

Section 650

Page 45

M9208G rev.D

INDUSTRIAL BATTERY CHARGER

OWNER'S MANUAL

INDUSTRIAL BATTERY CHARGER

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GENERAL INFORMATION

Safety

Safety First! Please take time to study this manual before installing, operating or trouble shooting. Special attention should be given to WARNING and CAUTION labels on the charger and in this manual.

Battery chargers are safe when properly operated under intended use and by trained operators. Untrained operators and service personnel risk the possibility of serious injury to themselves and others.

Improper application of battery chargers can also result in extensive and costly damage to batteries and equipment. Only trained operators and service personnel that are familiar with this manual should install, operate, or trouble shoot the battery chargers.

WARNING: EXPLOSION

Connect or disconnect the battery plug only when the AC line is disconnected or the charger is in the "OFF" position. Failure to follow this instruction may result in arcing and burning of the DC connector contacts. Arcing contacts may ignite a mixture of oxygen and hydrogen, which is produced during battery charging. DO NOT smoke, weld, grind, or use torches around batteries.

DANGER: ELECTRIC SHOCK

Do not touch uninsulated portion of output connector or uninsulated battery terminal. Do not operate charger unless connected to battery.

Before maintenance or troubleshooting, make sure all circuits are de-energized in the following manner:

1. Make sure charger is in "OFF" position
2. Disconnect charger plug from battery.
3. Make sure no AC power can be supplied to the charger from breaker or disconnect switch.
4. Short circuit capacitors with insulated screwdriver.

Avoid operating or trouble shooting in damp or wet locations. Use insulating gloves and shoes in such environments.

Replace defective cord or wires immediately.

GENERAL SAFETY PRECAUTIONS

When servicing battery chargers the main power supply switches or other switches from which power could enter the circuit should be locked in an open

position and tagged e.g.

"Open Circuit for Repairs - DO NOT Tamper".

If it is impractical to open the main power switch use extreme caution working on energized circuits. Even though power circuits may be off, certain control circuits may still be energized. To take voltage readings on energized components, turn off the charger and attach alligator clips before turning the charger back on. This procedure will avoid sticking both hands with meter probes into a live charger, which is extremely dangerous.

Do not work alone. Have someone capable of rendering first aid. Do not wear loose clothing or jewelry. Do not use bare hands to remove live parts, such as fuses. Think before you act.

RECEIPT AND INSTALLATION

Equipment Identification

Chargers are identified with a model number, which appears on the charger nameplate.

Any charger model number, which has the suffix letter "X" followed by one or more letters, incorporates one or more options listed on Page 6 of this manual. Certain information contained in this manual may be superseded by specific operating instructions, and schematic addendums.

Charger Model Designation eg. 6M450B

6 - battery cells

450 - 8 HR. recharge rate

B - case size & AC input volts

Receiving

Check the charger nameplate against packing lists and purchase orders to verify receipt of proper equipment. Any discrepancies should be brought to our attention. All shipments leaving our facility have been carefully inspected. If a shipment arrives with the crating or packing damaged, have the carrier note the condition on the receipt. Check as soon as possible for concealed damage. Notify and file a claim with the carrier at once of any damage. Do not return the unit to the shipper. Failure to follow this procedure may result in refusal by the carrier to honor any claims.

Location

Operating life and performance will be influenced by charger location. Select a dry and well-ventilated location. Allow 6 inches from walls and other chargers for proper ventilation. Chargers should not be exposed to rain, high temperatures, dust, corrosive fumes, combustible materials, or explosive gases. Dusty environments may require more frequent maintenance to obtain maximum life and optimum performance.

Mounting

Chargers may be stacked 3 high. Optional wall mount brackets are available to secure charger to wall. See Options section or Contact factory for further information.

Moving and Transport

Care should be taken when lifting units with forklifts or pallet jacks. Forks should extend completely under charger so as to prevent accidents. Lifting eyes are available for lifting units with hoists. Contact factory for further information.

Grounding

Follow applicable local codes or National Electric Code revisions that may supersede the following instructions.

The battery chargers must be grounded to prevent lethal injury. Route ground conductor through knock-out side of charger. Connect AC ground wire (green) to ground terminal next to fuses. The case is then grounded once this connection is made.

If the AC supply cable does not include a ground conductor see table on pg. 3 for proper sizing of separate ground conductor or consult the National Electrical Code.

AC Line Voltage Changeover

Before making any reconnection, check the charger nameplate to make sure the disconnect switch and supply wiring is of sufficient size to carry the desired input voltage and amps.

Check the fuse label on inside of door to make certain the input fuses are proper for input line voltage. INCORRECT FUSING WILL VOID CHARGER WARRANTY.

1. Remove nuts on voltage select panel.
2. Align arrow on removable board to match AC line voltage on main panel.
3. Tighten mounting nuts previously removed.

The above procedure automatically makes all connections on the power transformers and control transformer. No further adjustments, taps, or jumper wires are necessary.

AC Line Connection

Follow applicable local codes or National Electrical Code revisions that may supersede the following instructions:

Make sure main power supply switches or other switches from which power could enter the circuit are locked in an open position.

Check that charger is connected for proper input voltage - arrow on voltage adjust board matches incoming AC line voltage on main panel.

Refer to charger nameplate for input amps at incoming line voltage. See table on pg.3 for recommended disconnect switch, branch fuse size, power and ground cable size. Route appropriate conductor through AC knock-out provided on side of charger case. Crimp wire to inside ring terminal barrel located at base of fuses.

DC Cables and Plugs

When changing DC cables use the following table for up to 20 feet.

Max DC Amp	Wire Size A.W.G.
65	#6
75	#4
120	#2
180	1/0
240	2/0
270	3/0

For lengths over 20 feet use one size larger cable. Cable length over 35 feet is not recommended.

Make sure DC plug is connected for proper polarity. Positive on plug to positive charging lead. Negative on plug to negative charging lead. Improper connections may result in dangerous arcing and blown DC fuses.

When changing or repairing connectors make certain plug contacts are crimped and/or soldered properly.

A poor solder joint will overheat and drop output. Make sure the plug contacts are firmly seated in the plug housing.

Charger Fusing

The fuse label (inside door) is marked to show original factory set voltage and AC fuse size. The label is also marked to show proper fuse size for

other voltages.

INCORRECT FUSING WILL VOID CHARGER WARRANTY.

OPERATION

See Pg.7 for specific operating instructions and additional information. Refer to charger model number, which appears on charger nameplate. Any charger specification number with letter suffix "X" followed by one or more letters, incorporates certain options which may not be relevant to the following standard charger instructions.

Pre-Operation

Make sure the charger has been installed according to the directions in this manual. Failure to do so could result in personal injury and damage to the equipment.

Double check nameplate to verify charger is correct DC voltage for batteries being recharged. Ampere-hour capacity on nameplate should correspond to the battery ampere-hour capacity for normal 8-hour recharge cycle.

General Operating Instructions

WARNING EXPLOSION

Connect or disconnect the battery plug only when the AC supply is disconnected or the charger is in the "OFF" position. Failure to follow this instruction may result in arcing and burning of DC connector contacts. Arcing contacts can ignite a mixture of oxygen and hydrogen, which is produced during battery charging.

Operating Characteristics

The battery charger, when connected to a discharged battery and energized, delivers maximum rated output current. As battery voltage rises, output charge current decreases in proportion to increasing battery voltage, output charge current decreases in proportion to increasing battery voltage. When the battery becomes nearly full, the charger reduces output current to a pre-established finish rate. This ensures proper mixing of electrolyte.

Service

Maintenance

Observe all safety instructions presented in the front

of this manual before attempting any maintenance or service.

The charger is designed to provide years of trouble free service. Routine maintenance checks will prevent potential problems and ensure maximum performance.

Cleaning

Keep the charger free from accumulated dirt and dust buildup. Wipe or blow dirt and dust deposits from the charger interior at least twice a year or as the situation demands. Clean components will keep the charger running cooler and more efficiently.

Connections

Make sure all connections are clean and tight. Look for discolored connections and broken or loose wires.

All DC connections are especially critical. Loose DC connections create high resistance hot spots that reduce charger output and impair efficiency. Inspect the DC cables to make sure the cable insulation is not damaged. Check charger connector for damage and check to make sure plug contacts are properly seated. See pages 11 -15 for trouble shooting information.

Specific Information by Case Type and Control

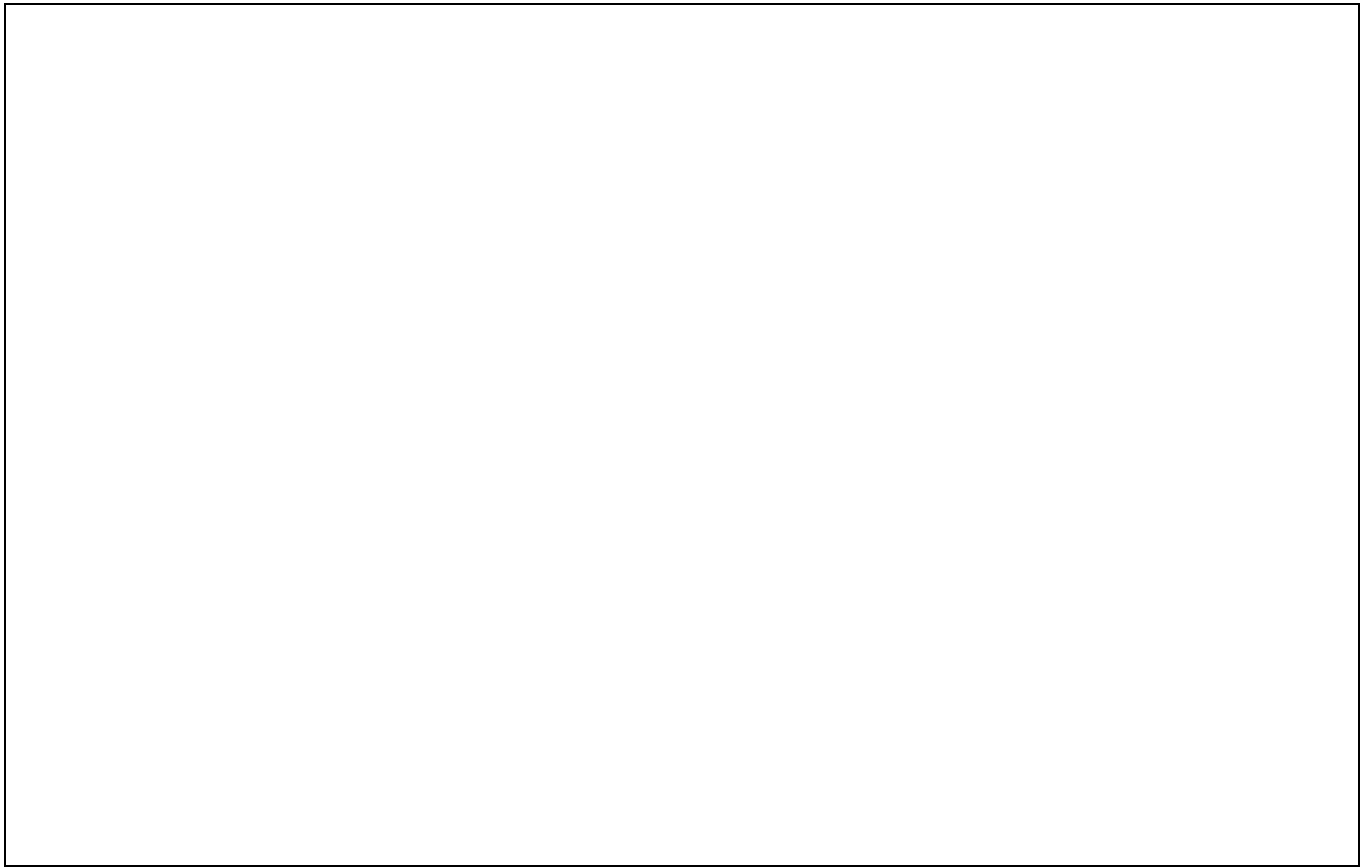
See specific charge control & case type on following pages for more information.

AC SUPPLY WIRING				
MAX Line Amps	Disconne ct Switch Amps	Branch Fuse Size (Amps)	Copper Cable Power	Size No. Ground
2.5	30	5	14	14
4.5	30	7	14	14
7.5	30	10	14	14
12.0	30	15	14	14
16.0	30	20	12	12
18.0	30	25	10	12
22.0	30	25	10	10
24.5	60	35	10	10
32.5	60	40	8	8
40.0	60	50	6	8
45.0	60	60	6	8
57.5	100	80	4	8
78.0	100	100	2	8
102.5	200	125	1/0	6
135.0	200	1150	3/0	4

The above table is based on 60 deg. C (140 deg. F) rated conductors and 40 deg. C (104 deg. F) ambient temperatures. Refer to National Electrical Code Tables 310-16 corrected to 40 deg. C (140 deg. F).

DESCRIPTION OF EQUIPMENT

The battery charger is designed to recharge lead acid batteries. The rugged case is constructed to protect internal components, and provide adequate cooling plus component accessibility. The charger is equipped with one of three different control options; timer, microprocessor w/LED indicator, and microprocessor control w/digital display. The enclosure is designed in 4 standard case types: A, B, C & D. Figures 1 & 2 show the dimensions of each case type.



CASE TYPE	Dimensions in Inches							
	A	B	C	D*	E*	F	G	H
A	22 3/4	13 3/4	14	11 1/2	12 3/8	11 1/8	3 1/4	2
B	26 1/2	20 3/8	21 7/8	18 1/2	17 3/4	21 1/4	4	2

D* & E* : 3/8 Diam mounting hole location

DESCRIPTION OF EQUIPMENT



CASE TYPE	Dimensions in Inches							
	A	B	C	D*	E*	F	G	H
C	30	26 3/4	24 1/2	24 3/4	20	11 1/4	3 1/4	3 1/2
D	32	32 1/2	24 1/2	30 1/2	20	11 1/4	3 1/4	3 1/2

D* & E* : 3/8 Diam mounting hole location

OPTIONS

Refer to charger model number, which appears on the charger nameplate. Any charger model number with letter suffix "X" followed by one or more letters, incorporates the following options. Special operating instructions and schematics are included which supersede standard Owner's Manual information.

SUFFIX DESIGNATION	OPTION
B	Finish Voltage Booster
D	Delay Start Peak Power Timer
R	Remote Charge Control
S	Series Charging Cable w/Connectors
P	Parallel Charging Cable w/Connectors
C	AC Cord - 120VAC input only
H	480/575 VAC input
M	240/480/575 VAC input
F	50HZ input
J	JIC Flange Mounted Disconnect Switch
W	Wall Mount Bracket
G	Lifting Eyes
K	Extra Output Cable
V	Special Input Voltage

OPERATING INSTRUCTIONS

Timer Control

1. With timer in "OFF" position connect charger and battery plugs of matching DC voltage.
2. Daily charge - turn timer to 8 hours. Equalize charge - turn timer to 11 hours.
3. To interrupt charge cycle - turn timer to "OFF" position.

LED Microprocessor Control 2200 Series

Check charger nameplate model designation. Suffix 22 in the number indicates that the charger is equipped with this charge control option.

FEATURES

- This control transforms ordinary chargers into "smart" chargers. A microcomputer monitors the battery, determines when it is fully charged, and terminates the charge cycle.
- Charge Complete Indicator - Remains lighted after the charge has been terminated by the control circuit to indicate that the battery has received a full charge.
- 80% Charge Indicator - Lights when the battery reaches 80% of full capacity.
- Incomplete Indicator - Lights to indicate that charging is required.
- Charger On - Provides an indication that the charger is supplying power to charge the battery.
- Abnormal Cycle - A back-up 16 hr. timer on the control turns off the charger and lights this lamp if a normal shutoff does not occur. This would happen if the batteries are too large for the charger.
- AC interrupt - When AC power is interrupted the circuit switches to standby mode. When power is restored the charger will continue where it left off.
- DC interrupt - Always STOP the charger before disconnecting the DC plug. If the plug is inadvertently disconnected the charger will shut off. Charger will then be ready for another charge cycle.

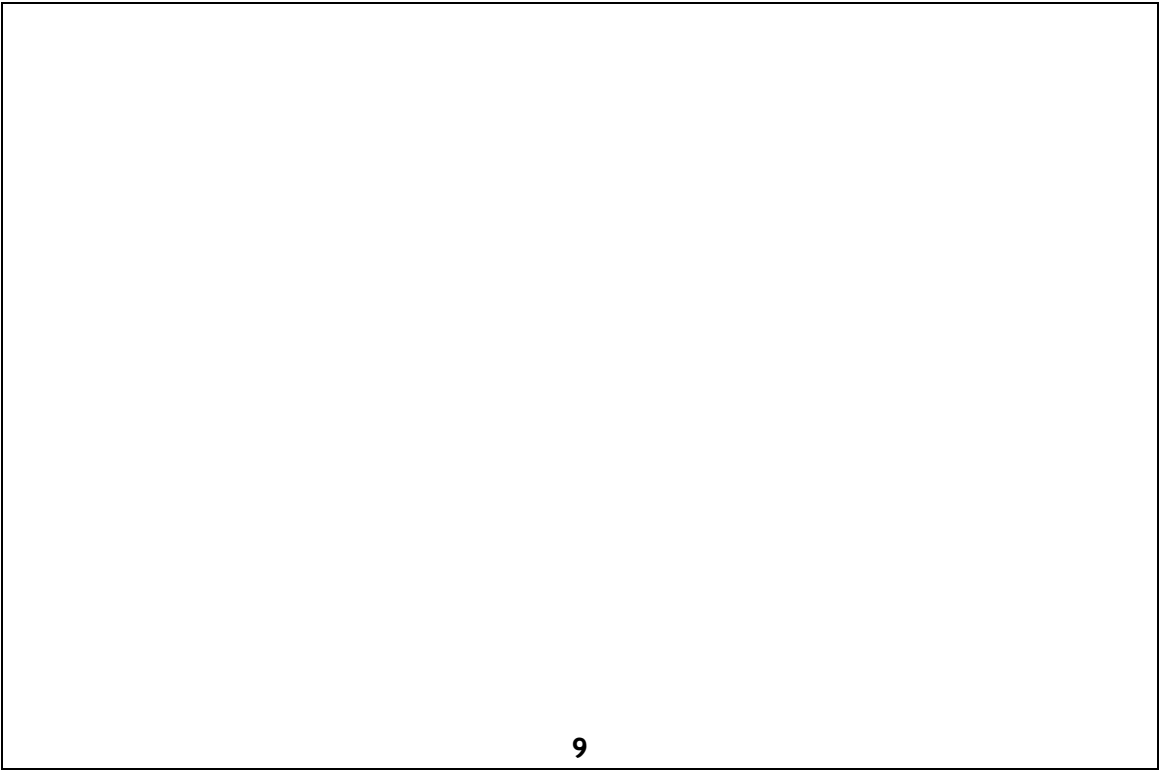
CONTROLS

Stop Button - Stops charge cycle. If charger is on, always use this button before disconnecting charging plug from battery.

Equalize Button - Extends charge cycle by 100 minutes.

OPERATING INSTRUCTIONS

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 over charging or under charging. The automatic control is designed to extend battery life and reduce operation costs. 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. Following a short delay the charger initiates charge and the yellow Charger On indicator illuminates. Charger On light remains on until batteries are charged, then the green Complete Light will come on and remain on until batteries are disconnected.



DIGITAL DISPLAY MICROPROCESSOR CONTROL

If charger nameplate model designation shows suffix 23 in the number, it indicates that the charger is equipped with this control option.

FEATURES

- This control features state of the art in battery charger control. It transforms ordinary chargers into "intelligent" chargers that keep batteries in top condition.
- Delayed Start - Turn on time can be delayed up to 9 hours, 50 minutes to take advantage of low demand power rates.
- Battery Voltage - Digital display indicates battery terminal voltage during charge and retains the voltage reading at turn off. This reading provides an excellent measure of battery condition.
- Charge Current - Display shows current in amperes during charge.
- Elapsed Charge Time - Dynamically indicates and stores the time that the battery was on charge. This can be used to indicate how deeply the battery is being discharged, i.e., how often it needs charging.
- Ampere hours returned - Display shows total amp hours returned to battery
- Equalize - Adds an additional 3 hours of charging time after the battery reaches full charge to equalize battery cells.
- Abnormal Cycle indicator - A backup 16 hr. timer on the control turns off the charger and lights this lamp if a normal shutoff does not occur. This would happen if the charger is connected to too large a battery.
- AC interrupt - When AC power is lost, the circuit switches to standby mode. When the power is restored the charger will continue to charge. Programmed delayed start time is erased.
- DC interrupt - Always STOP the charger before disconnecting the DC plug. If the plug is inadvertently disconnected the charger will shut off.

CONTROLS

Start/Stop Switch - Used to turn off the charger before the charge is complete or to turn on the charger before the programmed delayed start timer has elapsed.

Equalize - Press this switch to turn on equalize mode. A lamp in the display will light to indicate that this mode has been selected. Press a second time to cancel equalize mode.

Delayed Start - Press the delayed start switch to select delayed start mode. Each press of this pad adds ten minutes to the delayed start time up to 9 hours 50 minutes. The battery plug must be disconnected to set the delayed start. It is then connected and the charger will wait the programmed time before starting the charge. A lamp in the display will light to indicate that this mode has been selected.

Display Select - The display select option operates in four modes depending on battery condition and position in charge cycle:

SITUATION	DISPLAY	
A. Battery connected-charger on	Charge current	(XXX"A")
	Elapsed time	(HH:MM)
	DC volts	(VV.V)
	Ampere hours returned	(XXX)
B. Charge cycle complete-charger off	Charge current	(OFF)
	Elapsed time	(HH:MM)
	DC volts	(VV.V)
	Ampere hours returned	(XXX)
C. Battery disconnected-charger off	Charge current	(OFF)
	Elapsed time	(HH:MM)
	DC volts	(00.0)
	Ampere hours returned	(XXX)

OPERATING INSTRUCTIONS

1. Program delayed start time if required. (see CONTROLS section on previous page)
2. Connect charging plug to battery. Charger will wait approximately 5 seconds then begin charge if delay has been programmed.
3. Read charging current on the display.
4. After the charge is complete the display will indicate "OFF". Press display select to read elapsed charging time. For a battery in excellent condition finish voltage will be 2.5 volts per cell or greater. For instance a 36 volt battery in excellent condition will show a finish voltage of 45 volts. (18 cells X 2.5 volts/cell)



GENERAL SERVICE INFORMATION

WARNING: Observe all safety instructions presented in the front of this manual before attempting any service.

DANGER: Electric Shock Hazard - Disconnect AC Power and battery plug before any service is performed. Discharge capacitors with insulated screwdriver.

NOTE: If testing requires energized circuits, observe all safety precautions in the front of this manual. Disconnect all AC power, apply alligator clips so that you do not have to touch any probes or part of the equipment before turning the power back on to take a reading. Follow the sequence of this trouble shooting manual step by step as each successful procedure will aid in isolating the problem.

TROUBLE SHOOTING		
TIMER CONTROL		
PROBLEM	CAUSE	REMEDY
1. No charge current, No ammeter deflection-Pilot light does not glow. No transformer hum.	No line voltage	Check wall circuit breaker. Check for voltage at AC supply connection at base of fuses.
	AC fuse blown. Incorrect fuse (also refer to Problem #4)	Check for voltage at loadside. Check fuse label on inside of door. Replace fuse
	Defective control transformer.(applicable models)	Check for 120volts at X1 and X2 on control transformer. Replace.
	Control transformer fuse blown.(applicable models)	Check fuse for continuity. Replace fuse.
	Defective timer switch contacts or motor lead connections.	With timer in the "ON" position Check continuity between B and C terminals on timer. Replace if no continuity. Check for AC voltage to motor leads.
	Defective contactor coil (applicable models)	With power off use insulator to force contact closed. Restore power. If charger operates properly, replace contactor.
2. No charge current (amps). No ammeter deflection. Pilot light is on. Transformer hums.	DC circuit open	Inspect DC cables and plug connections. Verify plug contacts are properly seated in housing.
	DC fuse blown	Check first for shorted diode (using Diode Checkout Procedure)and reverse polarity (From charger to battery post pos. to pos., neg. to neg.) before replacing.
	Open ammeter (loose shunt connection)	Check for continuity. Tighten and clean connections.
	Capacitor shorted	See Capacitor Checkout Procedure.

TROUBLE SHOOTING

TIMER CONTROL

3. Low charge current	Open Capacitor	See Capacitor Checkout Procedure.
	Open Diode	See Diode checkout procedure.
	One AC fuse blown (3 phase models)	Check for continuity - replace fuse - check for shorted diode at DC plug.
4. AC wall breaker trips or DC fuse blows or AC fuse blows immediately.	Shorted diode	See Diode Checkout Procedure
	Shorted transformer winding	Replace - look for burned winding. Replace.
	Short in wiring	Check - look for "hot spots" or arc marks or loose connections.
	Wall breaker too small	Wall breaker must be larger than "start" amps on circuit.
	Wire to charger too small	Field wire to charger from breaker must be sized to carry amp load of charger
5. Charger does not shut off.	Timer contacts welded together	Check - there is no continuity between terminals B and C on timer with timer in off position.
	Timer motor not turning	Check for AC volts to motor leads.
6. Overcharges, Does not taper.	Charger and battery not properly matched.	Check specifications on both battery and charger.
	Excessive battery temperature causing suppressed voltage.	Allow battery to cool.
	Defective battery or poor DC connection.	Battery or DC connection: check battery voltage while charger is ON. The charger rate is controlled by the battery state of charge, which will adjust the output to the proper level if the battery is in good condition. If voltage does not come up to finish rate this may indicate a bad cell within the battery or a marginal DC connection between the battery and the charger. Look for hot terminals or connectors by feeling for heat carefully. Cell condition may be checked by testing cell voltage on all cells with charger off, or open circuit. This will show bad cell voltage lower than others. Specific gravity should be checked in each cell. A 40 point difference may indicate a potential problem with a faulty cell.

TROUBLE SHOOTING**2200 CONTROL**

1. Will not turn on. No self test.	Charge plug not connected to battery.	Connect DC plug.
	AC fuse or wall breaker open	See "Timer Control Trouble shooting"
	DC fuse open	See "Timer Control Trouble shooting"
TURN WALL CIRCUIT OFF - DISCONNECT BATTERY PLUG		
	Control Circuit fuse blown	Replace. Check that circuit, battery, and charger are correct voltage.
	Loose DC connection to control circuit	Clean and tighten. Repair as found
		Check control circuit lead connections at both ends.
	Loose AC connection in control circuit wires	Check connections.
2. Will not turn on. Self test OK	Loose DC connection between battery and control circuit	Clean and tighten. Repair as found
	No AC to charger(2200C only)	Check control circuit lead connections at both ends.
3. Abnormal charge cycle lamp lit	Battery not fully charged	Battery and charger not matched. "Battery too big"
		Check battery for shorted or open cell
		Check all DC connections between circuit board and battery
4. Early turn off (battery not charged). Less than 1 hour run time.	Loose DC connection	Check all connections from battery to Control Circuit.
		If battery voltage is higher than charger voltage, charger will shut off a few seconds after turn on.

TROUBLE SHOOTING

2300 CONTROL

DANGER!! - MANY OF THE TESTS DESCRIBED REQUIRE WORKING IN CLOSE PROXIMITY TO LETHAL HIGH VOLTAGES - BE EXTREMELY CAREFUL!!!

CAUTION - REMOVE POWER BEFORE MAKING ANY WIRE CONTINUITY CHECKS!!

1. Will not turn on. No display.	Wall breaker open	See "Timer Control Trouble Shooting"
	AC fuse open	See "Timer Control Trouble Shooting"
	Control circuit fuse blown	Replace. Check that battery and charger are correct voltage.
	Check control transformer CTX1	Check for line voltage input, if 0 check wiring.
		Check for 120 VAC output, if 0 replace transformer.
	Check control transformer CTX2	Check for 120 VAC input to lower transformer terminals, if 0 check wiring.
		Check for 16 VAC output at outside upper terminals, if 0 replace transformer.
Check for loose connections to circuit.	Correct as found.	
Replace circuit. (contact factory for replacement)		
2. Will not turn on, display "OFF"	DC fuse open	See "Timer Control Trouble Shooting"
	Loose DC connection between battery and circuit board.	Correct as found.
	Replace circuit. (contact factory for replacement)	
3. Will not turn on, display "0"	Check voltage across contactor coil.	If 120 VAC replace contactor.
	Loose control circuit connections, repair.	
	2300 circuit defective. (contact	

TROUBLE SHOOTING**2300 CONTROL**

	factory for replacement)	
4. Battery not fully charged	Check battery for shorted or open cell	
	Check all DC connections between circuit board and battery.	Break DC connection to recycle and complete charge.
		After complete charge, break DC connection and reconnect. Charger should shut off in about 2 hours. If not shut off in 4 hours contact factory for assistance.
5. Does not turn off, abnormal lamp not lit.	Check contactor coil voltage.	If voltage is 0 VAC, replace contactor.
		If voltage is 120 VAC, control circuit has failed, replace as required.
6. Early turn off (battery not charged). Less than 1 hour run time	Loose DC connections	Check all connections from battery to Control Circuit.
5. Does not turn off, abnormal lamp not lit.	Check contactor coil voltage.	After complete charge, break DC connection and reconnect. Charger should shut off in about 2 hours. If not shut off in 4 hours contact factory for assistance.

DIODE/CAPACITOR CHECKOUT PROCEDURE

QUICK TIP - a shorted diode can be diagnosed by checking for continuity at positive and negative of plug contacts. If test shows open, DC fuse is probably blown - check for continuity. To bypass open DC fuse check continuity for shorted diode at positive and negative lugs behind DC fuse. Reverse the ohmmeter probes. A shorted diode will show continuity on both tests.

To isolate defective diode, unbolt connection at end of flexible lead to isolate from circuit. Set ohmmeter to RX100 range.

TEST #1 Place one ohmmeter lead on aluminum heatsink and the other probe at end of loose flexible lead.

TEST #2 Reverse the position of the ohmmeter probes.

GOOD DIODE - The ohmmeter needle should deflect on either test #1 or #2 - not both.

SHORT DIODE - The ohmmeter needle will deflect on both tests #1 and #2. Replace diode.

OPEN DIODE - The needle will not deflect in either tests #1 or #2. Replace diode.

CAPACITOR CHECKOUT PROCEDURE

CAUTION: Short out capacitors with insulated screwdriver before performing test. Disconnect leads. Set ohmmeter to RX100 scale. Connect meter leads to capacitor terminals.

GOOD CAPACITOR - Needle will deflect toward right and then be followed by a deflection in the opposite direction. Reverse ohmmeter probes to validate test accuracy.

SHORTED CAPACITOR - Needle deflects toward right and remains. Replace.

OPEN CAPACITOR - No needle deflection. Replace.

BATTERY VOLTAGE TABLE (INDUSTRY STANDARD)					
CELLS	DC VOLTS	DEAD @1.9	DISCH W/LOAD @1.75	START RATE @2.133	FIN RATE @2.5
6	12	11.4	10.5	12.8	15.0
12	24	22.8	21.0	25.6	30.0
18	36	34.2	31.5	38.4	45.0
24	48	45.6	42.0	51.2	60.0
36	72	68.4	63.0	76.8	90.0

REPLACEMENT PARTS IDENTIFICATION

	DESCRIPTION
1	AC Fuse
2	Ammeter
3	Ammeter Shunt (pc)
4	Capacitor
5	Capacitor Strap
6	Case Transformer Mtg. Angles
7	Case Back
8	Case Base
9	Case Control Panel
10	Case Door
11	Case Foot
12	Case Pillar Left
13	Case Pillar Right
14	Case Side Left
15	Case Side Right
16	Case Top
17	Contactactor
18	Control Transformer
19	Control Transformer Fuse
20	Control Transformer Fuse Holder
21	DC Fuse
22	Diode
23	Heatsink
24	Main Panel
25	Transformer
26	Varistor
27	Voltage Adjust Board

AC Fuse Part Number Conversion

AMP RATING	VOLT RATING		BUSS P/N		SHAWMUT P/N			
6	250		NON6	OR	FRN-R6	OT6	OR	TR6
10	250		NON10		FRN-R10	OT10		TR10
15	250		NON15		FRN-R15	OT15		TR15
20	250		NON20		FRN-R20	OT20		TR20
25	250		NON25		FRN-R25	OT25		TR25
30	250		NON30		FRN-R30	OT30		TR30
6	600		NOS6		FRS-R6	OTS6		TRS6
10	600		NOS10		FRS-R10	OTS10		TRS10
15	600		NOS15		FRS-R15	OTS15		TRS15
20	600		NOS20		FRS-R20	OTS20		TRS20
25	600		NOS25		FRS-R25	OTS25		TRS25
30	600		NOS30		FRS-R30	OTS30		TRS30
35	600		NOS35		FRS-R35	OTS35		TRS35
40	600		NOS40		FRS-R40	OTS40		TRS40
45	600		NOS45		FRS-R45	OTS45		TRS45
50	600		NOS50		FRS-R50	OTS50		TRS50
60	600		NOS60		FRS-R60	OTS60		TRS60

*** NOTE *** A-Case use 250 volt fuses; B, C & D-Cases use 600 volt fuses.

*** NOTE *** For replacement parts, call with spec no., model & serial no. from data plate.