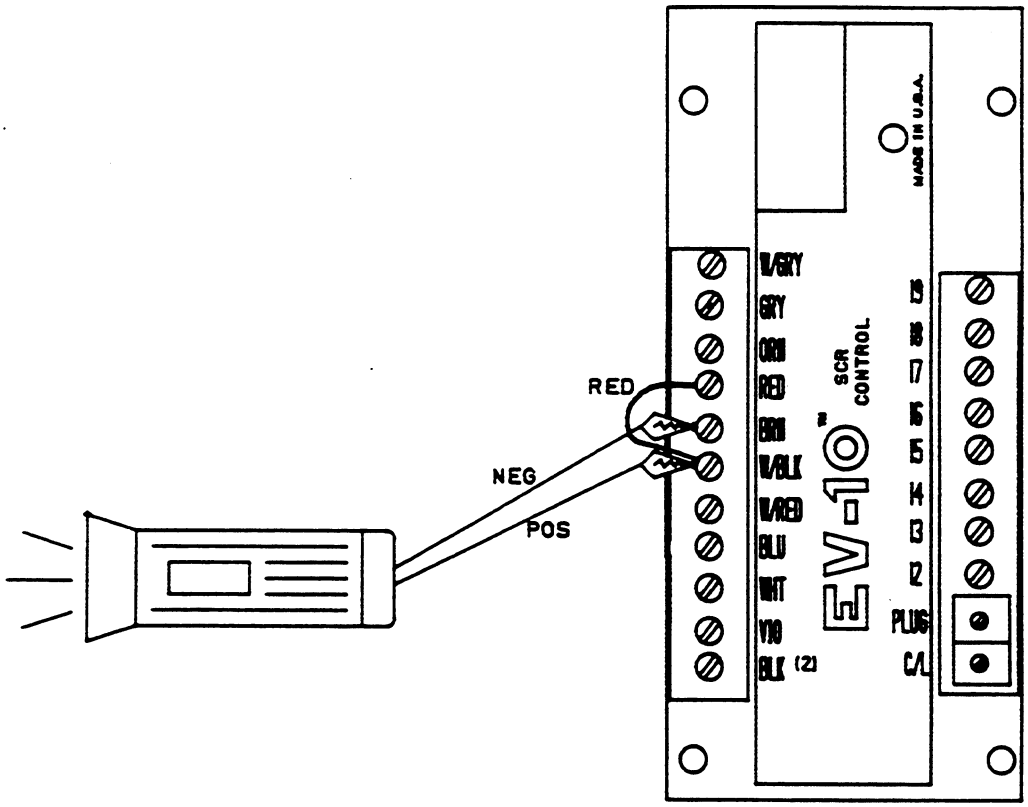


Figure 5.4.17
5 REC TEST LIGHT CHECK

Ref. 91.TMP.42

5 REC (Continued)

USING A VOM SET TO THE R X 1 SCALE:

1. Disconnect the W/BLK wire from terminal board point W/BLK (anode).
2. Disconnect the BRN wire from terminal board point BRN.
3. Connect the negative lead of the VOM to the BRN wire (cathode).
4. Connect the positive lead of the VOM to terminal board point RED (gate). Replace 5 REC if the reading is either zero or infinity.
5. Reverse the meter leads and check again. Replace 5 REC if the reading is zero or infinity.

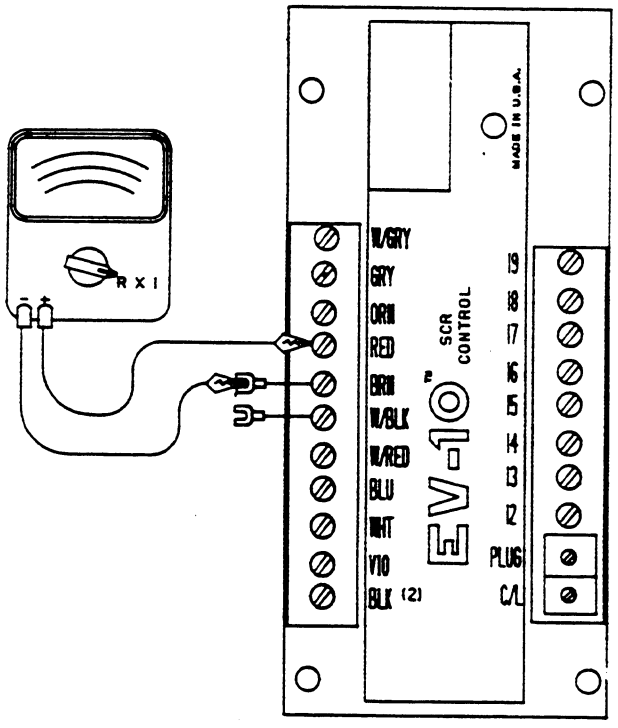


Figure 5.4.18
5 REC VOM CHECK

Ref. 91.TMP.43

5 REC (Continued)

SWITCH THE VOM TO THE R X 100 SCALE:

6. Connect the negative lead of the VOM to the W/BLK wire (anode).

7. Connect the positive lead of the VOM to the BRN wire (cathode). Replace 5 REC if the meter reads zero.

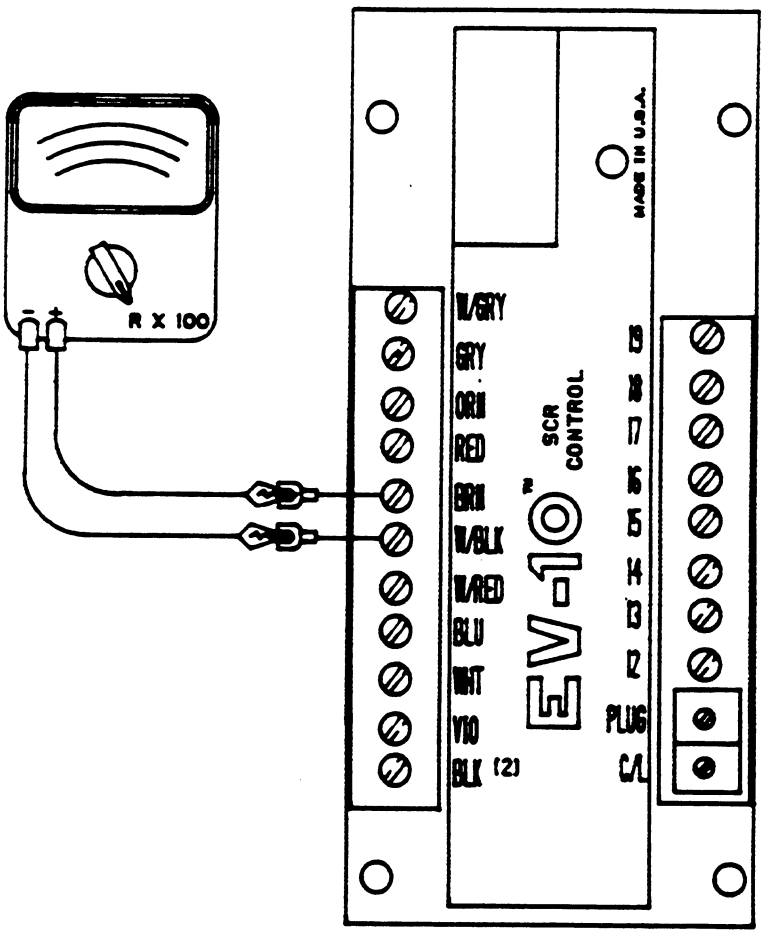


Figure 5.4.19
5 REC VOM CHECK

Ref. 91.TMP.44

RECTIFIERS (3 AND 4 REC) (4H)

WARNING

TO AVOID ELECTRICAL SHOCK OR A RUNAWAY VEHICLE, WHEN CHECKING DIODES, DISCONNECT THE BATTERY AND DISCHARGE THE CAPACITOR 1C.

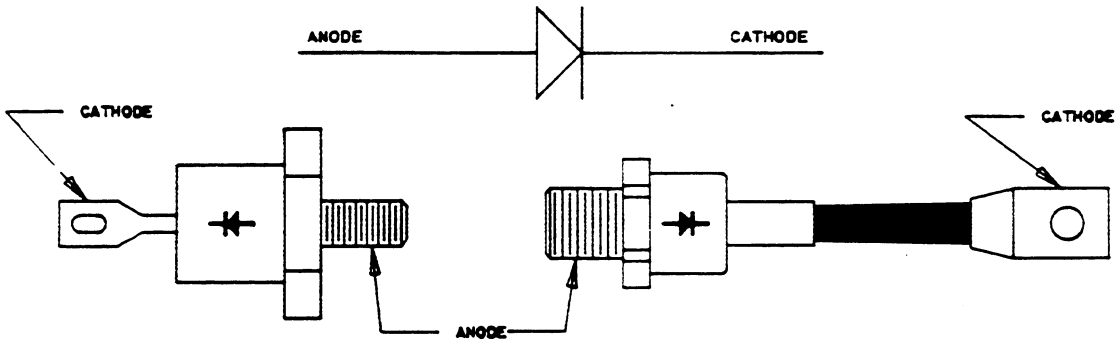


Figure 5.4.20
DIODE DESCRIPTION

Ref. 91.TMP.45

RECTIFIERS (3 AND 4 REC) (Continued)

USING A CONTINUITY TEST LIGHT:

1. Disconnect the cathode end from the panel wiring.
2. Connect the negative lead of the test light to the anode.
3. Connect the positive lead of the test light to the cathode. If the light comes on, the REC has shorted. If the light does not come on, continue testing.

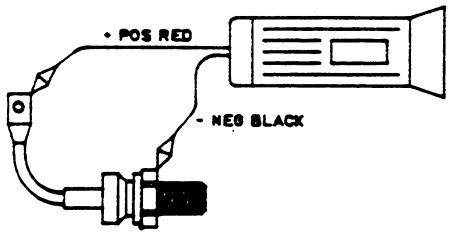


Figure 5.4.21
3 AND 4 REC TEST LIGHT CHECK

USING A CONTINUITY TEST LIGHT (Continued):

4. Connect the negative lead of the test light to the cathode.
5. Connect the positive lead of the test light to the anode. The light should normally come on. If it comes on, the test is concluded using a continuity light. If it does not come on, the diode is open.

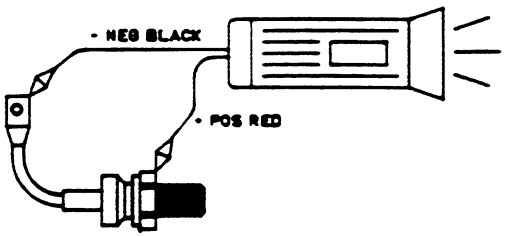


Figure 5.4.22
3 AND 4 REC TEST LIGHT CHECK

Ref. 91.TMP.46
Ref. 91.TMP.47

RECTIFIERS (3 AND 4 REC) (Continued)

USING A VOLT-OHM-METER (VOM) SET TO THE R X 10,000 SCALE:

1. Disconnect the VOM.
2. Connect the positive lead of the VOM to the cathode.
3. Connect the negative lead of the VOM to the anode.
   Meter reading: 50,000 ohms or more.

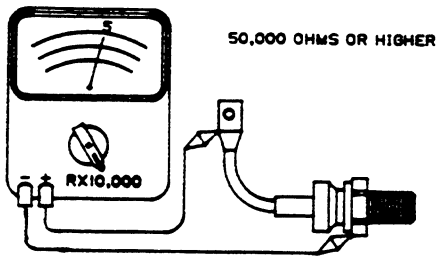


Figure 5.4.23
3 AND 4 REC VOM CHECK

USING A VOLT-OHM-METER (VOM) SET TO THE R X 10,000 SCALE (Continued):

SWITCH THE VOM TO THE R X 1 SCALE:

4. Connect the positive lead of the VOM to the anode.
5. Connect the negative lead of the VOM to the cathode.
   Meter reading: 7 to 12 ohms.

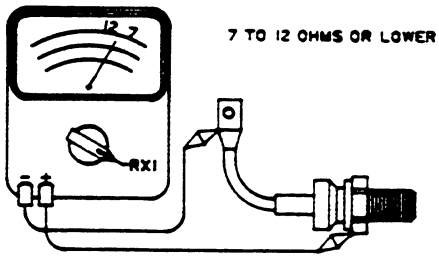


Figure 5.4.24
3 AND 4 REC VOM CHECK

Ref. 91.TMP.48
Ref. 91.TMP.49

THERMAL PROTECTOR (TP) (4J)

USING A VOLT-OHM-METER (VOM) SET TO THE R X 100 SCALE:

1. Disconnect the GRY wire from terminal board point GRY.

2. Connect the leads of the VOM to the GRY wire and to terminal board point BLK as shown in Figure 5.4.25. The resistance should be less than 200 ohms when at normal temperature.

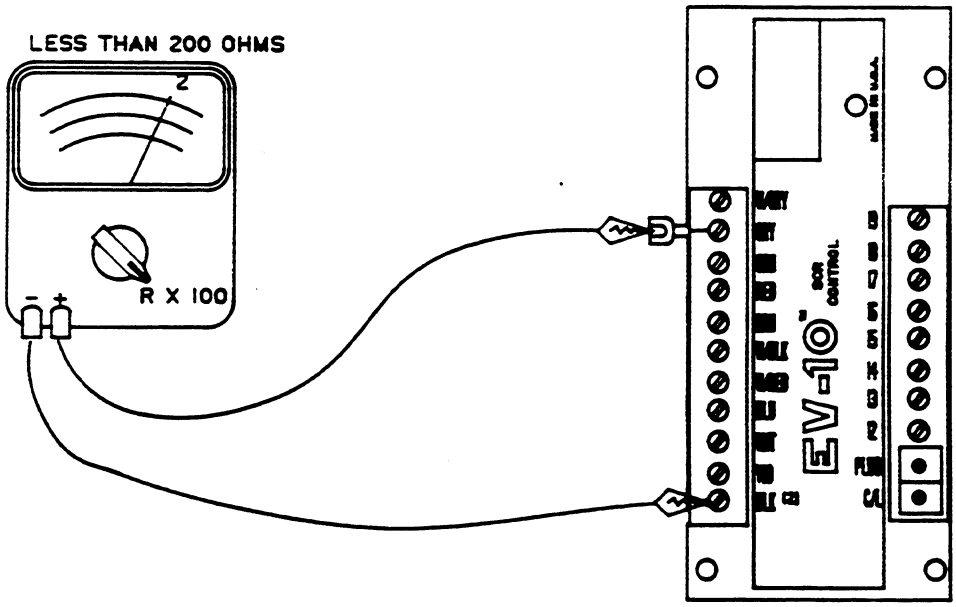


Figure 5.4.25
THERMAL PROTECTOR CHECK

Ref. 91.TMP.50

TRANSFORMER (4K)

USING A VOM SET TO THE R X 1 SCALE:

1. Connect the leads of the VOM to the negative (transformer) and 1C.
   Meter reading: less than 2 ohms.

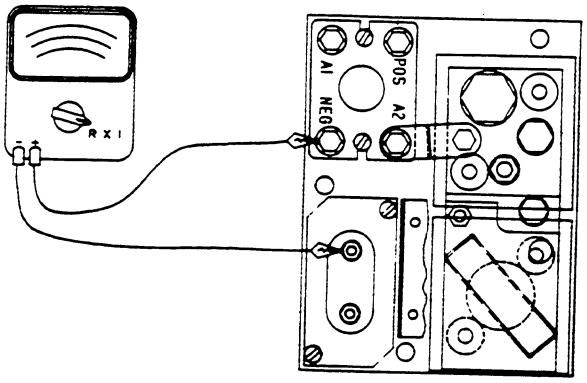


Figure 5.4.26
TRANSFORMER CHECK

2. Connect the leads of the VOM to A2 (transformer) and terminal board point BRN.
   Meter reading: less than 2 ohms.

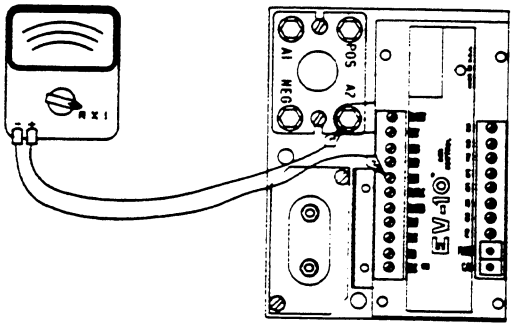


Figure 5.4.27
TRANSFORMER CHECK

Ref. 91.TMP.51
Ref. 91.TMP.52

VOLTAGE CHECK (4L)

USING A VOM SET TO THE DC VOLTAGE SCALE:

1. Set the VOM equal to or greater than the anticipted voltage.
2. Connect the black negative head of the VOM to the SCR negative.
3. Connect the red positive lead of the VOM to the point described in the Troubleshooting Diagnostic Diagram.
4. Read the voltage.

MILLIAMP CHECK (4M)

USING A VOM SET TO THE 10 MA. SCALE:

1. Connect the black negative lead of the VOM to the SCR negative.
2. Disconnect the wire from the point described in the Troubleshooting Diagnostic Diagram.
3. Connect the red positive lead to the point indicated.
4. Read the milliamps.

SECTION 5
REPLACEMENT OF COMPONENTS

NOTE

The use of a heat transfer grease such as GE Versilube G-350-M or its equivalent is recommended.

REPLACEMENT OF THE 1 REC MODULE

1. Remove the 1 REC gate wire (WHT) from the inside card terminal board.
2. Remove the wires from the outside card terminal board.
3. Remove the two card mounting screws and rotate the card over the capacitor and the transformer.
4. Unplug the two thermal protector wires.
5. Disconnect the T2-strap from the top heat sink.
6. Remove the spring assembly by first removing its mounting bolts.
7. Clean both heat sinks with a clean rag and isopropyl alcohol.
8. Apply a light coat of heat transfer grease to both ends of the 1 REC Press-Pak.
9. Install and torque the heat sink/spring assembly according to the torquing instructions that follow.
10. Reconnect the thermal protector, strap (T2), card, and card wires.

TORQUING INSTRUCTIONS

MOUNTING PROCEDURE

1. Apply Silicon Grease (Dow No. 44) to both sides of the SCR.
2. Locate the SCR in place with the pin on the large heat sink.
3. With the anode down, place the upper heat sink on top with the clamp in position. (See Figure 5.5.1.)

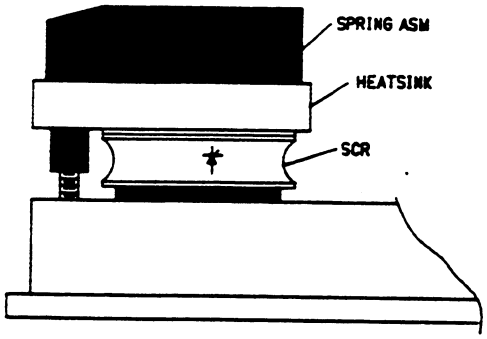


Figure 5.5.1
MOUNTING PROCEDURE

4. Tighten the bolts evenly until they are finger tight. Then tighten each bolt 1/4 turn using a 7/16 socket wrench on the bolt heads.
5. Place the force indicator gauge firmly against the springs, as shown on the outline drawing, so that both ends and the middle are in solid contact with the springs. The edges of the gauge will then indicate the spring deflection or force. Correct mounting force is indicated when the proper edges coincide.

. 91.TMP.53

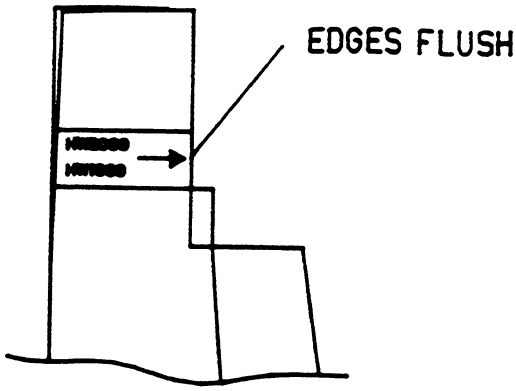


Figure 5.5.2
CORRECT TORQUING FORCE

6. If the mounting force indicated is less than rated force, tighten the bolts alternately 1/4 turn at a time until the points coincide. (See Figure 5.5.3.)

7. If excessive force is indicated, loosen the bolts and start over. Never try to adjust spring force by backing off the bolts. Spring friction will produce false readings.

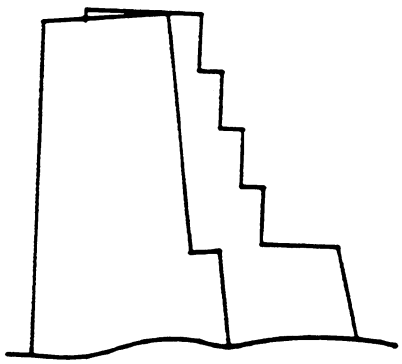


Figure 5.5.3
LESS THAN RATED FORCE

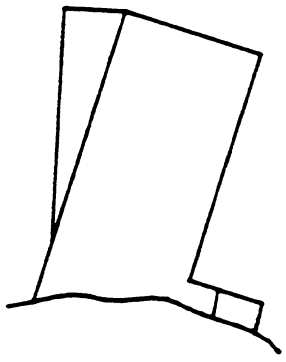


Figure 5.5.4
EXCESSIVE FORCE

Ref. 91.TMP.54
Ref. 91.TMP.55
Ref. 91.TMP.56

CALIBRATE THE FORCE GAUGE

If you suspect the force gauge is out of calibration due to wear or damage, check it on a flat surface, as indicated in Figure 5.5.5.

NOTE

If the edges are not flush within ±.010, calibrate the gauge by filing the bottom contact points.

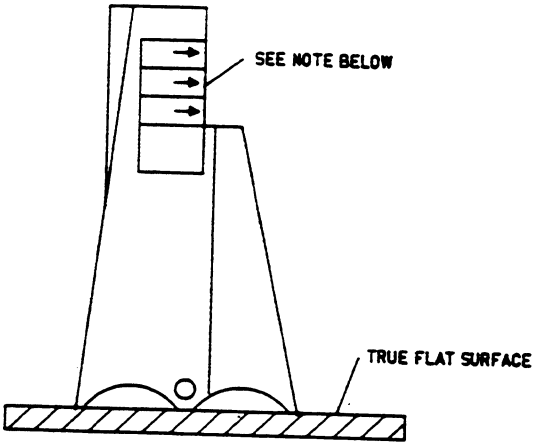


Figure 5.5.5
FORCE GAUGE

Ref. 91.TMP.57

REPLACEMENT OF THE CAPACITOR

1. Remove the nuts from the capacitor connections and remove the wires.
2. Remove the two mounting screws and bracket.
3. Reverse this procedure to install a new capacitor.

REPLACEMENT OF THE TRANSFORMER/CHOKE

1. Disconnect all transformer leads.
2. Remove the two mounting screws and lift the transformer free.
3. Reverse this procedure to reassemble.

REPLACEMENT OF THE CONTROL CARD

1. The panels are factory-adjusted for a particular motor and truck and should not need adjustment when used with this motor and truck.

NOTE

If the panels are used to control motors or trucks for which they were not factory-adjusted, the settings may be out of optimum adjustment to the extent that they do interact.

2. Clockwise (CW) rotation increases the function being adjusted.
3. Connect the shunt, the millivoltmeter, and the voltmeter to measure the battery current and motor voltage.
   a. Connect the shunt and the millivoltmeter between battery negative and 1 REC (or between the truck receptacle and the battery plug).
   b. Connect the voltmeter between battery positive and T2 on the SCR panel.
4. Jack up the truck so that the drive wheels are free to rotate. If a brake interlock is used, jumper it out so that power and the brakes can be applied at the same time.

5. Equipment required:

   a. 50 millivolt dc shunt.

NOTE

The shunt rating must be greater than the current to be measured. Best results are obtained when the reading is between half and full scale on the meter. If a shunt of too high a rating is used (i.e., a 500 amp rating to read 100 amps), the meter will be hard to read and the accuracy of the reading will be poor.

6. Check that the ohms in the accelerator potentiometer are less than 200 ohms in the top SCR range.

7. Check the card settings:

   a. Check the current limit by first moving the accelerator until either the F or R contactor operates. Do not move the accelerator to the point where 1A picks up. Apply the brakes until the wheels come to a standstill (the wheels must not be turning) and read the current to see if it falls below the maximum rating of 170 amps and within the rating specified by the truck manufacturer.

WARNING

Do not stall the motor for more than 30 seconds at a time. Allow time for the motor to cool between stalls. To avoid personal injury or a runaway vehicle, do not operate the motor at high speeds or plug the motor with the wheels jacked up.

   b. **With the truck on the ground, plug the truck from top speed. If the stopping distance is not as desired, adjust the plugging trimpot.**

8. Tuneup Procedure.

   a. Turn the plugging trimpot fully clockwise to prevent any interaction when setting the current limit trimpot.

   b. Turn the current limit trimpot fully counterclockwise.

   c. Check to be sure the plugging trimpot is turned fully clockwise.

   d. Depress the accelerator until F or R operate, but not the 1A contactor.

   e. Apply the brakes until the wheels come to a standstill and remain at a standstill.

   f. Slowly turn the current limit trimpot in a clockwise direction until the current reaches 170 amps, or as specified by the truck manufacturer.

NOTE

Since these controls are used on a variety of types and sizes of trucks for various applications, it is common for the truck manufacturer to set the current limit at some value below this maximum. For this reason, it is recommended that you obtain the actual current limit setting for your particular truck from the truck manufacturer.

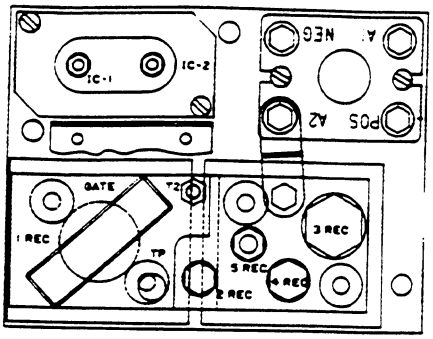
WARNING

Do not stall the motor for more than 30 seconds at a time. Allow time for the motor to cool between stalls. To avoid personal injury or a runaway vehicle, do not operate the motor at high speeds or plug the motor with the wheels jacked up.

g. To adjust the static plugging, the truck should be in its normal running condition and on the ground. Turn the plugging trimpot fully counterclockwise. This will give the longest distance for stopping.

h. Turn the trimpot clockwise to increase the stopping distance. If the stopping distance is too short or too long, continue to adjust the trimpot until the desired stopping distance is obtained.

PLACEMENT OF THE COMPONENTS



WIRE NO	COLOR SIZE	FROM	TO	WIRE DESCRIPTION
	GRY/#22	CARD GRY	TP (EITHER)	TWISTED PAIRS
	BLK #22	CARD BLK	TP (EITHER)	
	VIO #22	CARD VIO	1REC MS-T2	2S9A9900 P10 TWISTED PAIRS
	WHT/#22	CARD WHT	1REC GATE	
	BLU/#22	CARD BLU	MS-A2	2S9A9900 P6
	WHT/RED/#22	CARD W/RED	2REC GATE	2S9A9900 P12 TWISTED PAIRS
	WHT/BLK/#22	CARD W/BLK	2REC-C	2S9A9900 P11
	BLK/#22	CARD BLK	IC-2	2S9A9900 P2
	WHT/GRN/#22	CARD W/GRN	4REC-C	2S9A9900 P13
	ORN/#22	CARD ORN	TRANS-POS	2S9A9900 P8
	BRN/#22	CARD BRN	3REC-C	2S9A9900 P7
	RED/#22	CARD RED	3REC GATE	2S9A9900 P3 TWISTED PAIRS
5 CHOKE 25 16	BLK #8	4 REC-C	TRANS-A1	6BA754HP8BK49
		2 REC-C	IC-1	
	BLK #12	5 REC-A	IC-1	6BA754HP12BK19
	BLK #10	IC-2	1 REC-T2	6BA754HP10BK19
	WIRE STRAP	TRANS-T3	5 REC-C	
		TRANS-T2	1 REC-T2	

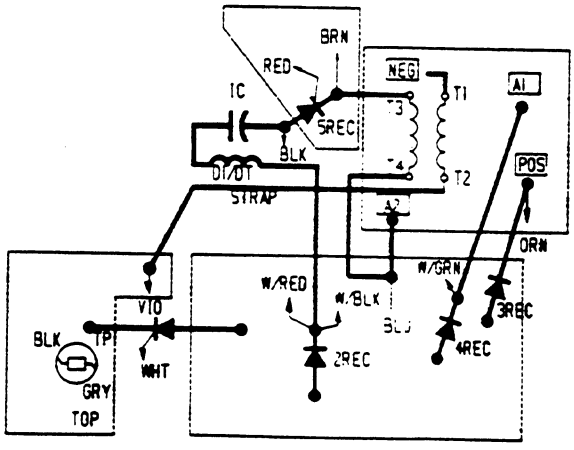


Figure 5.5.6
PLACEMENT OF COMPONENTS

Ref. 91.TMP.58



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