



# **SERVICE MANUAL**

## **FOR THE**

# **MIL-9000 and MIL-12000**

## **ELECTRIC WINCHES**

- **COMPLETE REBUILD INSTRUCTIONS**
- **TROUBLESHOOTING GUIDE**

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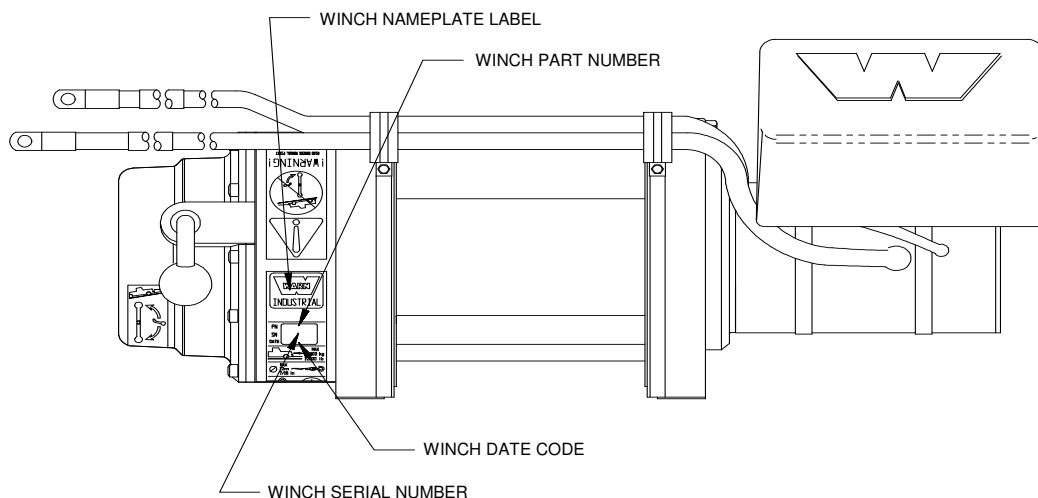
# **! CAUTION !**

**ALTHOUGH THIS MANUAL IS FOR THE WINCH OWNER, SOME REPAIRS SHOULD BE DONE BY A WARN INDUSTRIAL AUTHORIZED SERVICE TECHNICIAN. YOU MAY NEED SPECIALIZED TOOLS THAT MAY NOT BE READILY AVAILABLE TO THE OWNER. WE HIGHLY RECOMMEND THAT YOU DO NOT ATTEMPT REPAIR OF YOUR WINCH WITHOUT THE PROPER TOOLS AND EQUIPMENT. FAILURE TO CORRECTLY FOLLOW THESE INSTRUCTIONS MAY CAUSE WINCH FAILURE RESULTING IN SERIOUS BODILY INJURY OR PROPERTY DAMAGE.**

## **SECTION 1 - GETTING STARTED**

### **1.1 WINCH MODEL IDENTIFICATION**

To ensure proper winch repair it is necessary to correctly identify the model and part number of your winch. This will make it easier to order replacement parts, and help you obtain the proper information you need from your Authorized Service Center.



*Figure 1.1*

See *Figure 1.1* for Locations

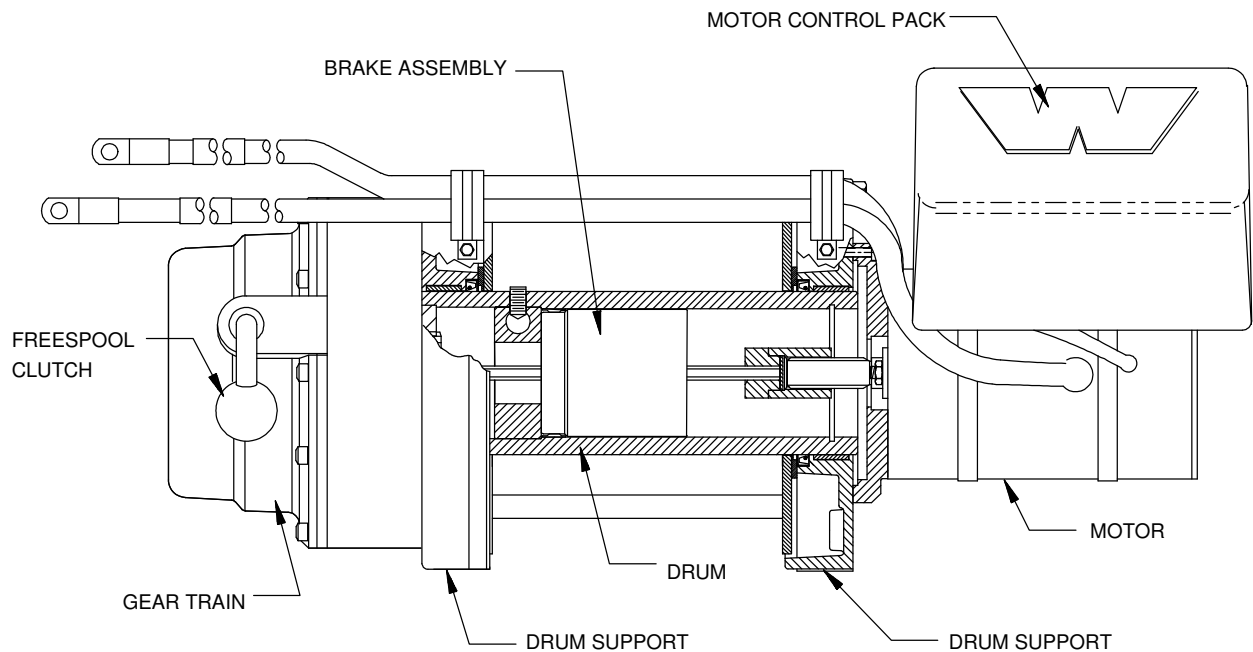
1. Winch Nameplate Label - identifies model designation.
2. Winch Part Number - identifies winch configuration.
3. Winch Date Code - identifies when it was manufactured.
4. Winch Serial Number - individually identifies winch.

## 1.2 DEFINITIONS AND WINCH OPERATION

### 1.2.1 DEFINITIONS

Operation and service of a Warn Industrial planetary winch can be explained easier by defining a few major structural components. Refer to *Figure 1.2* for the following definitions:

- **Motor** - The winch is driven on one end by a two direction electric motor, generally run by 12 or 24 volts DC. The motor is internally protected by a thermal switch that is activated when the motor gets too hot to operate efficiently. The motor is most often powered by a vehicle battery.
- **Motor Controls** - Winch motor controls consist of a control pack (also referred to as a solenoid pack) most often mounted to the motor, and a remote control handle connected to the control pack with a cord. The winch motor power source cables are connected to the control pack which in turn feeds power to the winch motor through electrical cable connections. The main function of the control pack is to allow the operator to switch the winch on and off in both directions. The winch control pack may also include an Electronic Current Limiter (ECL) to limit the pulling load of the winch.
- **Drum** - The winch drum is the structural component of the winch used to store wire rope and to transmit torque from the winch motor and gears to the wire rope.



*Figure 1.2*

- **Drum Supports** - Drum supports are the structural components of the winch that mount the winch to the vehicle. The drum rotates while being held by the drum supports and both the motor and gear train are attached to a drum support.
- **Gear Train** - Warn Industrial electric planetary winches consist of a gear train made up of three planetary gear stages. The gear ratios range from 156:1 to 315:1. The purpose of the gear train is to multiply motor torque and to reduce motor speed transmitted to the drum. Warn Industrial gear trains are enclosed in a housing and are lubricated with grease.
- **Freespool Clutch** - A freespool clutch is included in the gear train to allow the user to pull the wire rope out to the point where the hook will be attached without using the winch motor. This feature is essential for speeding up the time it takes to hook up and make a pull.

- **Brake** - All planetary winches are equipped with an automatic brake. When the wire rope is reeled in, the brake is not activated. When reeling out under load, however, the brake slows the winch drum to an acceptable speed and holds the load when the winch is shut off. The brake is usually located inside the winch drum and dissipates heat through the drum and wire rope. The brake requires that the wire rope be wound onto the drum in the correct direction to operate properly.
- **Power In and Power Out** - Terms used to describe winch operation. When the wire rope is reeled in under motor power, it is being "powered in". When the wire rope is reeled out under motor power (generally under load), it is being "powered out" (this is different than when the winch is "freespooled out", which refers to the wire rope being pulled out by hand with the freespool clutch disengaged).

## 1.2.2 WINCH OPERATION

A Warn Industrial electric winch is a compact device used to pull large loads over long distances. (Refer to *Figure 1.2* when reading the following section.) The power for pulling is generated in the vehicle battery and charging system. Power is fed from the vehicle into the winch control pack. At the push of a remote control switch from the operator, the power then proceeds from the control pack into the winch motor.

The winch motor turns the electrical energy into mechanical torque. The motor shaft turns the drive coupling and hex drive shaft which in turn drives the brake. On power in operation, the brake simply rotates and drives the planetary gears, starting with the gear carrier stage furthest from the winch drum (first stage carrier). The first stage carrier in turn drives the second stage which in turn drives the third stage. The third stage is directly coupled to the drum and drives the drum. Since the wire rope is connected to the drum, it winds around the drum as the drum turns, causing the load to move.

On power out operation, the motor is reversed and the wire rope moves in the opposite direction. All the winch components operate in the same manner as when powered in, except the brake. During power out operation, the load tries to overspeed the motor (make the motor turn faster than it would under its own power). When the brake senses a difference in speed between the motor and gear train ends of the drive shaft, it engages enough to make the load and motor run at the same speed again. Since the motor continues to power out, the load once again tries to overspeed the motor. Again, the brake engages enough to control the load. This process continues repeatedly throughout the power out, but at a speed so fast that it can not be detected as a "stop-start-stop" process. When the remote control switch is released, the brake engages and completely stops the load.

The Mil-9000 and Mil-12000 winches are equipped with a patented Warn Industrial Electronic Current Limiter (ECL), a device designed to protect the winch in case of overload. The ECL monitors the electrical current input to the winch motor when "powering in" a load. If the "power in" current to the winch motor exceeds a factory preset value (its "trip" point) corresponding to the winch rated load on the first layer, the ECL will switch the winch motor off. To reset the ECL after it "trips", the winch cable must be "powered out" for at least 1 1/2 seconds. This will release the overload condition and winch operation can be resumed at a lower load.

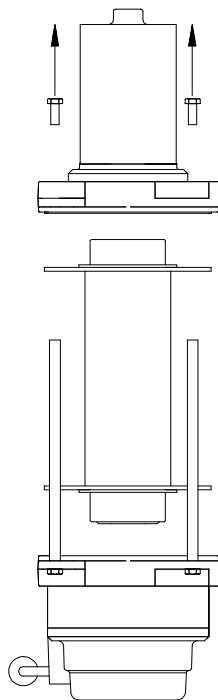
## SECTION 2 - DISASSEMBLY AND ASSEMBLY

Refer to the Replacement Parts List for your specific winch part number in the winch Operators Manual.

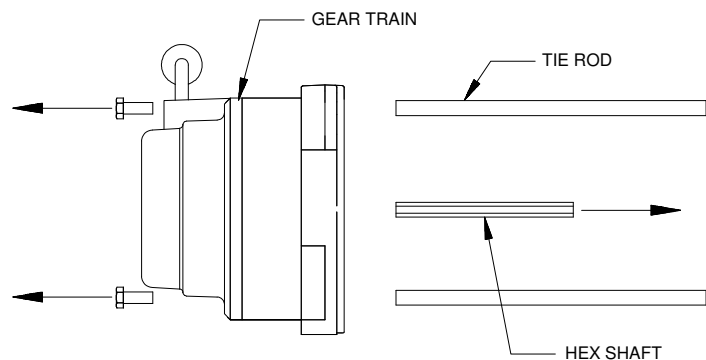
### 2.1 GEAR TRAIN REPAIR

#### 2.1.1 DISASSEMBLY

1. Disconnect winch battery cables at the vehicle battery before beginning any work on the winch. Mark cable connections for easier assembly later. Repairs to the winch are easier and safer when it is removed from the vehicle and located on a work bench. Remove two cable clamps that may connect electrical cables to your winch.
2. Stand the winch on the gear housing end (*Figure 2.1*). **NOTE:** Plastic sealing material may have to be peeled off to access parts on the motor end of the winch. Mark the three tie rod locations for easier re-assembly. Remove the motor end and drum by removing the three 3/8 inch tie rod bolts on the motor end. (If your winch is equipped with a wire rope tensioner, see Appendix 4.2 for removal and re-assembly.)

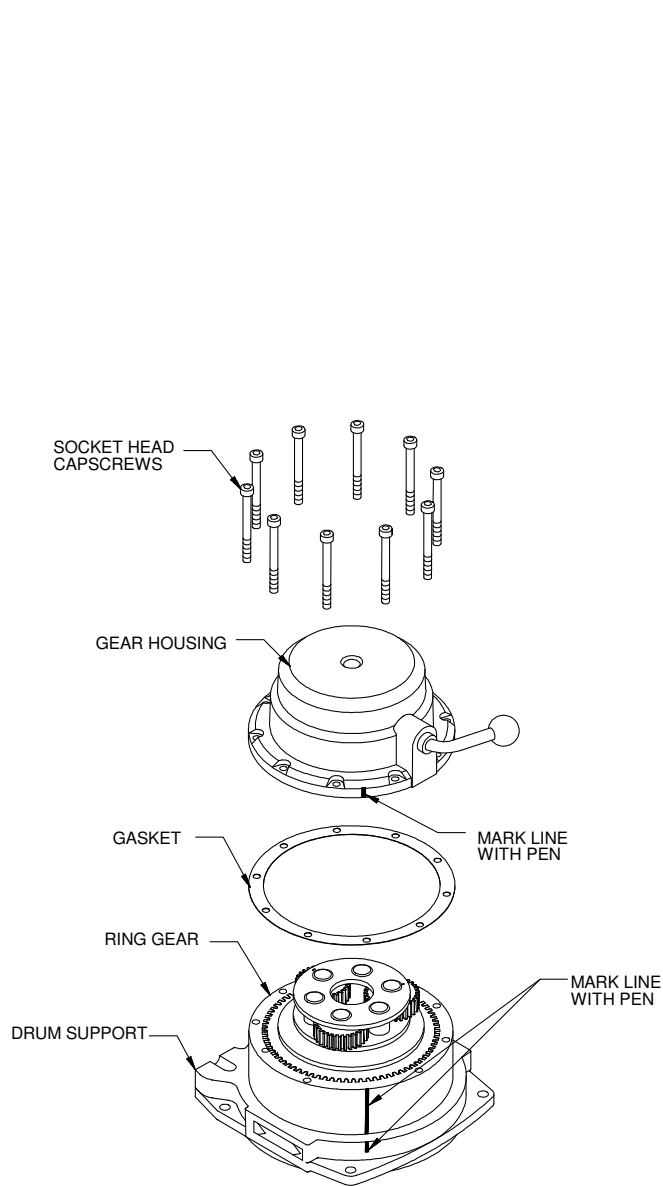


*Figure 2.1*

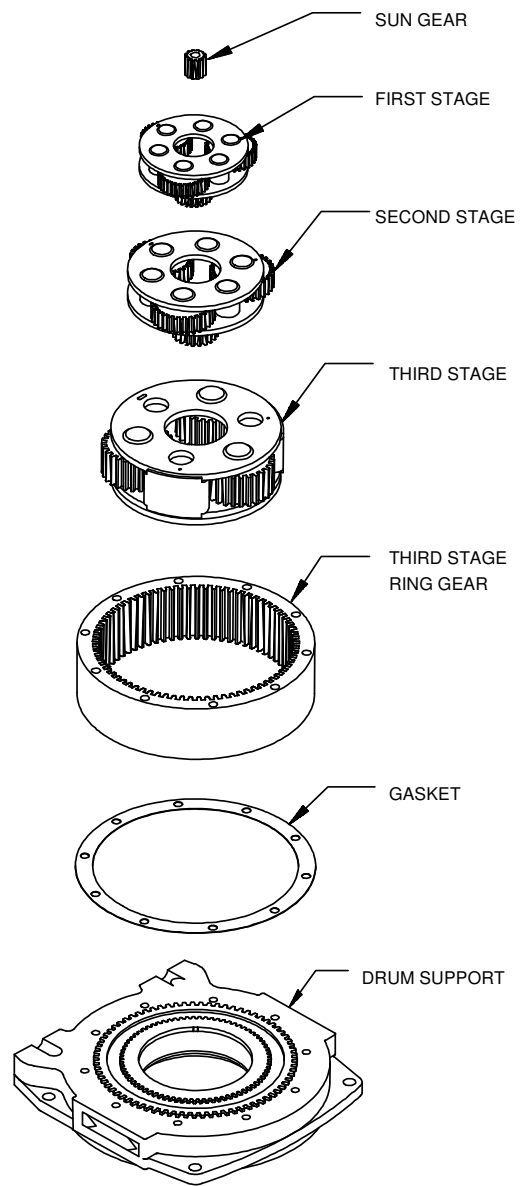


*Figure 2.2*

3. Set the gear train back down in a horizontal position and remove the other three tie rod bolts and tie rods (*Figure 2.2*). A clamp or pliers may have to be attached to the tie rods to remove the bolts. Remove the hex drive shaft.
4. Rotate the gear train so that the ten socket head cap screws are facing up (*Figure 2.3*). Remove the ten cap screws. Mark the housing ring gear and drum support with a marking pen in one location so they can be easily re-aligned during assembly. Remove the housing and ring gear.

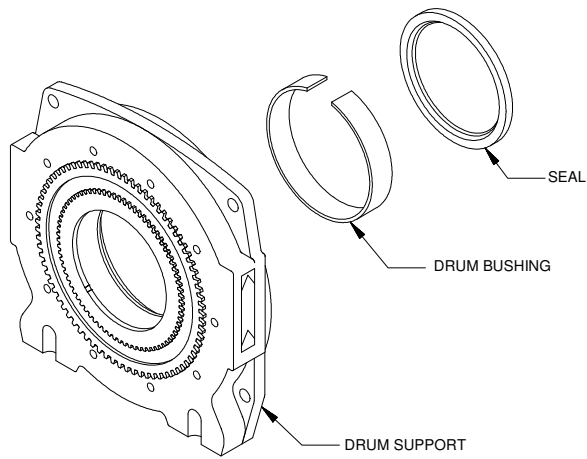


**Figure 2.3**



**Figure 2.4**

5. Remove the three stages of planetary gears from the drum support (*Figure 2.4*). Also remove the loose first stage sun gear.
6. Remove the split plastic drum bushing and carefully pry out the drum shaft seal (*Figure 2.5*).



**Figure 2.5**

### **2.1.2 ASSEMBLY**

1. Press a new seal into the drum support (*Figure 2.5*). Install the split plastic drum bushing.
2. With the drum support seal facing down, place a gasket over the ten tapped holes and then the large ring gear on top of it (*Figure 2.4*). Align the markings previously made during disassembly (*Figure 2.3*).
3. Using a grade of moly-disulfide grease with good performance between -50°F and +125°F (Aeroshell 17 is recommended), coat the inside of the ring gear teeth until all of the spaces between the teeth are filled. Install the third stage carrier, center spline down (*Figure 2.4*).
4. Completely fill the center hole in the third stage carrier, between the planet gears and up to the top of the carrier plate, with grease. Insert the second stage carrier into the third stage. Fill the second stage carrier hole with grease. Insert first stage carrier. Fill first stage center hole with grease. Insert loose sun gear into the first stage (*Figure 2.4*).
5. Fill the spaces between the teeth of the clutch ring gear with grease (*Figure 2.6*). Place a gasket on top of the large ring gear. Using a very thin screwdriver, hold clutch detent pin in place while turning gear housing over onto the gears. Line up marks previously made (*Figure 2.3*).
6. Slowly rock and rotate the gear housing until it drops down tightly on the ring gear. Install ten socket head cap screws into the gear housing flange. Torque to 100-120 in-lb.
7. Re-install the winch tie rods in the previously marked positions on the motor end and finger tighten bolts (*Figure 2.2*).

8. Install hex drive shaft into center of gear train. With the clutch lever in the engaged position, rotate the shaft several times to make sure the gears move freely (*Figure 2.2*).
9. Set drum into seal and bushing. Insert hex drive shaft and motor coupler into drum and into engagement with coupler (*Figure 2.1*).
10. Install three motor end cap screws into tie rods. Torque all six cap screws to 18-22 ft. lb. (*Figure 2.1*).
11. Re-attach any electrical cables to the winch that may have been removed during disassembly.

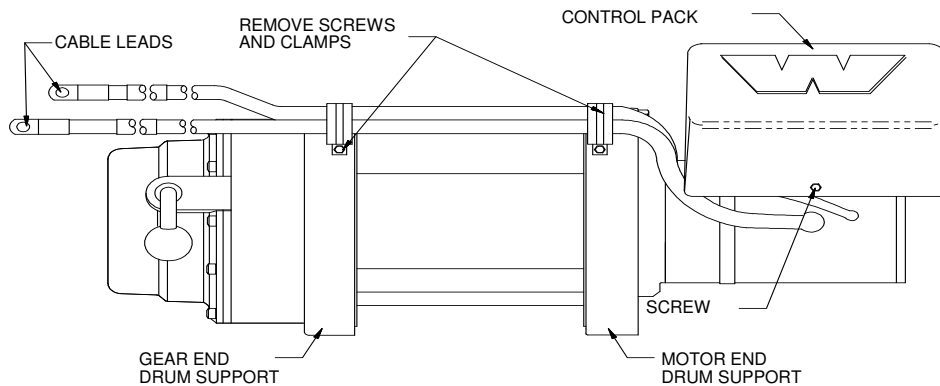
## 2.2 ELECTRIC MOTOR REPAIR

**NOTE:** MIL-9000 and 12000 winches have electric motors and control packs sealed in a plastic material during factory assembly. Repair of motors and control packs may be quite difficult due to the presence of the sealer. Removal of the sealer from electrical terminals and hardware (with a needle nose pliers or other sharp instrument) will be necessary to perform repairs or replacement of parts.

### 2.2.1 DISASSEMBLY

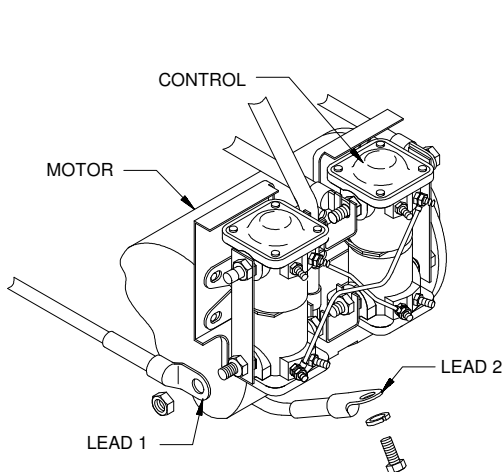
**NOTE:** Tag cable and wire leads for assembly.

1. Remove two screws, clamps and leads 1 and 2 from motor end and gear end drum supports if winch is equipped with this wire routing arrangement (*Figure 2.8*).

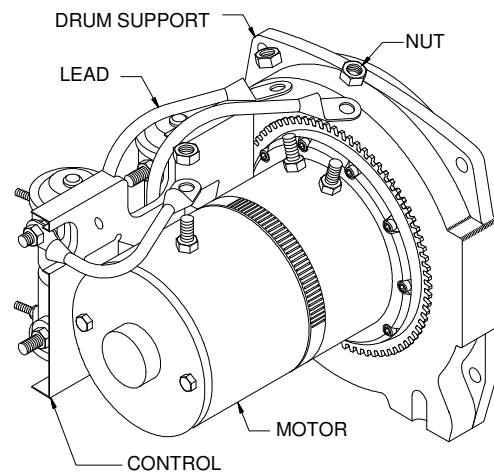


**Figure 2.8**

2. Remove three screws and plastic control cover from motor control pack.
3. Remove nut and lead 1 from control (*Figure 2.9*).
4. Remove cap screw, lockwasher and lead 2 from motor.
5. Remove three nuts and control leads from motor. Disconnect leads (*Figure 2.10*).

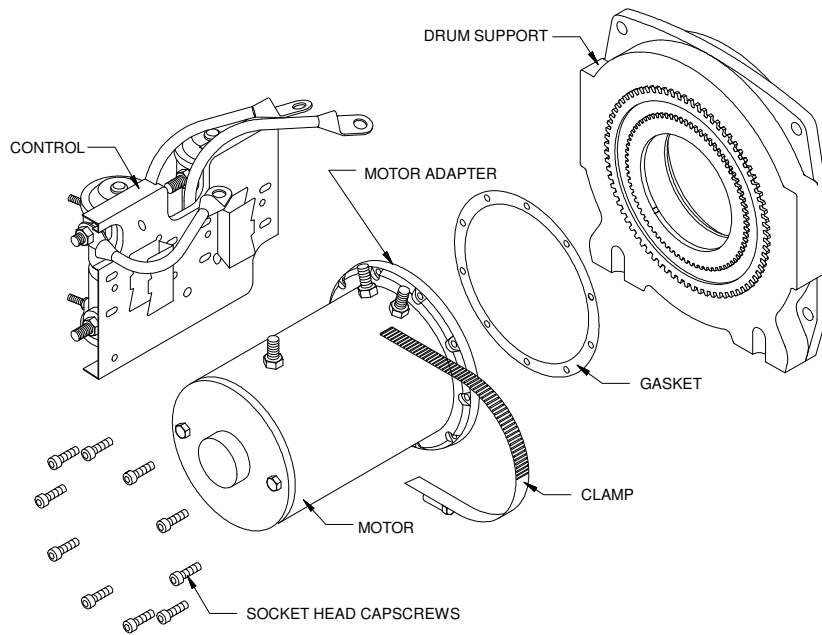


**Figure 2.9**



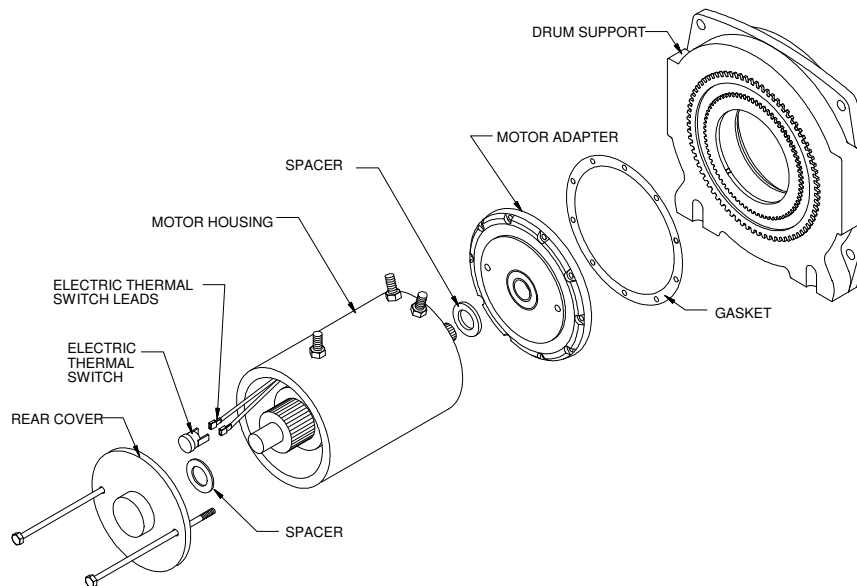
**Figure 2.10**

6. Loosen two clamps (some winches have only one clamp) and remove control from motor (*Figure 2.11*).



**Figure 2.11**

7. Remove clamps from motor. Mark the motor, motor adapter, and drum support with a marking pen in one location so they can be easily re-aligned during assembly.
8. Place winch on end with motor end up and remove ten socket head screws from motor end drum support.
9. Remove motor and gasket from drum support assembly (*Figure 2.12*).



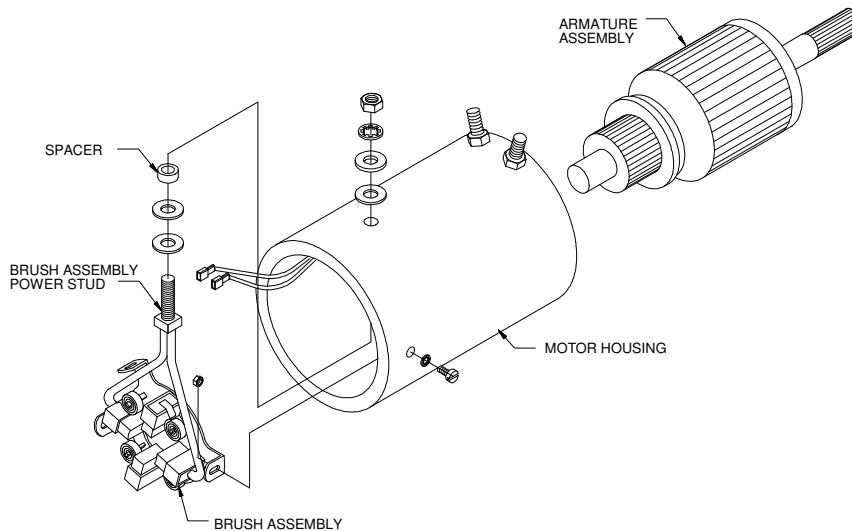
**Figure 2.12**

10. Remove two bolt assemblies, motor adapter, spacer, rear cover and spacer from motor housing.

**NOTE:** Perform Steps 12 through 15 only if replacing brush assembly.

11. Remove electric thermal switch from two electric thermal switch leads.

12. Remove armature assembly from brush assembly (*Figure 2.13*).



**Figure 2.13**

13. Remove nut, lockwasher, washer and insulator securing brush assembly power stud to motor housing.
14. Remove three nuts, screws and brush assembly from motor housing.
15. Remove spacer, insulator and washer from brush assembly power stud.

### 2.2.2 ASSEMBLY

**NOTE:** Do not apply coating to any electrical contacts of the armature assembly.

Perform Steps 1 through 4 only if replacing brush assembly.

1. Install washer, insulator and spacer on brush assembly power stud.
2. Install brush assembly in motor housing and secure with three screws and nuts (*Figure 2.13*).
3. Secure brush assembly power stud to motor housing with insulator, washer, lockwasher and nut.
4. Coat inside diameter of the bushing in the rear cover. Install armature into brush assembly. Pull brushes back first with screwdriver or other pointed tool.
5. Connect thermal switch to two electric thermal switch leads (*Figure 2.12*). **IMPORTANT:** Always check for a short circuit after replacing the thermal switch. Touch one multimeter probe to a thermal switch terminal and the other probe to the motor case. Use the OHM setting on the meter. If there is a reading on the meter, then there is a short circuit. Check the connections, making sure that bare connections are not touching the motor housing. Insulate these connections with a small amount of silicone RTV or other insulating material. Re-check with the meter. If there is no reading, the circuit is OK.

6. Position spacer on inside of motor adapter and rear cover; and install motor adapter and rear cover on motor housing and secure with two bolt assemblies.
7. Install gasket on motor drum support assembly.
8. Install motor on drum support assembly making sure motor shaft is engaged into motor shaft coupling. Be careful armature doesn't fall out of brushes when tipping motor over or brushes may be damaged.
9. Secure motor to motor end drum support with ten hex socket head screws. Tighten socket head screws to 30-40 lb.-in. (*Figure 2.11*).

**NOTE:** If motor or control have been precoated with sealing compound, remove compound from between motor and control mounting spline contact area. Failure to do so may cause improper grounding or control.

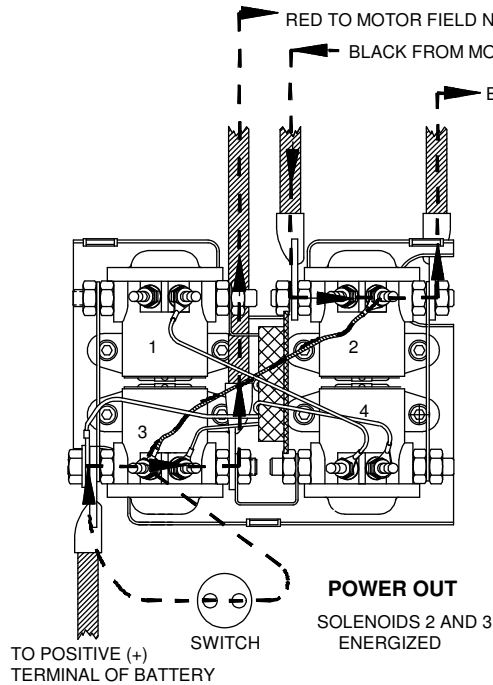
10. Install two clamps on motor (*Figure 2.11*).
11. Install control on motor.
12. Connect leads to terminals and secure with three nuts (*Figure 2.10*).
13. Secure control to motor with two clamps.

**NOTE:** Lead 1 must be positioned to align with opening in cover.

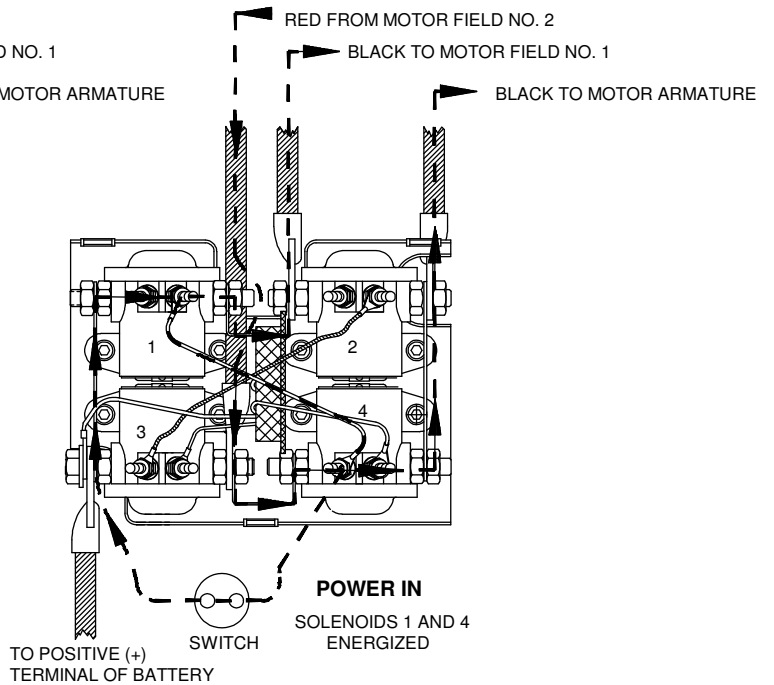
14. Connect lead 2 to motor and secure with lockwasher and cap screw (*Figure 2.9*).
15. Connect lead 1 to control and secure with nut.
16. Coat motor end of winch up to motor end drum support with plastic sealing compound (*Figure 2.8*). **NOTE:** Coating is generally applied by hand with a brush for service. Contact Warn Industrial for coating specifications.
17. Install motor control cover on control and secure with three screws.
18. Secure lead 1 and 2 to drum supports with two clamps and screws if winch is equipped with this arrangement (*Figure 2.8*).



In the power-in mode (*Figure 2.16*), solenoids number 1 and 4 are energized. Current again flows from the battery positive cable, but this time current flows through solenoid number 1 then through the ECL to the black motor cable to field winding number 1. Current then flows through field winding number 2 to the red motor cable to the control assembly. Current flowing in the reverse direction through the field windings cause the motor to turn in the opposite direction. From the red motor cable current then flows through solenoid number 4 to the black cable going to the motor armature to ground.



*Figure 2.15*



*Figure 2.16*

### 2.3.2 DETERMINING THE DEFECTIVE ELECTRICAL COMPONENT

Refer to drawing 982624 for illustration and schematic.

**! CAUTION !**

**DISCONNECT THE CABLE AT THE POSITIVE (+) BATTERY TERMINAL BEFORE ATTEMPTING ANY TROUBLESHOOTING OR REPAIRS.**

#### A) POWER SUPPLY

Check for tight fit of all connections and use a volt meter to verify  $24 \pm 2$  VDC at the bus bar connecting solenoids #1 and #3. See referenced figure. Connect meter leads as follows: black to ground(-) and red to hot bus bar. The black insulating coating put on some winches can sometimes contaminate electrical terminations and may need to be scraped off of contact surfaces.

POWER SUPPLY:  $24 \pm 2$  VDC,  
CURRENT AVAILABLE: 100 AMPS MINIMUM FOR TEST  
200 AMPS MINIMUM FOR OPERATION

#### B) GROUNDING

Solenoid mounting plate should be grounded to the motor by means of a band clamp. New winches also have a ground wire connecting the mounting plate with the motor ground bolt(-). Use an ohm meter to measure resistance between mounting plate and motor case; resistance should be less than  $1\Omega$ .

#### C) ECL

The ECL (electronic current limiter) can be tripped when first powered 'on' so always reset by powering out the wire rope for 2 seconds to reset the limiter. If the winch will power-out but will not power-in, the ECL may be defective. First, check that the red wire coming from the 24 VDC charged bus bar is connected properly and that the mounting L-bracket of the ECL circuit board is cleanly grounded to the solenoid plate. If still no power-in, by-pass the ECL as follows: cut the wire coming from the thermal switch to the ECL near the splice on the ECL side. Take the cut wire coming from the thermal switch and connect it to solenoid #4 on the same terminal that the green ECL wire is attached. The winch should operate in both directions. If not, continue with more trouble shooting steps.

#### D) THERMAL SWITCH

The motor will not run if the thermal switch is open or if its terminals are in contact with the motor case. The switch should normally open when the temperature at the motor brushes reaches  $400+^{\circ}\text{F}$ . To check a faulting or shorting switch, use an ohm meter and measure the resistance of the thermal switch between the wire cut in the previous step and the socket pin (#472) of the plug, which is connected to the green wire. If the butt splice and switch are good, the resistance should be less than  $1\Omega$  across the switch. If the switch is open at room temperature then it should be replaced. Next check the resistance between the cut wire and the bare motor case. This resistance should be greater than 1 megaohm. If not, the switch may be installed incorrectly and be shorting to the motor case.

#### E) SOLENOIDS

To check for bad solenoids, disconnect the three cables connected to the motor on studs marked F1, F2, and A. Also disconnect the red(+) battery cable to keep the motor cables from shorting during this test. Measure resistance across large studs of solenoid #1 and see if the solenoid closes, i.e. resistance drops, when 24 vdc is supplied to the small terminal of solenoid #1 that has the wire lead attached. Apply voltage to the same small stud and check the resistance change across #4 solenoid. Similarly, measure resistance across large studs of solenoid #2 while applying 24 vdc to the small terminal of solenoid #2 that has the wire lead attached. Measure the resistance change across the #3 studs when applying 24vdc to same #2, small stud. If the resistance across the solenoid does not go from open to closed (megaohms to tenths) then the solenoid is bad.

#### D) MOTOR

If the motor is suspected to be failing check these: While the motor is disconnected from the control pack, measure the resistance between F1 and F2 and between A and ground. Resistance should be less than  $1\Omega$ . The motor brushes could be worn and should be replaced, or the internal wiring could be burned and the motor should be replaced.

## 2.4 BRAKE REPAIR

**NOTE: Warn Industrial does not offer replacement brake parts. The complete brake assembly must be replaced. There were two distinct models of brakes installed in Mil-9000 and 12000 winches at different times. Refer to the winch to determine the type used.**

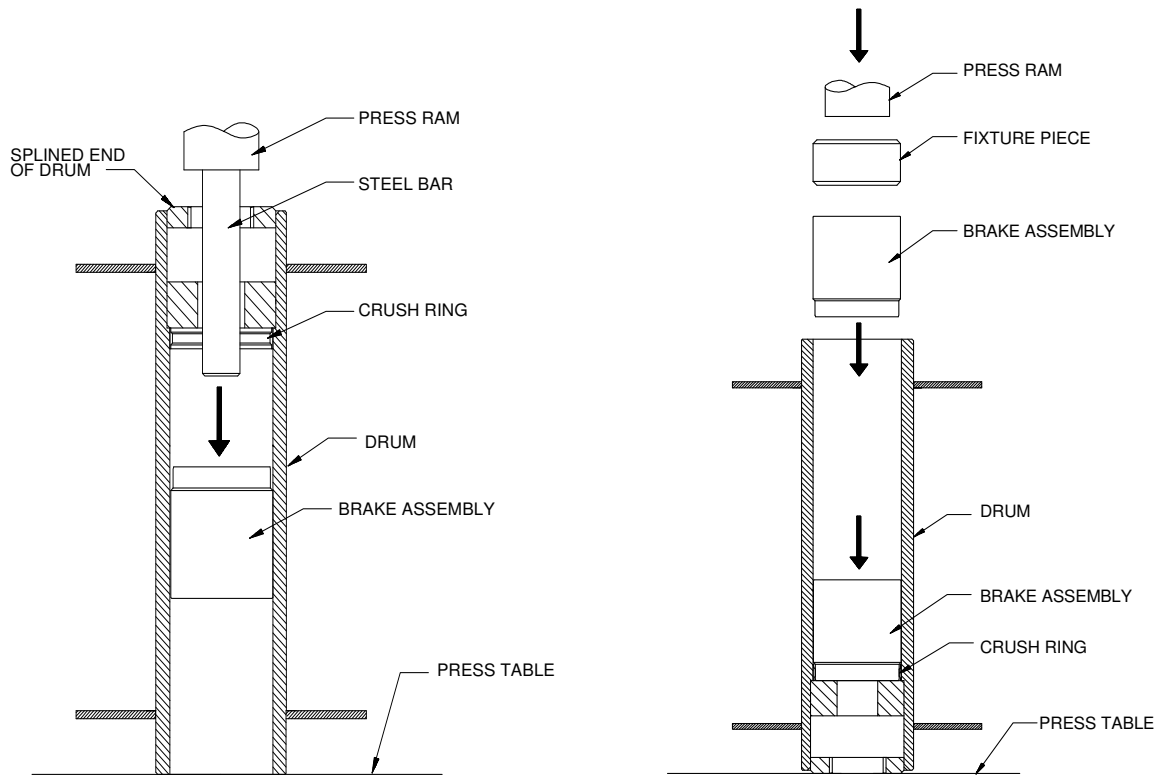
### 2.4.1 DISASSEMBLY

1. Remove the drum from the winch as in the Gear Train Disassembly, Section 2.1.1.
2.
  - a) If the winch has a hex drive shaft on the motor end: Place the drum in a 2-3 ton press. Insert a 6 - 8 inch long piece of steel bar into the splined end. Press on the bar with the press until the brake assembly drops to the bottom of the drum. Remove brake and crush ring from drum (crush ring may be up against the splined drum end)
  - b) If the winch has no input hex shaft on the motor end:
    - i. Remove all the wire rope from the drum and remove the drum from the winch as described in *Gear Train Disassembly*, Section 2.1.1.
    - ii. Set drum on solid working surface (table, bench, etc).
    - iii. Remove spacer and brake driver (*Figure 2.19*).
    - iv. Loosen, but do not remove, the socket head setscrew from the center of the drum just enough so brake assembly will slide out of the motor end of the drum (*Figure 2.19*). If assembly refuses to slide, it may be necessary to insert a hex key in the shaft and tap it until assembly is dislodged.

**NOTE:** Ball bearing supporting gear train end of brake assembly should be checked and replaced if necessary. (*Figure 2.19*).

### 2.4.2 ASSEMBLY:

- a) If the winch has a hex drive shaft on the motor end:
  1. Slide the crush ring into the drum all the way down until it stops against the splined end wire rope retainer (*Figure 2.18*).



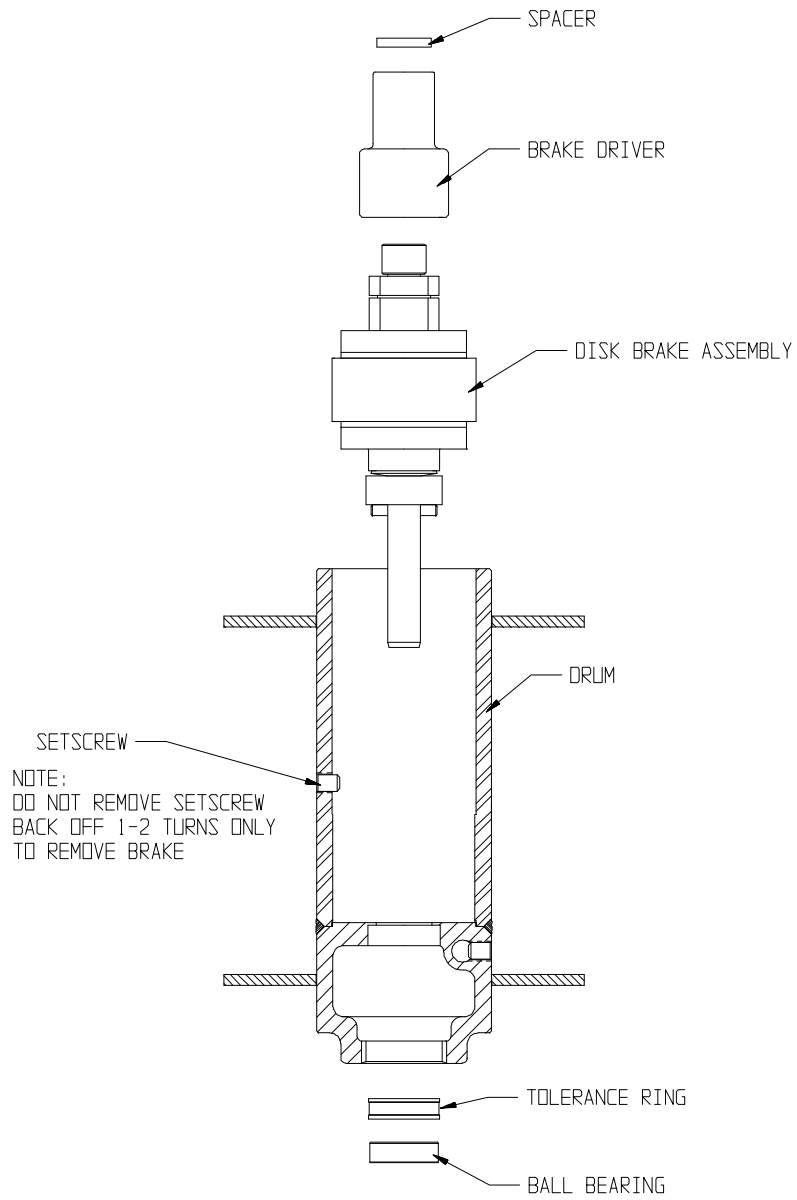
**Figure 2.17**

**Figure 2.18**

2. Using a 2-3 ton press and the fixture piece provided, press the brake into the crush ring until it stops against the wire rope retainer in the drum. **NOTE:** The fixture piece must be used and must be over the crush ring completely (*Figure 2.18*).
3. Reassemble hex drive shafts and winch as in section 2.1.
  - b) If the winch has no input hex shaft on the motor end:
    - i. Slide the new brake assembly into the drum.
 

**IMPORTANT:** The brake assembly must be completely seated in the drum. the distance from the end of the drum to the end of the assembly (inside the drum) must be no less than 1-9/16”.
    - ii. Tighten the socket head set screw in the center of the drum. Torque to 120-130 in.-lbs.
    - iii. Install the drum assembly into the gear train end of the winch insuring that the hex drive shaft (extending from the gear train) aligns with the brake hex on the brake assembly.
    - iv. Install the brake driver and spacer on the other end of the opposite end of the brake assembly.
    - v. Install the motor and drum support assembly aligning the motor shaft to the brake driver.
    - vi. Reinstall drum into winch and reattach wire rope.

**IMPORTANT: All brakes used in the Mil-9000 and 12000 electric winches operate in one direction ONLY. The wire rope MUST be installed in the proper direction to insure proper brake operation.**



**Figure 2.19**

## SECTION 3 - TROUBLESHOOTING GUIDE

### PROBLEM 3.1.1: Winch does not hold the load.

#### POSSIBLE CAUSE:

- A) Brake inside winch drum is badly worn or broken.
- B) Load exceeds rating for winch.
- C) The wire rope is on the drum backwards.

#### CORRECTIVE ACTION:

- A) Replace the brake. **NOTE:** Warn Industrial **does not** offer replacement brake parts. The complete assembly must be replaced. Refer to the appropriate chapter in this manual for winch brake replacement. Refer to the winch Operators Manual for proper operating instructions for the winch brake.

**! WARNING !**

**REPLACEMENT OR SERVICE OF THE BRAKE ASSEMBLY MUST BE DONE PROPERLY OR MALFUNCTION OF THE BRAKE MAY RESULT IN SERIOUS INJURY OR PROPERTY DAMAGE. IF YOU HAVE ANY QUESTIONS, PLEASE REFER TO THE BRAKE REPLACEMENT CHAPTER IN THIS MANUAL OR CALL THE FACTORY FOR ASSISTANCE.**

- B) Refer to the operators manual for the correct line pull rating for your winch. **DO NOT EXCEED THE LINE PULL RATING SHOWN ON THE IDENTIFICATION LABEL.**
- C) Remove all the wire rope and respool in the proper direction (see directional label on drum support).

### PROBLEM 3.1.2: Brake overheats and will not hold the load.

#### POSSIBLE CAUSE:

- A) The wire rope is spooled onto the drum in the wrong direction. Therefore the winch is working against the brake in the "power in" mode.
- B) Load exceeds rating for winch.
- C) After a very long "power out" cycle, in excess of 50 feet under high loads, the brake has overheated and needs a cool down cycle of approximately 30 minutes.

### **CORRECTIVE ACTION:**

- A) The wire rope must always spool onto the drum as indicated by the drum rotation label on the winch. Winches are equipped with an automatic brake and **WILL NOT FUNCTION** if the wire rope spools in the opposite direction. The wire rope spooling can accidentally be reversed by running the wire rope all the way out and re-spooling in with the control switch in the "power out" mode.
- B) Refer to the operators manual for the correct line pull rating for your winch. **DO NOT EXCEED THE LINE PULL RATING SHOWN ON THE IDENTIFICATION LABEL.**
- C) These winches are rated for intermittent duty operation only. As the load is increased, the duration of power out cycles must be reduced to limit the brake temperature. Allow adequate time for the brake to cool between uses when performing extended power out cycles.

### **PROBLEM 3.1.3: It is difficult to spool the wire rope off the drum by hand.**

#### **POSSIBLE CAUSE:**

- A) Bent drum flanges.
- B) Drum bushings are worn.
- C) Free spool clutch is damaged inside the gear train.
- D) Wire rope is bound up on the drum.
- E) Winch is not mounted correctly, causing the drum to bind.

#### **CORRECTIVE ACTION:**

- A) Rotate the drum while it is still on the winch to see if the drum flanges appear to be bent. If flanges appear to be bent, the drum will have to be removed and repaired. Refer to the Section 2.1.1 of this manual for drum removal. To prevent the drum flanges from being bent, read the Operators Manual for proper operating instructions.
- B) Remove the drum from the winch. Inspect the drum bushings and drum supports for wear. Replace if necessary. Refer to Section 2.1.1 of this manual for drum removal and inspection.
- C) Remove and inspect clutch ring gear, clutch lever, and gear housing for burrs and rub marks. Remove burrs with a file or grinding wheel or replace parts if necessary. Refer to Section 2.1.1 of this manual for gear train disassembly.
- D) Should the wire rope become bound onto the drum, connect the hook to a load, then by alternately "powering in" then "powering out", the wire rope will usually work itself free.

In any event, DO NOT PUT YOUR HANDS ANYWHERE NEAR THE WIRE ROPE WHEN WORKING A BIND FREE. Refer to the Operators Manual for proper operating instructions. **NOTE:** A roller fairlead and/or wire rope tensioner will usually help prevent the wire rope from being bound onto the drum.

- E) Correctly mount the winch. Follow the mounting specifications as described in the Operators Manual. Use shims if necessary to mount winch correctly.

## **! CAUTION !**

**DISCONNECT THE CABLE AT THE POSITIVE (+) BATTERY TERMINAL BEFORE ATTEMPTING ANY TROUBLESHOOTING OR REPAIRS.**

### **PROBLEM 3.1.4: Winch lacks power or will not run at all.**

#### **POSSIBLE CAUSE:**

- A) The ground cable is not attached directly to the motor housing.
- B) The vehicle battery is inadequate in size, terminals are corroded, is defective or worn out, or is not fully charged.
- C) Loose cable connections on battery or motor terminals.
- D) The solenoid mounting plate is not attached to the winch motor or the winch mounting plate, and therefore is not electrically grounded, or is improperly grounded.
- E) There is a short circuit in the power supply to the winch.
- F) The remote control switch or cord is damaged or defective.

#### **CORRECTIVE ACTION:**

- A) Attach the ground cable to the threaded hole in the motor housing, not to a terminal.
- B) Use a fully charged conventional automotive battery with a minimum of 650 cold cranking amps rating to obtain peak performance from your winch. Make sure terminals are clean and the battery is fully charged. Replace battery if necessary.
- C) Be sure all connections are clean and tight.
- D) Attach the solenoid mounting plate to the winch motor, the winch motor plate, or any other location grounded to the same electrical source as the winch.
- E) Check all battery and motor cable leads for loose connections, worn or cracked insulation, frays or any bare spots. Replace cable if necessary.

- F) Check the remote control switch for continuity. Using a multimeter on the OHMS setting, touch the test probes between two of the three terminals on the remote plug while holding down the remote control switch. At least two of the terminals should show a zero meter reading. Repeat for the other switch direction. If there is a reading much above zero, the switch may have a short circuit or broken wire and should be replaced.

**PROBLEM 3.1.5: When the remote control switch is activated, there is only a "clicking" sound, and the winch does not operate in either "power in" or "power out" modes.**

**POSSIBLE CAUSE:**

- A) The battery is not fully charged, terminals are corroded, battery is defective or worn out.
- B) The electrical grounding wire is not attached to the motor housing.
- C) The motor armature is damaged or shorted, possibly from incorrect wiring of the control pack to the motor or overheating of the motor.
- D) Water in the motor, caused by submersion or improper installation of the motor, or the motor vent fitting was not hooked up, causing an electrical short.
- E) Worn or damaged brushes, caused by a damaged armature commutator or normal wear.

**CORRECTIVE ACTION:**

- A) Recharge the battery. If the battery will not take a full charge, replace it or check the charging source. Clean the battery terminals and wire terminals.
- B) Attach the electrical ground wire to the motor housing.
- C) Replace the motor armature. See Section 2.2.
- D) Replace the motor. See Section 2.2.
- E) Replace the motor brushes. See Section 2.2.

**PROBLEM 3.1.6: Winch does not have the same pulling power as when it was new. See CAUSES and CORRECTIVE ACTION for PROBLEM 3.1.5.**

**PROBLEM 3.1.7: Winch runs slowly and lacks power when pulling a load, won't pull load, or stalls easily.**

**POSSIBLE CAUSE:**

- A) See CAUSES for PROBLEM 3.1.5.
- B) Check the wire rope. If it is spooling onto the drum in the wrong direction, it will be working against the automatic brake.
- C) Winch is mounted incorrectly, causing the gear train to bind.

**CORRECTIVE ACTION:**

- A) See CORRECTIVE ACTION for PROBLEM 3.1.5.
- B) Remove all the wire rope and respool onto the drum in the proper direction. **NOTE:** Be sure to follow the drum rotation decal.
- C) Be sure mounting surface is flat within  $\pm .020$  inch. Use shim stock if necessary. Be sure all mounting bolts are tight.

**PROBLEM 3.1.8: Electrical sparks appear around the motor adapter or screw heads.**

**POSSIBLE CAUSE:**

- A) See CAUSES for PROBLEMS 3.1.4 and 3.1.5.
- B) Electrical ground is not sufficient. Ground wire was not installed, or the battery ground wires and wire terminals are corroded.

**CORRECTIVE ACTION:**

- A) See CORRECTIVE ACTION for PROBLEMS 3.1.4 and 3.1.5.
- B) Install a ground wire to the motor housing, and attach to the negative terminal of the battery.

**PROBLEM 3.1.9: When the remote control is activated, the winch will operate only in one direction.**

**POSSIBLE CAUSE:**

- A) One of the solenoids in the control pack is sticking or is damaged from prolonged use.
- B) Remote control switch is damaged.
- C) If winch only operates in power in direction, ECL or thermal switch may have tripped.

**CORRECTIVE ACTION:**

- A) Replace the control pack. Plastic sealing material may make it very difficult to replace parts.
- B) Check the remote control switch and cable, replace if necessary (See CORRECTIVE ACTION for PROBLEM 3.1.4). Check all connections inside the control pack. Make sure they are clean and tight.
- C) Power out winch for at least 1 1/2 seconds. If ECL was tripped, winch should now operate in power in mode. If winch still doesn't power in, the thermal switch may have tripped. Let motor cool for at least 30 minutes, then try to power in again.

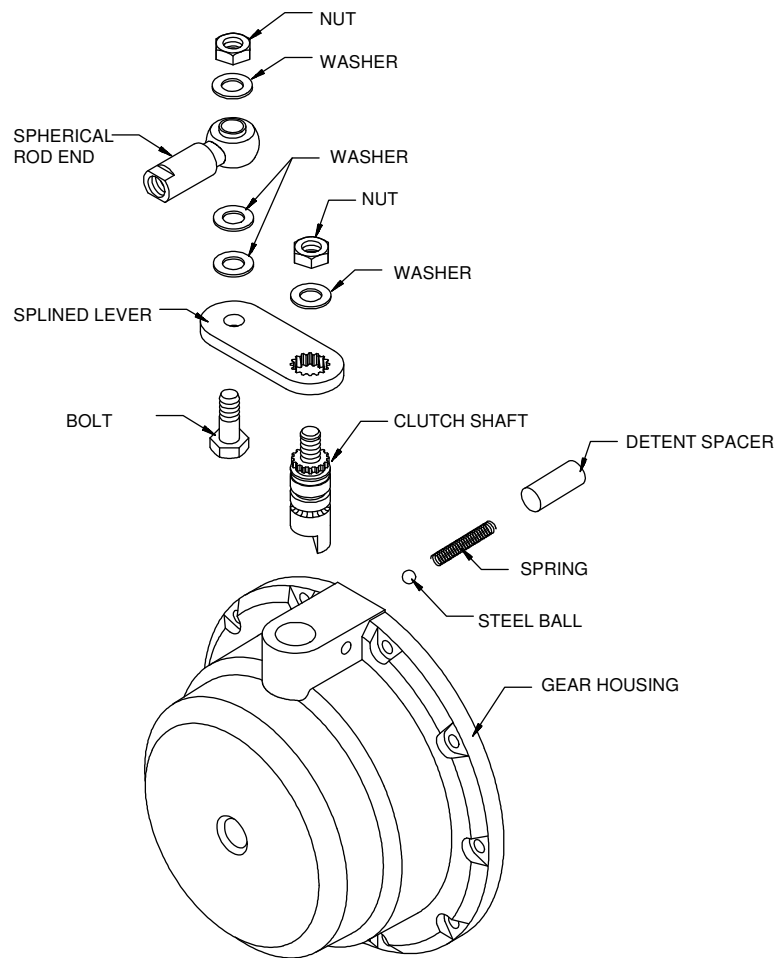
# SECTION 4 - APPENDIX: OPTIONAL EQUIPMENT

## 4.1 MECHANICAL REMOTE CLUTCH

If your winch is equipped with a mechanical remote clutch, use this section instead of the standard clutch lever disassembly instructions found in Section 2.1.1.

### 4.1.1 DISASSEMBLY

1. Mark the position of the splined clutch lever on the winch so it can be easily re-aligned during assembly.
2. Remove the spherical rod end and splined clutch lever from the clutch shaft (*Figure 4.1*).
3. Follow steps 1-7 of Section 2.1.1.
4. Remove the detent spacer, spring and ball from a hole in the flange of the gear housing. Pull the clutch lever out of the housing.



*Figure 4.1*

#### 4.1.2 ASSEMBLY

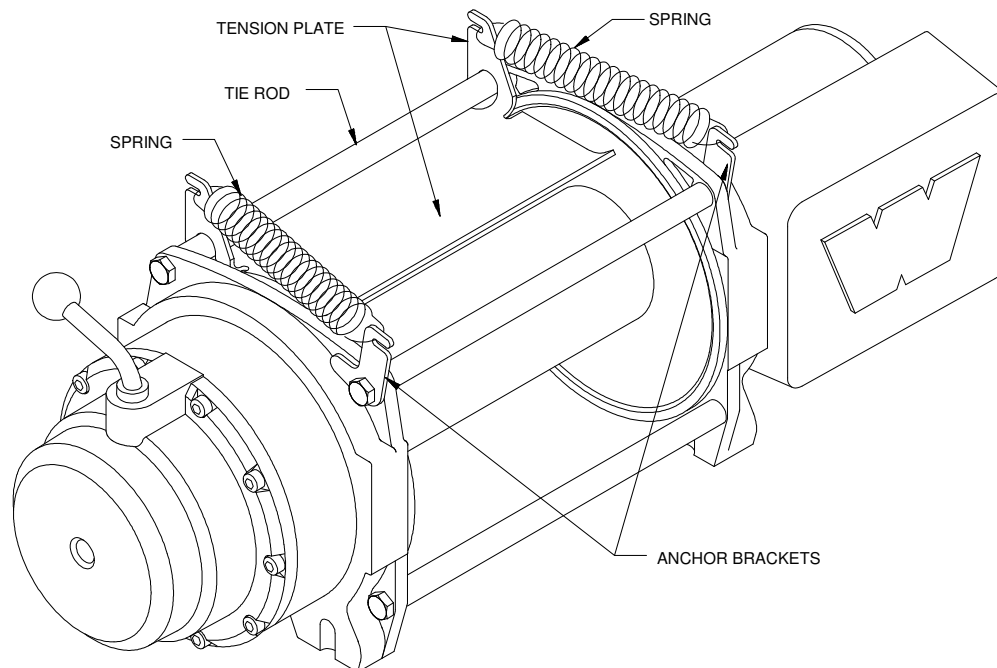
1. Re-install the clutch shaft in housing in exactly the same position it was removed. Apply a light coating of oil or grease to hole where the clutch shaft is installed (*Figure 4.1*).
2. Re-install the detent spacer, spring and ball in housing.
3. Follow step 3 of Section 2.1.2.
4. Re-install the splined lever to the clutch shaft. Be sure to line up the marks made during disassembly.
5. Rotate the clutch ring gear by hand and check engaged and disengaged positions of the splined lever. The lever should rotate 135° from engaged to disengaged positions. If it rotates less than 135°, the shaft is incorrectly installed. Pull back the ball, spring and detent spacer and rotate the clutch shaft 180°. Re-align the splined lever and re-install ball, spring and detent spacer. Recheck for 135° rotation.
6. Continue with steps 4-14 of Section 2.1.2.

## 4.2 WIRE ROPE TENSIONER

If your winch is equipped with a wire rope tensioner, use this section for removal and installation.

### 4.2.1 DISASSEMBLY

1. Mark the tie rod on which the tension plate pivots and the tie rod the spring anchors are attached to. This will aid re-assembly (*Figure 4.2*).
2. Unhook the springs from the tensioner. Use of a locking pliers with smooth jaws may be required to remove springs.
3. Follow step 2 of Section 2.1.1. Then, remove the tension plate.
4. Remove spring anchors from the other tie rod.



*Figure 4.2*

### 4.2.2 ASSEMBLY

1. Re-install the spring anchors on previously marked tie rod. **NOTE:** Anchors must be on the outboard side of the drum support or tensioner will not function properly (*Figure 4.2*).
2. Re-install tension plate on tie rod previously marked.
3. Re-assemble winch. Torque tie rod bolts to 18-22 lb-ft.
4. Re-install springs after attaching wire rope to the drum. Use of a locking pliers with smooth jaws may be required to re-install springs.