OPERATION, PREVENTIVE MAINTENANCE, TROUBLESHOOTING AND SERVICE GUIDE

MODELS 488L and 488-6

THIS GUIDE CONTAINS IMPORTANT OPERATION AND SAFETY INFORMATION AND SHOULD BE KEPT AVAILABLE TO THOSE PERSONNEL INSTALLING AND OPERATING THIS EQUIPMENT.

P/N A6474X210
Revision 3, June / 02

SAFETY PRECAUTIONS AND GUIDELINES

OVERVIEW

Before you operate, maintain or in any other way, use this unit -

READ and STUDY this guide. KNOW how to safely use the unit's controls and what you must do for safe maintenance.

ALWAYS wear or use the proper safety items required for your personal protection.

If you have ANY QUESTIONS about the safe use or maintenance of this unit:
ASK YOUR SUPERVISOR - NEVER GUESS - ALWAYS CHECK

PRE-START INSPECTION

Read this entire guide BEFORE attempting to operate this unit. You should be familiar with the controls and their functions before the unit is energized.

INSPECT your machine by doing a pre-operational inspection. Have any malfunctioning, broken or missing parts corrected or replaced before use.

VERIFY that all maintenance has been performed.

VERIFY that all the instruction and safety labels are in place and readable. These are as important as any other equipment on the machine.

CLEAN any foreign material from the operator's compartment.

THIS Model 488 Series UN-A-TRAC® was shipped from the factory equipped with a protective canopy. This canopy MUST be securely in place before operating the unit.

STARTING

DO NOT operate any levers or pedals from outside the operator's compartment to keep the machine from hitting you or other personnel.

FOLLOW the instructions in the STARTING PROCEDURES section of this guide (page 23).

DO NOT operate any levers or pedals if anyone is in the Hazard Zone (page 21).

BE familiar with the operation of the tape switches and be prepared for the sudden stop when the tape switches are struck.

OPERATING

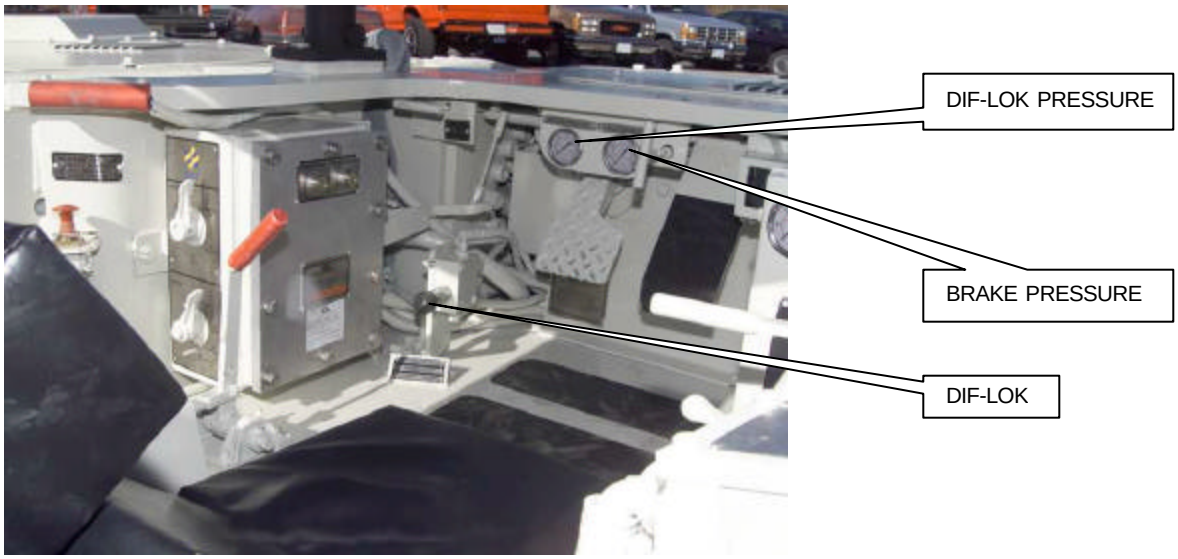
ALWAYS make sure that no person or obstruction is in your line of travel BEFORE starting the unit into motion or in the articulation area when steering the unit.

NEVER climb onto, or climb out of the machine while it is in motion.

DO NOT operate the machine with any part of your body outside of the operator's compartment in order to prevent body parts from being crushed between the machine and objects outside.

USE extreme caution and be observant when working in close quarters or in congested or blind-travel areas. The warning gong should be sounded to alert personnel of your movement.

FIGURE 10 – GAUGE PANEL AND DIF-LOK (OPTIONAL)



DIF-LOK (OPTIONAL)

The operator controlled “DIF-LOK” actuator (Figure 10) is located to the operator’s left and on the floor. When actuated, pushed in, the differential locks are engaged in both the front and rear axles. To release the differential lock, pull out on the push button.

GENERAL HYDRAULIC CONTROL SYSTEM INFORMATION

In the operator's compartment located to the right of the operator’s seat is a group of control levers and gauges (Figure 11). These levers control the steering, bucket position, ejector blade position, winch operation and battery changer system by means of a hydraulic valve bank located behind the panel to the operator's right. The gauges include emergency brake, accumulator, and system pressure. The hydraulic system pressure relief valve is set at the factory at 2000 psi (138 bar), and should not be changed. Should the "SYSTEM PRESSURE" gauge (Figure 11) read more than 2250 psi (155 bar), SHUTDOWN the Model 488-6 and call a maintenance person (see page 29 for Shutdown Procedure).

HYDRAULIC CONTROL PANEL GAUGES	
GAUGE	**PRESSURE READING**
Emergency Brake	1500 – 1800 psi (103 –124 bar)
Accumulator	1500 – 1875 psi (103 – 129 bar)
System Pressure	2250 psi (155 bar)

WARNING

SHOULD EITHER GAUGE SHOW ABOVE OR BELOW THE PRESSURES LISTED ABOVE, SHUTDOWN THE UN-A-TRAC® AND CALL A MAINTENANCE PERSON (SEE PAGE 29 FOR SHUTDOWN PROCEDURE).

TOWING A DISABLED MACHINE

IT IS NOT POSSIBLE, WITHIN THE SCOPE OF THIS GUIDE, TO ANTICIPATE ALL POSSIBLE ARRANGEMENTS FOR TOWING A DISABLED UNIT. BEFORE ATTEMPTING TO TOW ANY VEHICLE, YOU MUST TAKE ALL POSSIBLE PRECAUTIONS TO PROTECT THE OPERATORS AND ANY ONE AROUND BOTH VEHICLES FROM BEING INJURED BY EITHER THE TOWING VEHICLE, THE TOWING DEVICES OR THE VEHICLE BEING TOWED. THE PRIMARY TOWING DEVICE USED (CABLES, BARS, ETC.) AND THE TOWING VEHICLE (SCOOP, TRACTOR, ETC.) MUST BE STRONG AND HEAVY ENOUGH TO MAINTAIN CONTROL OF BOTH VEHICLES THROUGH ALL BOTTOM CONDITIONS TO BE ENCOUNTERED AT ALL TIMES. SAFETY CHAINS OR OTHER SAFETY DEVICES MUST BE USED IN CASE OF FAILURE OF THE PRIMARY TOWING DEVICE. ALL OPERATORS MUST BE ALERT AT ALL TIMES TO PREVENT EITHER UNIT FROM "RUNNING AWAY" OR RUNNING OUT OF CONTROL DURING TOWING. THE VEHICLE TO BE TOWED MUST BE SECURELY COUPLED TO THE TOWING VEHICLE BEFORE THE BRAKES ARE RELEASED ON THE DISABLED UNIT. THE OPERATOR OF THE TOWING VEHICLE MUST BE IN PLACE IN THE TOWING VEHICLE WITH THE BRAKES APPLIED BEFORE THE BRAKES OF THE DISABLED VEHICLE ARE RELEASED.

1. Couple the towing vehicle securely to the disabled vehicle.

2. Close the valve to tank circuit that is on the hand pump. This isolates the park brake solenoid from the circuit.

3. Begin pumping the hand pump. The building pressure moves the shuttle valve and allows the Automatic (Park) Brake system to be pressurized.

4. The Automatic (Park) Brake is "released" as indicated by the Brake Release gauge.

AT NO TIME DURING TOWING SHOULD ANYONE RIDE IN OR ON THE VEHICLE BEING TOWED OR STAND IN BETWEEN THE TOWING VEHICLE AND THE DISABLED VEHICLE.

5. Begin towing the vehicle.

6. Once the destination is reached, stop both vehicles and set the parking brake on the disabled vehicle before removing the towing devices. The disabled vehicle should be choked in both directions at all four wheels for additional stability. The brake is "set' by opening the valve on the hand-pump.

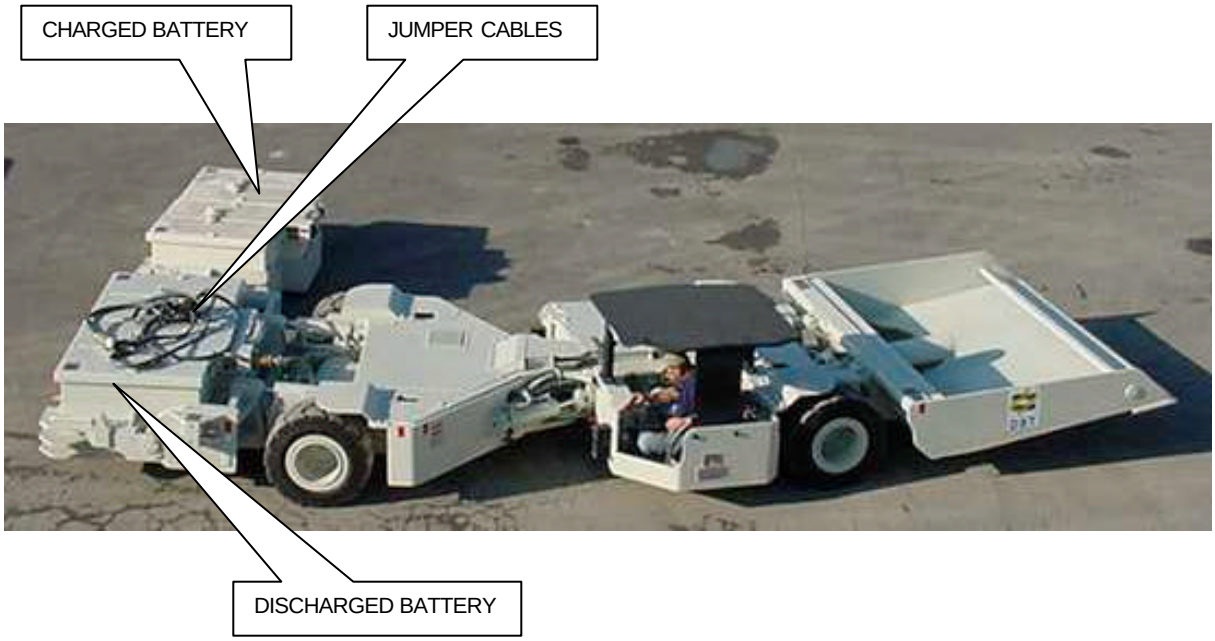
FAILURE TO SET THE PARKING BRAKE ON THE DISABLED VEHICLE BEFORE REMOVING THE TOWING DEVICE COULD ALLOW THE DISABLED VEHICLE TO ROLL AWAY UNCONTROLLED.

BATTERY CHANGE PROCEDURE (GROUND LEVEL)

Two people are needed to change the battery in the UN-A-TRAC®. Since one person may step into the Hazard Zone, the other person (operating the UN-A-TRAC®) must be very careful and look each time before moving any levers or pedals. Take time now to refamiliarize yourself with the Hazard Zone (page 21).

1. Line up the battery end of the UN-A-TRAC® with the place where the battery is to be deposited (Figure 24) (see Starting Procedure, page 23).

FIGURE 24 – BATTERY CHANGE PROCEDURE (GROUND LEVEL)



WARNING

THE "BATTERY" CHANGE CONTROL LEVER SHOULD NEVER BE OPERATED EXCEPT AT A BATTERY CHANGE STATION OR WHEN ITS NECESSARY TO ADJUST THE BATTERY'S TERRAIN CLEARANCE. IF THE "BATTERY" CHANGE CONTROL LEVER IS OPERATED IN A LOW ROOF AREA, THE BATTERY MAY BE DAMAGED.

2. Unlatch both battery latch pins before placing the battery on the ground (Figure 25). If difficulty is encountered in unlatching the latch pins, it may be necessary to gently shake the battery up and down by using the battery "LIFT" control lever.

CRITICAL TORQUE VALUES

Torque values are expressed in lubricated and dry thread values. Lubricated thread torque values should be used any time the bolt threads are covered with oil, grease, anti-seize or thread-locking compounds. Dry thread torque values should be used when threads are completely clean and dry.

CRITICAL BOLT TORQUE VALUES (ft./lbs.) (m-n)

LOCATION	BOLT SIZE	GRADE	DRY	LUBRICATED
Steering Cylinder Pins	7/8 NC	Grade 8	N/A	460
Tire-Wheel Mounting Bolts (John Deere Axle)	3/4-16UNF X 2-1/2"	Grade 8	390 (529 m-n)	300 (407 m-n)
Tire-Wheel Mounting Bolts (Meritor Axle)	9/16 NC X 2-1/4"	Grade 8	160 (217 m-n)	120 (163 m-n)
Drive Motor-to-Gearbox Mounting Bolts	3/4NC X 2-3/4"	Grade 5	285 (387 m-n)	170 (231 m-n)

LUBRICANTS, FLUIDS AND CAPACITIES

LOCATION	TYPE OF LUBRICANT	APPROXIMATE CAPACITY	NOTES
Hydraulic Oil	Texaco Rando HD68	40 Gallons (151.5 l)	1
Speed Reducer (Gearbox)	Texaco Multigear EP 80W-90	As Required	
Axle Housing (Meritor Axle)	Texaco Multigear 80W-90	As Required	2
Planetary Wheel Ends (Meritor Axle)	Texaco Multigear EP 80W-90	As Required Each Wheel end	2
Wet Disc Brakes (Meritor Axle)	Texaco TDH 1893 or Amoco 1000 or Unicol 1006	As Required For Each Brake	2
John Deere Axle	John Deere Hy-Gard Oil	20 Qt. (18.9 l)	5
Winch	API GL-4 or (140) Worm Gear Oil Peragma Grade 8	5 pints (2.36 l)	
SROIB Park Brake	SROIB Oil	2 Qt. (1.89 l)	4
Multi-Purpose Grease	Texaco Multifak EP-1	As Required	3

Notes:

1. With ejector blade completely retracted.
2. The axle housing, brake cooling sumps, and planetary wheel end assemblies do not have a common oil source. Each assembly must be filled separately.

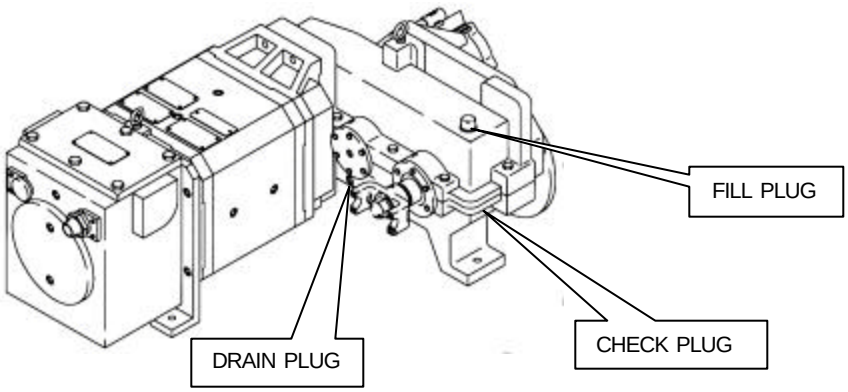
   Make sure the level and fill hole in the planetary wheel end cover is in the proper position. Rotate the wheel end as required to bring the fill hole to either the 3 o'clock or 9 o'clock position.

   When filling the axle housing and planetary wheel ends, allow enough time for the lubricant to fill the various cavities and around component parts in each assembly. Continue adding oil into each assembly until the required oil level is reached
3. Pump grease into fitting until old grease can be observed coming out of component.
4. If the SROIB brake is used as a service brake, sump oil capacity is 4 qt (3.78 l).
5. When bleeding brakes, bleed both ports at the same time.

9. Check the oil level in the speed reducer (gearbox).

A. Remove the check plug from the speed reducer (gearbox) (Figure 42). The oil level should be kept at the level of the check plug.
B. Should it be necessary to add oil, add the oil through the fill plug hole slowly until oil flows from the check plug hole. Do not overfill the speed reducer.
C. Replace the check and fill plug.

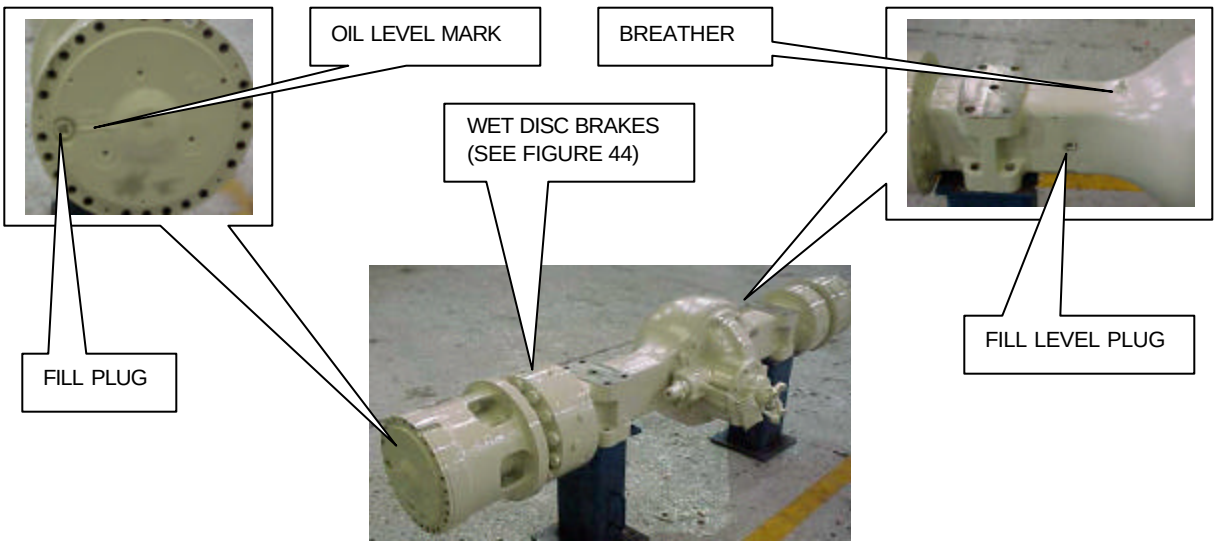
FIGURE 42 – SPEED REDUCER (GEARBOX) OIL LEVEL



10. Check the oil levels of both drive axles. (If equipped with John Deere axles, see Figure 45).

A. Park the UN-A-TRAC® on solid level ground and remove the oil level/fill plugs (Figure 43),
B. Make sure the level and fill hole in the planetary wheel end cover is in the proper position. Rotate the wheel end as required to bring the hole to either the 3 o'clock or 9 o'clock position.
B. The oil should just barely flow out from these holes when full.
C. Should it be necessary to add oil, add the oil through the level/fill plug hole slowly, just until it starts to run back out. Allow time for the oil to travel throughout the axle when filling.

FIGURE 43 – AXLE FILL POINTS (Meritor)



LUBRICATION CHART

CLEAN ALL EXCESS OIL AND GREASE FROM THE UN-A-TRAC® AFTER COMPLETING MAINTENANCE PROCEDURES.

ONCE PER WEEK

The following points should be lubricated at the grease fittings with heavy-duty, multi purpose grease.

SYMBOL	LOCATION
•	1. Bucket Pivot Pins (2 Places)
•	2. Bucket Lift Cylinders (Rod End)
•	3. Bucket Lift Cylinders (Base End)
•	4. Steering Cylinders (Rod End)
•	5. Steering Cylinders (Base End)
•	6. Automatic (Park) brake Caliper
•	7. Drive Line Universal Joints
•	8. Drive Line Slip Joints
•	9. Control Levers
•	10. Foot Pedals
•	11. Central Lubrication Fitting Block
•	12. Center Section Assembly
•	13. Winch

MAJOR MAINTENANCE PROCEDURES

CONTACTOR TIP REPLACEMENT

1. Insure electrical power is off and allow a minimum of one minute for capacitors to discharge (see page 69).
2. Change the stationary contactor tips (Figure 52):

   A. Remove the bolt that holds the old tip in place and remove the old tip.
   B. Position the new tip in place and replace the bolt. Check the placement of the tip to insure that it is correctly positioned and the bolt is tight.
   C. Repeat for all stationary tips.

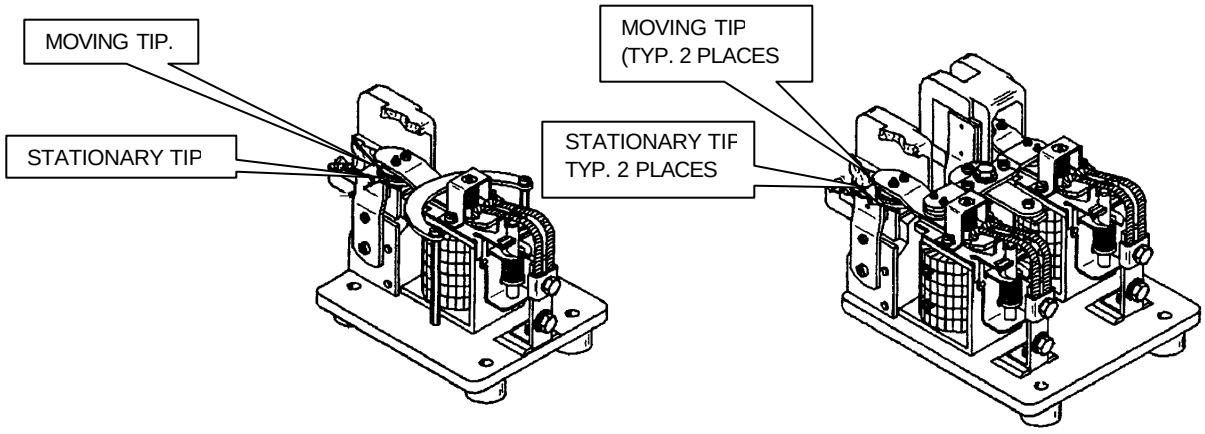
WARNING

THE BOLTS USED TO FASTEN THE STATIONARY CONTACTOR TIPS IN PLACE ARE SPECIALLY SIZED TO PREVENT THE CONTACTOR TIP FROM GROUNDING TO THE CONTACTOR COIL. IF REPLACEMENT BECOMES NECESSARY, IT IS IMPORTANT TO USE BOLTS AND WASHERS IDENTICAL TO THE ORIGINAL ONES. ALL CONNECTIONS MUST BE TIGHT BEFORE THE UNIT IS PUT BACK INTO SERVICE.

3. Check for grounding between the stationary tips and either terminal of the contactor coil by using a volt/ohm meter set on R x 1. Correct any shorts if found.
4. Change the moving contactor tips (Figure 52).

   A. Remove the two (2) nuts that secure the tip and remove the old tip.
   B. Position the new tip and secure with new nuts. Check the placement of the tip to insure that it is correctly positioned and the nuts are tight.
   C. Repeat for all moving tips.

FIGURE 52 – CONTACTOR TIP INSPECTION AND REPLACEMENT



SINGLE-POLE CONTACTOR DOUBLE POLE CONTACTOR

OPERATION, PREVENTIVE MAINTENANCE, TROUBLESHOOTING AND GUIDE

MODELS DBT 5, DBT 6, DBT 8, DBT 10, DBT 12 AND DBT 14

BATTERY CHARGERS WITH DIGITAL DISPLAY

THIS GUIDE CONTAINS IMPORTANT OPERATION AND SAFETY INFORMATION AND SHOULD BE KEPT AVAILABLE TO THOSE PERSONNEL INSTALLING AND OPERATING THIS EQUIPMENT.

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THEORY OF OPERATION FERRORESONANT DESIGN

The transformer in a ferroresonant design is non-linear. Its secondary is operated in saturation while the primary is operated in the linear region of the B-H curve.

A magnetic shunt is used to separate the primary and secondary fluxes, which are at different levels. This non-linear operation means that the transformer no longer obeys the turn's ratio laws of the linear transformer. That is, the secondary voltage is no longer a function of the turns ratio times the primary voltage. This means that changes in the primary voltage do not directly affect the secondary voltage value.

The secondary voltage is proportional to the voltage across the resonating winding only. The voltage of the resonating winding is affected by the amount of magnetic coupling to the primary, and by careful selection of magnetic shunts and capacitor values. Thus a battery charging curve can be established. The charging curve is essentially fixed and can only be altered by changes in the transformer design. Under short circuit conditions, the amount of primary to secondary magnetic coupling determines the value of the output current limit.

Rectifiers are added to convert the output of this A.C. regulator into D.C.

The ferroresonant circuit requires a good grade of capacitor in the resonating circuit to improve reliability and a careful design of the transformer. That is the principle of the ferroresonant design.

TROUBLESHOOTING

Troubleshooting should be performed only by trained service personnel or experienced electricians.

HAZARDOUS A.C. AND D.C. VOLTAGES ARE PRESENT WITHIN THE CHARGER'S CABINET.

Equipment: The only equipment required is a multimeter (volt-ohm meter).

General Inspection

On servicing new equipment, before setting up any complicated testing or jumping to any conclusions, give the unit a general inspection. Check the following:

1. Check d.c. output cables, connections, battery type, and number of battery cells with rectifier rating.
2. Check unit specifications with customer order.
3. Check input connections, input voltage and a.c. line breaker size.
4. Check for shipping damage, loose connections, broken wires, etc.
5. Certain failures can be caused by defective batteries and customer loads; make sure batteries and loads are free from defects.
6. Check all safety switches.

IF THE PROBLEM IS FOUND TO BE LOCATED IN THE PRINTED CIRCUIT BOARDS, THE BOARD SHOULD BE REPLACED. NO ATTEMPT SHOULD BE MADE TO REPAIR CIRCUIT BOARDS IN THE FIELD.

Service Information

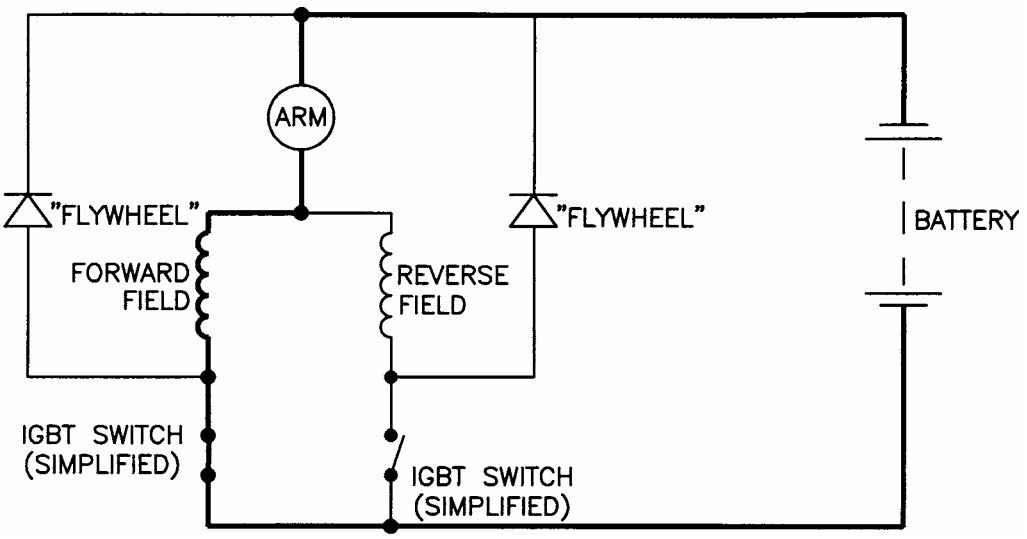
Information you should have when calling in for troubleshooting assistance:

1. Equipment model number and serial number.
2. The actual a.c. input voltage.
3. The d.c. output voltage with and without the battery.
4. Result of the check of a.c. input fuse and d.c. output fuse.
5. The actual d.c. output current and voltage when measured with battery connected to rectifier.

INTRODUCTION

LA 2000: Innovative Speed Control by DBT America

FIGURE 1 – SIMPLIFIED LA 2000 CIRCUIT



In the early 1970's, S&S Corporation lead the way in mining innovation with the introduction of Solid State speed controls for battery-powered underground mining equipment. Solid State controls increased the range and reliability of the battery powered vehicles along with providing smooth, stepless acceleration. Even with solid state speed control, direction change was achieved with the use of electromechanical contactors. These contactors provided an endless source of maintenance problems and consumed excessive amounts of valuable controller-box space. Also, most solid state controllers of the past utilize an electromechanical "bypass" contactor to connect the motor directly to the batteries which caused more contactor problems.

In the 1980's DBT America, in conjunction with Sevcon, developed a contactorless motor controller (X90) to be used exclusively on DBT equipment. The X90 system used a dual-field motor in combination with SCR's (Silicone Controlled Rectifier) to achieve solid state direction change.

Now DBT America, in conjunction with Sevcon, has developed the LA 2000 motor controller. The LA 2000 system uses IGBT's (Insulated Gate Bipolar Transistors) to achieve motor control and direction change. Unlike an SCR, an IGBT is turned ON and OFF via a gating electronic signal. This eliminated commutating capacitor banks and coils. The microprocessor based LA 2000 Logic Card provides complete motor control, and drives both a Diagnostic Dashboard Display along with a hand held Calibrator/Diagnostic Unit.

The IGBT switch operates so fast that it can connect and disconnect the motor in less than 1/1700 second. This is such a short time period that the dual-field motor does not have time to move. Each time the IGBT switch closes and reopens the full battery voltage is applied to the motor terminals for about 1/1700 second. This is commonly referred to as a "pulse."

The IGBT speed control works by feeding to the motor a rapid series of pulses. The number of pulses per second determines the average voltage at the motor terminals

Fault Message Chart
(Continued)

"LPTA Short"	"P. Up L. PTA Short"	Dual motor Block 1 point "A" short Motor shorted to ground or LEFT IGBT shorted Other electrical component (coil/etc.) shorted or grounded not allowing voltage to come up to or above 64VDC on IGBT panel.
"I. D. Fault"	"Vehicle ID Flt"	Vehicle Configuration ID invalid
"Bad Logic"	"Bad Logic"	Diagnostic point "A" trip failed to disable UVR coil. Faulty logic board.
"R FWD ON"	"Tract R. FWD on"	Diagnostic RIGHT FWD point "A" trip failed to be disabled. . Faulty logic board, shorted motor to ground or shorted IGBT.
"FWD ON"	"Tract FWD on"	Single motor Point "A" trip failed to disable FWD IGBT. Faulty logic board, shorted motor to ground or shorted IGBT.
"R REV ON"	"Tract R. REV on"	Diagnostic RIGHT REV point "A" trip failed to be disabled. Faulty logic board, shorted motor to ground or shorted IGBT.
"REV ON"	"Tract REV on	Single motor Diagnostic REV point "A" trip failed to be disabled. Faulty logic board, shorted motor to ground or shorted IGBT.
"L FWD ON"	"Tract L. FWD on"	Diagnostic LEFT FWD point "A" trip failed to be disabled. Faulty logic board, shorted motor to ground or shorted IGBT.
"L REV ON"	"Tract L. REV on"	Diagnostic LEFT REV point "A" trip failed to be disabled. Faulty logic board, shorted motor to ground or shorted IGBT.
"Drive off"	Drive 0 off Flt":	Diagnostic test to enable UVR coil driver failed. Faulty logic board.
"R FWD OFF"	"Tract R. FWD off"	Diagnostic RIGHT FWD point "A" trip failed to disable PWMO. Faulty logic board.
"FWD OFF"	"Tract FWD off"	Single motor Diagnostic FWD point "A" trip failed to disable PWMO. Faulty logic board.
"R REV OFF"	"Tract R. REV off"	Diagnostic RIGHT REV point "A" trip failed to disable PWMO. Faulty logic board.
"REV OFF"	"Tract REV off"	Single motor Diagnostic REV point "A" trip failed to disable PWMO. Faulty logic board.
"L FWD OFF"	"Tract L. FWD off"	Diagnostic LEFT FWD point "A" trip failed to disable PWM1. Faulty logic board.
"L REV OFF"	"Tract L. Rev off"	Diagnostic LEFT REV point "A" trip failed to disable PWM1. Faulty logic board.
"BAD LOGIC"	"BAD LOGIC"	Internal error (Software Only) Faulty logic board.

IGBT and Diode Measurements

Before taking readings, the following system conditions must be met:

1. Master switch or control handle in the “OFF” position.
2. Panel disconnected from and isolated from the battery (via main circuit breaker) and battery plugs being disconnected.
3. Motor leads disconnected from panel
4. After power is removed, wait for one (1) minute before making measurements to allow voltage to bleed down

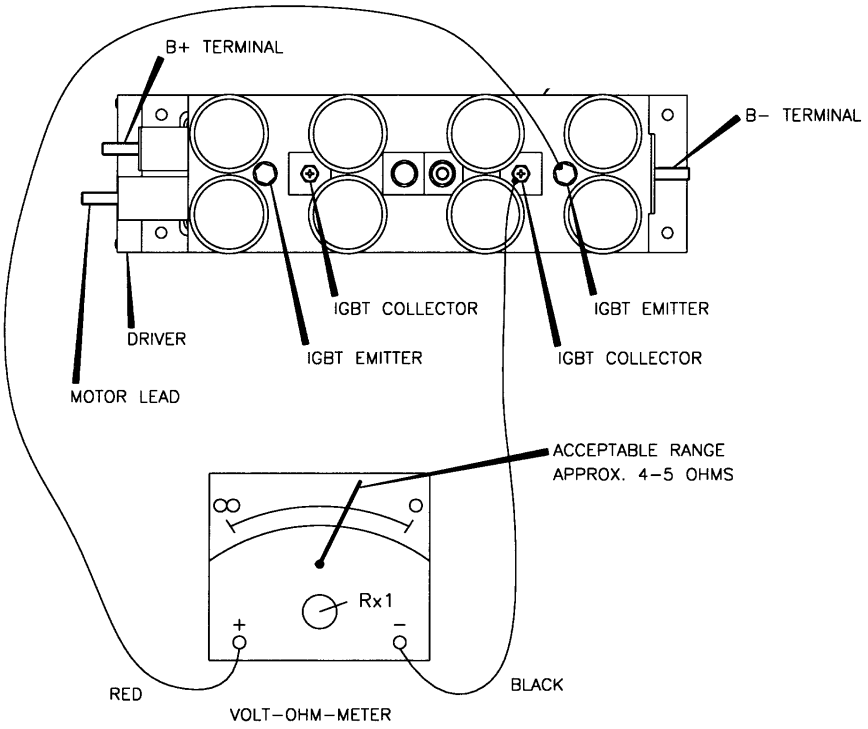
IGBT Measurements

(See Figure 11)

If reading is 0, IGBT is shorted.

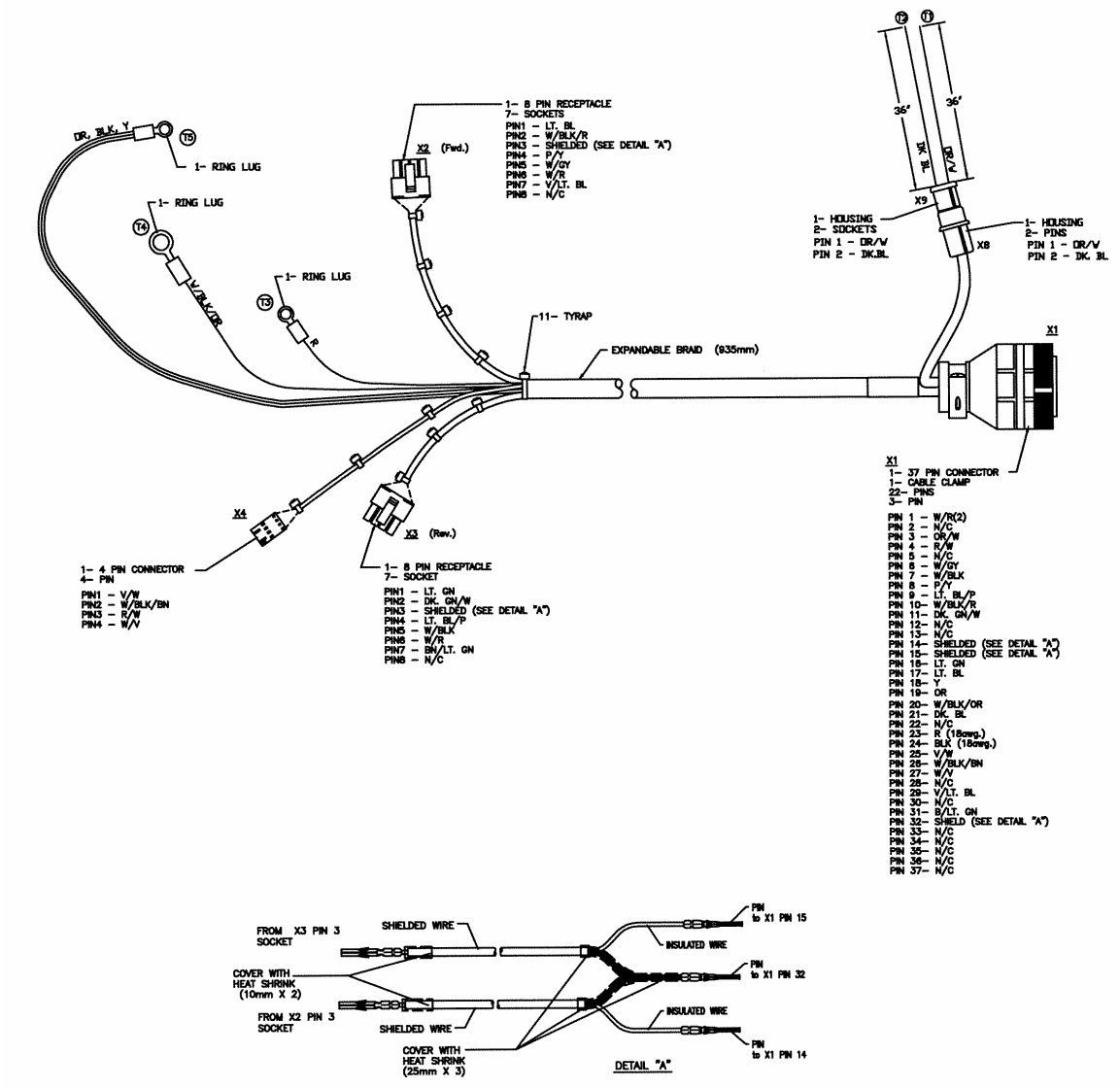
There are two IGBT’s wired in parallel; therefore, if one IGBT indicates short, it may be one or both.

FIGURE 11



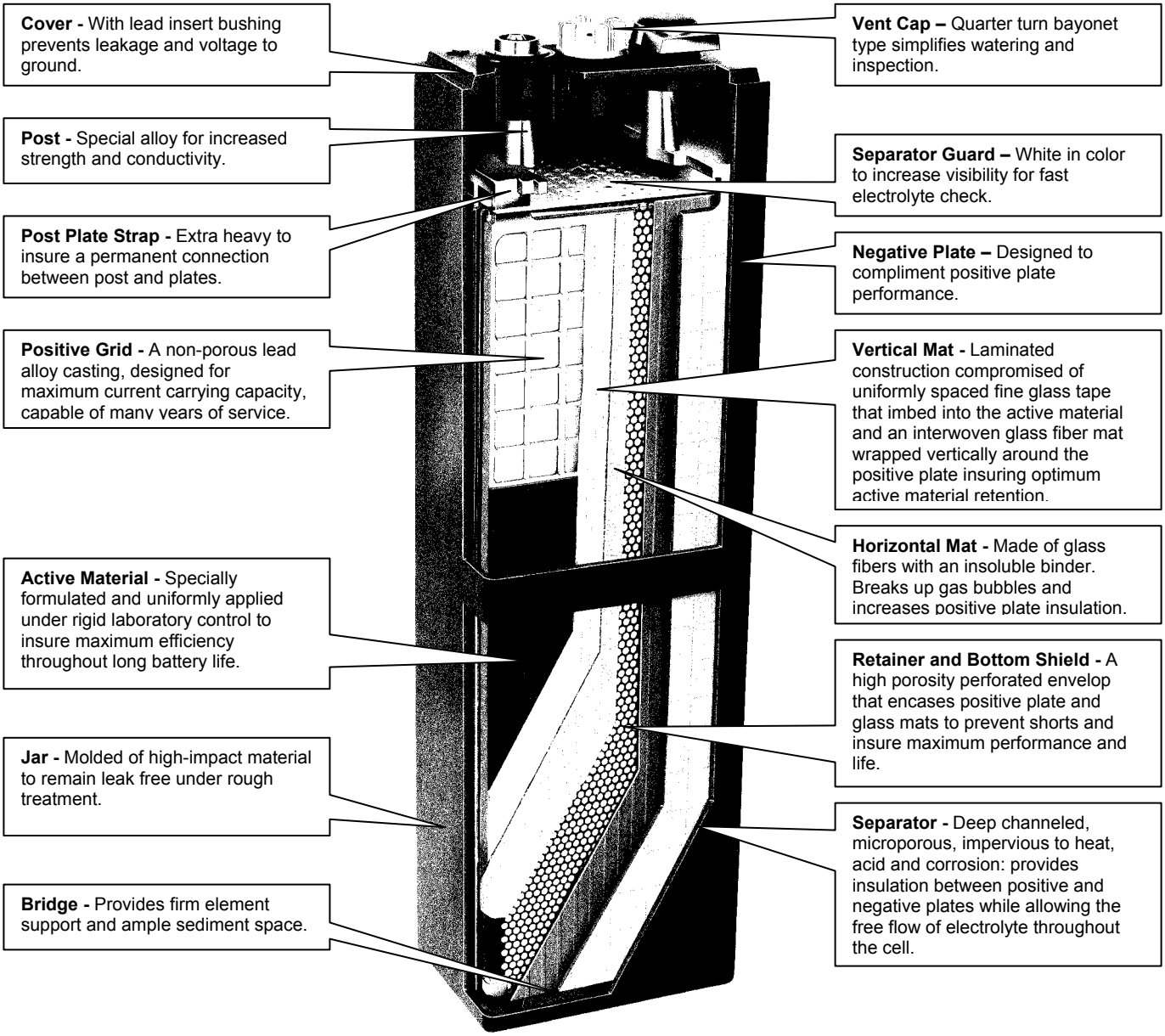
Single Motor Panel Harness Assembly

FIGURE 19



derived, and the electrolyte; both are contained by an impact resistant, molded plastic jar. The element is prevented from contacting the bottom of the jar by means of a high impact bridge, which consists of a series of support ribs. These ribs provide sediment space below the bottom of the element to accommodate particles of active material, shed by the positive plates during normal operation of the battery. (See Figure 2.)

FIGURE 2 – TYPICAL DBT AMERICA INC. CELL



DBT America Inc. mine batteries incorporate every feature required by today's mines. They are designed by engineering technology and built by master battery craftsmen according to strict quality control guidelines. DBT America Inc. batteries are the finest available to meet today's mining requirements, and our precision construction provides new equipment performance throughout a long life.

PROPER PROTECTIVE CLOTHING AND EQUIPMENT MUST BE USED WHEN SERVICING BATTERIES TO PROTECT AGAINST ELECTRICAL SHOCK AND BATTERY ACID.

BATTERIES, CHARGERS AND RELATED ELECTRICAL EQUIPMENT SHOULD ONLY BE SERVICED BY QUALIFIED, PROPERLY TRAINED PERSONNEL.

2-13. Charger Adjustment

Make sure that the charger adjustment, for control of charging rates and cut-off, are correct. This will ensure that the batteries are properly charged with no excessive overcharge. Batteries that are overcharged regularly will need water more often, and cell temperatures usually will be higher than normal. If either condition is evident, adjust the charge rate downward, in those chargers which have provision for adjustment, so it is between a normal finish rate and one-half normal finish rate.

2-14. Cleaning a Battery

Inspect the battery at least once each month to make certain the terminal connections are tight. Remove dirt or electrolyte accumulation from the tops of the cells. Wash weekly with clean water. Using a solution of baking soda and water (one pound of baking soda to one gallon of water), neutralize any acid which may be collected at cell or battery terminals to keep them free from corrosion.

Use the solution until all fizzing stops. Work the solution under the connectors. To remove all traces of soda solution and loose dirt, rinse the battery down with clear water from a low pressure hose. Whenever the battery top is being cleaned or rinsed, vent caps must be tightly in place.

2-15. Adding Water

A certain amount of water loss in cells is normal and it should be replaced with "pure" tap water or distilled water. In some geographical areas, tap water may contain chemicals or other impurities harmful to batteries. The NEMA recommendation for battery replacement water lists the following maximum allowable impurities (parts per million):

Total Solids	**350 PPM**
Chlorides as Cl	**25 PPM**
Nitrates as NO 3	**10 PPM**
Iron as Fe	**4 PPM**

DBT AMERICA INC. PROVIDES WATER ANALYSIS SERVICE. A MINIMUM OF ONE QUART IS REQUIRED. CONSULT YOUR SALES REPRESENTATIVE.

Check the height of the electrolyte at least weekly and if water is needed, add just enough to bring the electrolyte to proper level. Do not overfill. Batteries should be watered only when discharged and only cover plastic plate with holes - never any higher.

Add water often enough to prevent the electrolyte level from dropping below the perforated separator protector. Ideally, a watering schedule should be established. This schedule should assure adequate watering while taking into consideration those factors which control water consumption, such as (1) frequency of charging, (2) water storage capacity of the specific cell type, and (3) age and condition of the battery.

leakage around the posts. When replacing a cover of this type, first cut the compound with a warm putty knife. Cut the full depth of the cover adjacent to the jar wall from corner to corner on each of the four sides. Since reuse of covers which have been removed from the element is not recommended, use a post trimmer to cut off the post extensions above the cover. Break the lead bond between post and lead insert by driving the cover down approximately 1/32". The lead insert mold placed over the post and tapped with a hammer serves this purpose. Insert a hook through the vent opening and lift the cover off. Remove all sealing compound adhering to jar wall and neutralize these surfaces and upper portion of all terminal posts, using a cloth moistened with a soda solution. Thoroughly dry all of the neutralized surfaces. Install the new cover, complete cover-to-jar seal, and reburn cell connectors as described in Paragraph 3-10.

b. Epoxy Seal and Seal Nut Design - This is one of the newer systems which employs an epoxy or permanent, hard seal between cover and jar. To disassemble a cell of this design requires that the jar be cut and that both jar and cover be replaced. When reassembling with a new jar and cover, it is very important to adhere to the following procedure to obtain an effective seal:

1. Epoxy can be used only on rubber jars and covers.

2. Thoroughly clean cover and jar sealing areas first with xylol (xylene), then with isopropyl alcohol; use a separate cleaning cloth for each.

3. Caulk bottom of seal groove with glass cord. Tamp corners in. Make overlap small. Do not use warm compound with epoxy.

4. Use special epoxy sealant as recommended by the battery manufacturer. Follow instructions provided.

5. Apply epoxy in two pours. Make second pour within two hours after first pour. Fill to top of jar. Do not overfill.

6. Pressure test seal after three hours or more from time of final pouring. Pressure test to 1.5 psi for 10 seconds.

d. Heat Bonded Plastic Cover-to-Jar Seal and Lead Bushing Design - This is the newest of the sealing systems used with motive power batteries. To disassemble a cell of this design also requires that the jar be cut and both jar and cover be replaced. The seal between jar and cover is, in effect, a plastic weld. It can only be used with jars and covers made from identical plastic molding material.

Since special techniques must be used when resealing these covers, the battery manufacturer recommends that these cover-to-jar seals not be repaired in the field. Manufacturers' instructions request that such repairs be made in their service stations only.

3-12. Adjusting Specific Gravity of Electrolyte

Fully charged cells usually operate at a specific gravity between 1.275 and 1.295. Normally it should never be necessary to adjust the gravity, but upsets, jar breakage, additions of too much water, and careless use of hydrometer can result in electrolyte loss and possible reductions of battery capacity. Lost electrolyte must be replaced but only after it has been determined that charging will not restore the gravity to normal when at the recommended level.

Therefore a cell or battery should first be given an equalizing charge as described in Paragraph 2-10c. **Never make a gravity adjustment on a cell which does not gas vigorously while on charge.**

If, after the equalizing charge, the specific gravity of any cell, corrected for temperature, is lower than normal, it should be adjusted in the following manner: