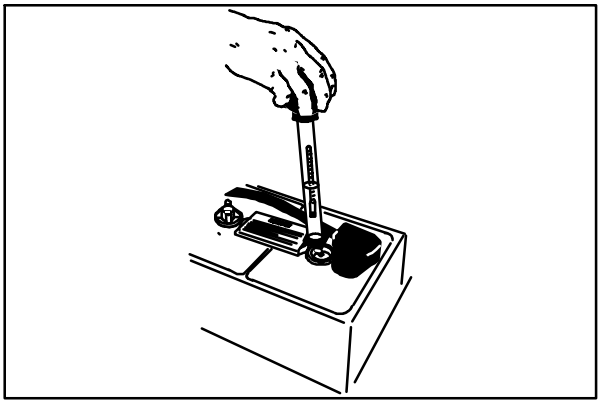
ELECTRICAL SYSTEM

The machine electrical system consists of the batteries, electrical drive motor, scrub brush motor, vacuum fan motor, power control panel and related components. This section includes information on these components and their troubleshooting.

BATTERY

The batteries are unique in that they hold their power for long periods of time. The lifetime of the batteries is limited by the number of charges the batteries receive. To get the most life from the batteries, charge them when the battery discharge indicator flashes.(XP and XPS only). The 5700 standard has an analog gauge.

Periodically clean the top surface of the batteries and the terminals, and check for loose connections. Use a strong solution of baking soda and water. Brush the solution sparingly over the battery tops, terminals, and cable clamps. Do not allow any baking soda solution to enter the batteries. Use a wire brush to clean the terminal posts and the cable connectors. After cleaning, apply a coating of clear battery post protectant to the terminals and the cable connectors. Keep the tops of the batteries clean and dry.



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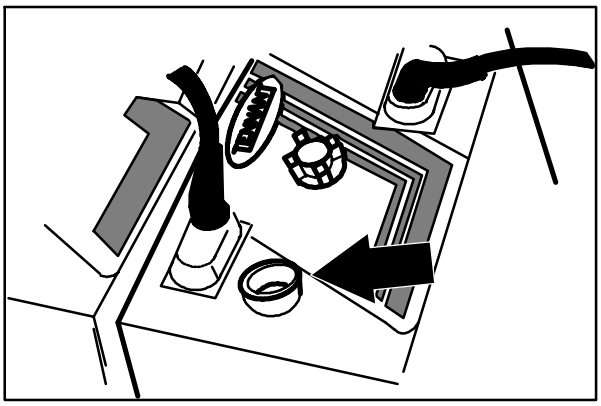
Keep all metallic objects off the top of the batteries, which may cause a short circuit. Replace any worn or damaged wires.

Never add acid to the batteries, only distilled water. Always keep the battery caps on, except when adding water or taking hydrometer readings.

FOR SAFETY: When Servicing Machine, Avoid Contact With Battery Acid.

Measuring the specific gravity using a hydrometer is a way to determine the charge level and condition of the batteries. If one or more of the battery cells reads lower than the other battery cells (0.050 or more), the cell is damaged, shorted, or is about to fail.



NOTE: Do not take readings immediately after adding distiled water. If the water and acid are not thoroughly mixed, the readings may not be accurate. Check the hydrometer readings against the following chart to determine the remaining battery charge level:

Specific Gravity at 27˚ C (80˚ F)	Battery Condition
1.315	100% charged
1.264	75% charged
1.213	50% charged
1.162	25% charged
1.110	Discharged

NOTE: If the readings are taken when the battery electrolyte is any temperature other than 27° C (80° F), the reading must be temperature corrected. Add or subtract to the specific gravity reading 0.004, 4 points, for each 6° C (10° F) above or below 27° C (80° F).

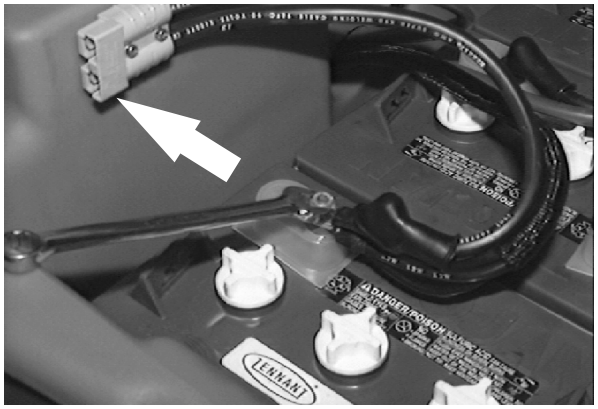
CHARGING THE BATTERIES

1. Drive the machine to a flat, dry surface in a well ventilated area.

2. Turn the machine power off and set the machine parking brake.

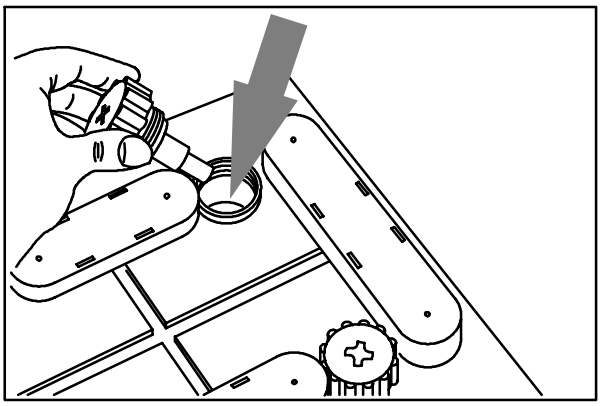
FOR SAFETY: Before Leaving Or Servicing Machine; Stop On Level Surface, Set Parking Brake, Turn Off Machine And Remove Key.

3. Open the solution tank to get access to the batteries.



4. Check the water level in all the battery cells. If the level is low, add just enough distilled water to cover the plates. DO NOT OVERFILL. The batteries can overflow during charging due to expansion.

NOTE: Make sure the battery caps are in place while charging.



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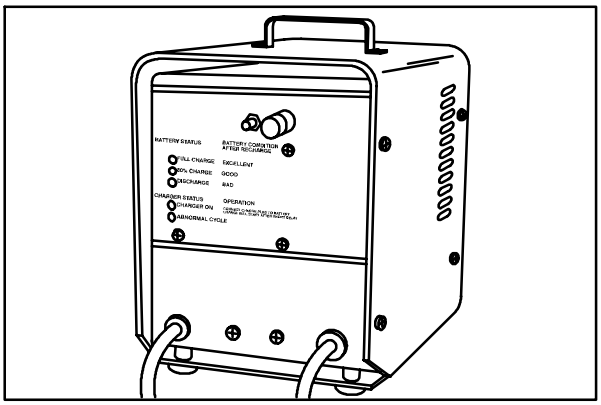
NOTE: If the red "ABNORMAL CYCLE" lamp lights when the optional TENNANT charger is plugged into a wall outlet, the charger can not charge the battery, and there is something wrong with the battery.



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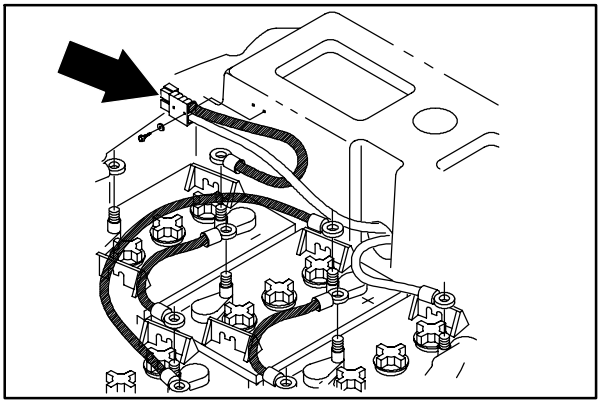
5. Plug the charger connector into the battery connector located on the inside rear of the recovery tank.

WARNING: Batteries Emit Hydrogen Gas. Explosion Or Fire Can Result. Keep Sparks And Open Flame Away. Keep Covers Open When Charging.



*NOTE: The key must be in the **OFF** position for the charging system to function.*

6. The optional TENNANT charger will start automatically. When the batteries are fully charged, the optional TENNANT charger will automatically turn off.

PORTABLE BATTERY CHARGER	801-04
V SERIES MICROPROCESSOR CONTROL	INSTRUCTION
MODELS V120-V240-V360	C11524G 4293

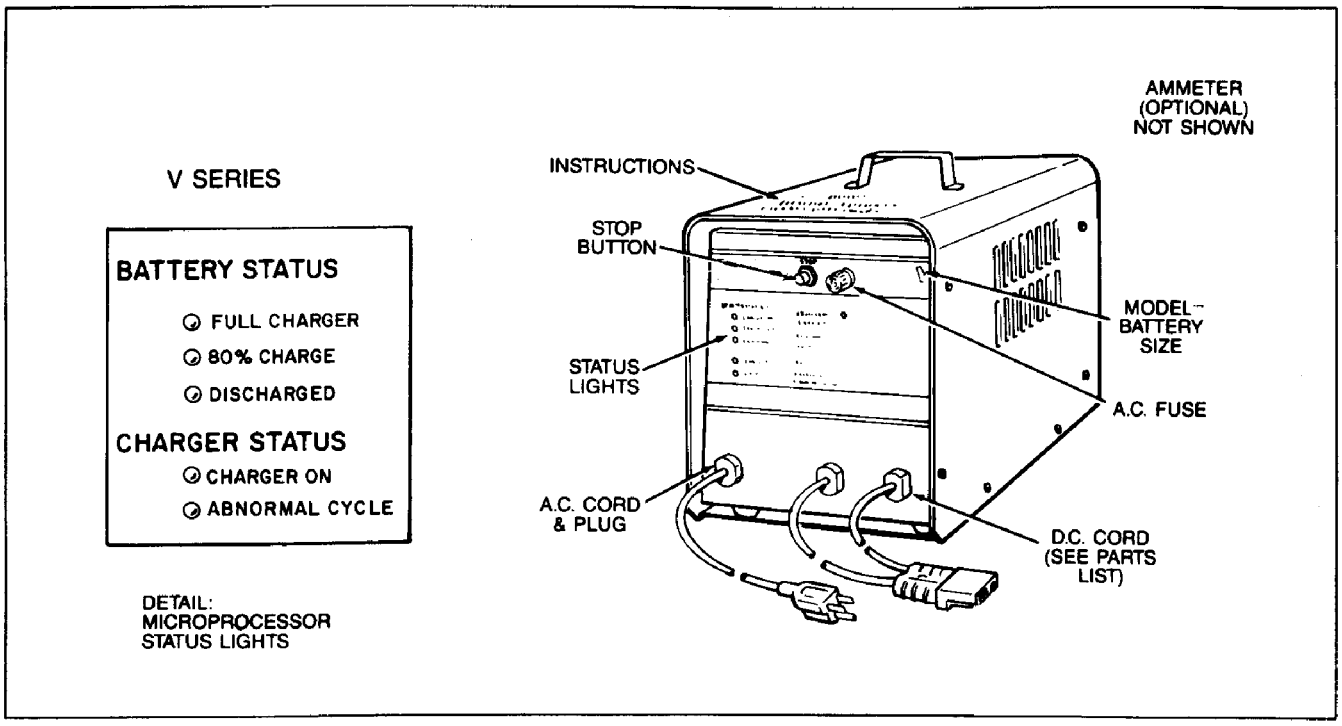


Figure 1. Battery Charger Model V

FEATURES

dv/dt microprocessor control circuit—State of the art microprocessor monitors battery condition and automatically determines when to shut the charger off.

Auto start/stop—Starts automatically after connecting charger to the battery. Eliminates potential operator error. No timers to set or buttons to push. Charger automatically stops after battery receives proper charge.

Fail-safe protection—Internal backup timer terminates charge cycle in the event abnormal conditions prevent normal charger shutdown. Red Abnormal Cycle Charger Status light will illuminate to indicate above condition.

AC Interrupt Protection—In the event of an AC power interruption the charger automatically restarts upon the resumption of AC power.

Status Indicator Lights—Provides operator important operating information on both the charger and battery throughout the charge cycle.

Battery Status

Charge Complete—charger is off and battery is fully charged.

80% Charge—battery is gassing and approximately 80% charged.

Incomplete—battery is in a discharged state.

Charger Status

Charger ON—charger is energized and charging the battery.

Abnormal Cycle—charge was terminated by backup timer.

Energy Savings

Significant reductions in the cost required to charge a battery are made possible by the microprocessor control circuit. This is especially true with partially discharged batteries. Instead of running for a fixed period of time the automatic control terminates the charge cycle when the batteries are full.

OPERATION

Operation is completely automatic. Just connect battery to the charger and the automatic circuit takes control of the charge operation. By analyzing the rate of change in battery voltage, the charge control determines when the batteries are full and terminates the charge cycle. Batteries are completely charged each time - no overcharging or undercharging. The Automatic control is designed to extend battery life and reduce operation costs.

CHARGE CYCLE

In a typical charge sequence, when the charger is connected to the battery, the control circuit goes through an automatic self diagnostic check. Indicator lights flash indicating the check is in progress. After this sequence the red incomplete battery Status light illuminates. Following a short delay the charger initiates charge and the yellow Charger On indicator illuminates.

As the charge progresses the red incomplete light goes out and the yellow 80% Charge indicator illuminates.

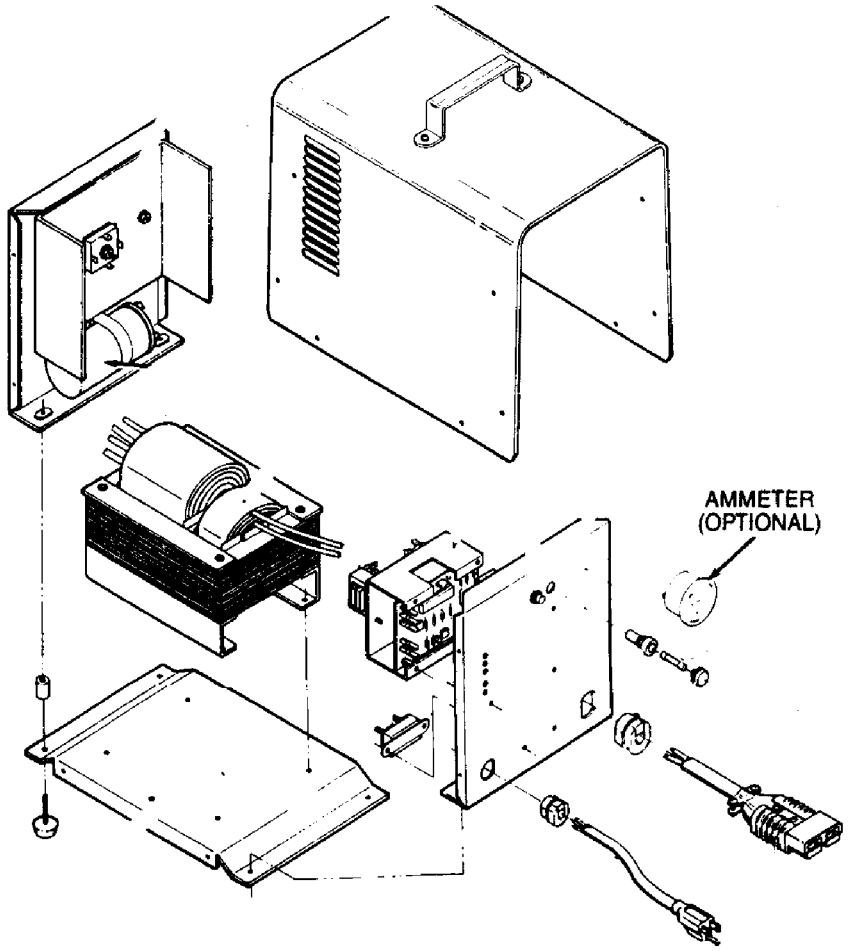
At this stage in the charge cycle the battery is gassing freely.

As the charge progresses further, the yellow indicator goes out and the green indicator illuminates indicating battery cell voltage is 2.5 volts per cell or more.

Finally when the microprocessor determines that the batteries are completely charged, the yellow Charger On light goes out indicating the charger is OFF. The green indicator remains on after charger turnoff to show the battery is in excellent condition. This Battery Status indicator remains on until the battery is disconnected from the charger.

THEORY OF OPERATION

The control circuit monitors rate of change of battery voltage. The microprocessor reads voltage at specific time intervals and stores the reading in memory. The stored reading is compared with the next reading. As long as the voltage rises faster than preestablished parameters, the microprocessor keeps cycling. As a battery approaches full charge the rate of change of voltage rise decreases. The automatic control determines if this rate of rise is proper to terminate the charge cycle.



2-1. INSTALLATION.

2-2. Installation of a charger consists of providing a proper AC power source and selecting a proper location. Even though the charger is portable, a permanent location for operation is strongly recommended. The permanent location must have enough room to bring in equipment for charging.

2-3. Always set the charger on a flat hard surface to insure proper air circulation under and around it. The area must be well ventilated, because explosive hydrogen gas is generated while charging the batteries. Exercise caution to avoid possible open flame or electrical sparks near the operation, the charger may be made accessible by keeping it on a sturdy, roller-type stand.

2-4. For general safety, do not place the charger on the floor. Make sure that the AC line cord (figure 1) and DC output cables do not obstruct traffic.

2-5. PRE-OPERATING PROCEDURE.

a. Open cover on battery case and remove vent caps from battery.

b. Check that each vent cap is clean and that each vent hole is open.

CAUTION Impurities in tap water will damage battery plates.

c. Check fluid level in each cell and, if necessary, add enough filtered or distilled water to cover the battery plates, but do not allow fluid to rise into the cell filler necks. **ALWAYS FILL CELL, IF LOW, AFTER CHARGE CYCLE ONLY TO PROPER LEVEL. SEE BATTERY INSTRUCTIONS.**

d. Check the specific gravity of each cell to determine the need for charging.

e. Recharge the battery if any cell indicates a reading of 1.250 or less.

2-6. OPERATING PROCEDURE.

a. Make sure the pre-operating procedure has been performed (para 2-5).

WARNING Hydrogen gas, formed while charging, is explosive. Avoid open flame or electrical spark near battery. To avoid accumulation of gas, be sure batteries are charged in a well ventilated area.

b. Check that there is no open flame or electrical spark in the area.

CAUTION Improper A.C. power can damage the charger.

c. Consult data plate on the charger to verify AC input power requirement.

WARNING An ungrounded or improperly grounded AC power source can cause severe electrical shock to the user.

d. Connect the AC line cord into a properly grounded AC power source.

e. Disconnect the battery from the electrical system at the DC connector.

NOTE Reverse polarity connection activates the circuit breaker and prevents the charger from operating.

f. Connect the battery DC connector to the charger DC connector being careful to match polarity. The charger will start after a 5-second delay.

g. After the charge is complete disconnect the DC connector from the battery. If the charge cycle needs to be interrupted, use STOP button to turn the charger off.

h. Disconnect the AC line cord from the power source.

i. Remove each battery cell vent cap and check the fluid level.

CAUTION Impurities in tap water will damage battery plates.

j. Add, if necessary, enough filtered or distilled water to each cell to cover the battery plates, but not enough to allow fluid to rise into the cell filler neck.

k. Replace the battery cell vent caps.

l. Reconnect the battery to the electrical system.

3-1. PARTS IDENTIFICATION.

3-2. The parts list and illustration (page 5) identify replaceable parts. The callouts on the illustration correspond to the index number in the parts list. By visually comparing the part in the equipment, errors in ordering can be minimized.

3-3. ORDERING PARTS.

3-4. When ordering parts, be sure to include all of the following:

a. Battery Charger Model No. (see data plate.)

b. Battery Charger Serial No. (see data plate.)

c. Battery Charger Spec. No. (see data plate.)

d. Part number.

e. Part name.

f. Quantity of parts required.

TROUBLESHOOTING GUIDE
MICROPROCESSOR dv/dt CHARGE CONTROL

Indicator Lamp Self Test Sequence

A.C. Power Only —	All 5 lamps flash 2 times, then each lamp flashes once.
A.C. Power + D.C. Power —	All 5 lamps flash 2 times, then each lamp flashes once, checking A.C. power. If D.C. is connected the test continues and all 5 lamps flash again then each lamp flashes once. When test completes there is a short delay and the charger turns on.
No A.C. Power —	No lamps will flash.

I. Will not turn on. No self test.

A. Charge plug not connected to battery
   1. Connect D.C. Plug.

B. A.C. fuse or wall breaker open
   1. See page 4.

C. D.C. circuit breaker trips
   1. See page 4.

TURN WALL CIRCUIT OFF - DISCONNECT BATTERY PLUG

D. Check that the circuit, battery, and charger are correct voltage.

E. Loose D.C. connection to control circuit.
   1. Clean and tighten. Repair as found.
   2. Check control circuit lead connections at both ends.

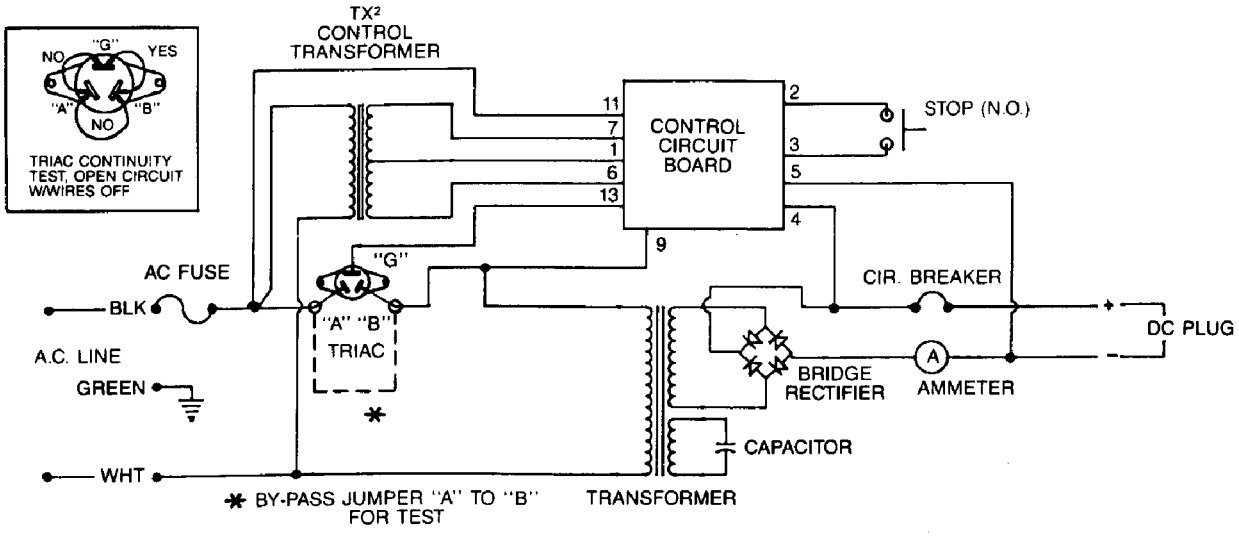
F. Loose A.C. connection in control circuit wires.
   1. Check faston connections. Push tight.

G. If a loose connection is not found, bypass control circuit with a jumper across triac. (See connection diagram, place a jumper between points A & B). Plug in battery, turn wall connection "ON".
   1. If charger is not on, contact Factory Service. Turn wall connection off and disconnect jumper.

WARNING THE FOLLOWING TEST REQUIRES WORKING IN CLOSE PROXIMITY TO HAZARDOUS HIGH VOLTAGES - BE EXTREMELY CAREFUL NOT TO TOUCH LIVE CONNECTIONS!!!!

H. Turn Wall Connection "ON" and with a voltmeter set for 100 VAC check for 18V at the outside top connections of the small control transformer TX2.
   1. If no voltage is found, turn off power and check wiring to TX2. If wiring is good, replace TX2.
   2. If voltage is found remove control circuit and replace. (Contact factory for replacement.)

CONNECTION DIAGRAM, V SERIES



TROUBLESHOOTING GUIDE
MICROPROCESSOR dv/dt CHARGE CONTROL

II. Will not turn on. Self test O.K.

A. Loose D.C. connection between battery and control circuit.
   1. Clean and tighten. Repair as found.
   2. Check control circuit lead connections at both ends.

B. Defective Triac.
   1. Turn off power. Bypass control circuit with a jumper across triac. (See connection diagram.) Place jumper between points A & B. Plug in battery, turn wall connection "ON".
      a. If charger turns on, turn off power, remove jumper, replace triac.
      b. If charger does not turn on after triac replacement, turn off power, replace control circuit board.

III. Abnormal charge cycle lamp lit.

A. Battery not fully charged.
   1. Battery and charger not matched. "Battery too big".
   2. Check battery for shorted or open cell.
   3. Check all D.C. connections between circuit board and battery.
      a. Break D.C. connection to recycle and complete charge.
      b. After complete charge, break D.C. connection and reconnect.

Charger should shut off in about 2 hours. If not shut off in 4 hours, contact factory for assistance.

IV. Does not turn off. Abnormal light not on.

A. Triac or Control Circuit failed.
   1. Replace as required.

V. Early turn off (battery not charged). Less than 1 hour run time.

A. Loose D.C. connection.
   1. Check all connections from battery to Control Circuit.
   2. Test as in IIIA2 above.
   3. If charger voltage and battery voltage are not matched. (Battery voltage being higher) Charger will shut off a few seconds after turn on.

Your charger incorporates very simple and reliable designs which makes troubleshooting relatively easy. Repair procedure involves testing individual components and isolating defective parts. The sequence of this procedure normally follows the flow of electricity through the circuit. Test procedures will be faster and more complete when a simple A.C.-D.C. volt-ohmmeter is available and continuity tester (light) can be used.

WARNING **Electric Shock Hazard**-Before checking charger disconnect A.C. supply cord from recepticle and D.C. plug from batteries. Discharge capacitors with insulated screw driver.

NOTE For testing, charger will not operate unless connected to proper battery voltage or bypass jumper on triac.

TROUBLE	CAUSE	REMEDY
1. Low charge current	1.a Open condenser	1.a See **Special Instructions** #1 below.
	1.b Open bridge	1.b See **Special Instructions** #2 below.
2. A.C. Wall breaker trips.	2.a Shorted bridge rectifier	2.a See **Special Instructions** #2 below.
	2.b Shorted transformer primary	2.b Replace

SPECIAL INSTRUCTIONS

#1 Condenser Check Out - Short out with insulated screwdriver before test. Disconnect leads, set ohmmeter to highest scale with leads to condenser terminals. If needle deflects (mid-scale) and is followed by a deflection in the opposite direction, condenser is good. If no deflection, condenser is open. A shorted condenser will indicate continuity.

#2 Bridge Rectifier Checkout - The full wave bridge rectifier can be tested for a defective diode either with a test light with a battery or a volt-ohmmeter. Set the ohmmeter to RX1K (highest scale). Touch one probe to the positive terminal on the bridge rectifier (marked), touch the other probe to the two unmarked terminals (A.C. terminals). Reverse the position of the ohmmeter probes and retouch the unmarked terminals with the probe that is not on the positive terminal. Repeat the process using the negative terminal on the bridge rectifier (marked). The needle (or light) should indicate continuity in one direction ONLY when checking the positive terminal and one direction ONLY when checking the negative terminal. Continuity in both directions or no continuity indicates a defective bridge rectifier; replace. To check for open diode, disconnect one of the A.C. leads from the rectifier and repeat the above test.