C&D BATTERIES
DIVISION OF ELTRA CORPORATION

Section 5-503

C&D AutoReg

HANDBOOK

for **FLOAT CHARGERS AND POWER SUPPLIES**

with Silicon Controlled Rectifiers

RS-227

PRICE $1

Model No. ARR 24 A/C 100 F3 Serial No. CSG-42

AC Volts 115/230 Phase 1 Cycles 60 Amps. Ph. 60/30

DC Volts 26.4 DC Amps. 100 No. Cells 12

Wiring Diagrams:

Control Circuit

General Circuit MBC-985

Assembly Drawings:

Arrangement MBC-1105

Parts List

INDEX

SECTION 1 — Introduction

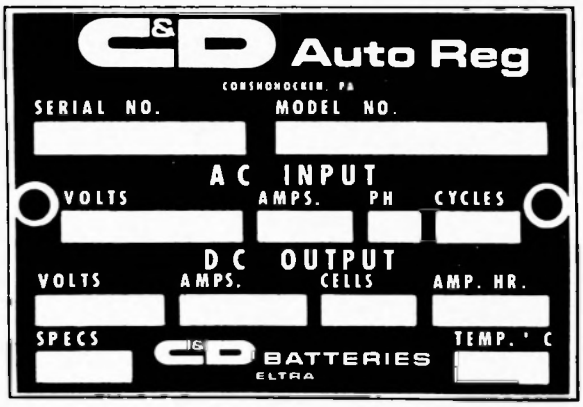
1–1 **Purpose:** This manual has been prepared for those directly concerned in installation, operation and maintenance of C&D AutoReg silicon controlled rectifier charges for float service.

1–2 **Application:** These battery chargers have been designed by battery oriented research engineers to properly maintain batteries in float service. They can be used on a continuous duty basis up to the output indicated on the name plate of each charger.

1–3 **Mounting:** Chargers may be wall, relay rack, floor or bench mounted. Physical size and personal requirements will decide the final installation method.

All chargers are furnished with brackets for wall or relay rack mounting Floor mounting brackets are furnished upon request, as well as extra-wide brackets for large relay racks. (See Section 5 for mounting dimensions.)

1–4 **Identification:** All C&D AutoReg chargers are equipped with a full identification nameplate as shown below:



When requesting information or ordering spare parts, please specify Model No. and Serial No. of charger. This information will expedite your request.

SECTION 2

2–1 **Unpacking:** Unpack carefully to avoid marring the case or damaging the apparatus. Make sure that no small parts are mislaid or thrown away with the packing material. If you are not going to use the equipment immediately, store it in a dry place and protect it from accidental damage.

2–2 **Location:** The charger should be located in a convenient, dry place, protected from overhead drip, and where there is an adequate supply of air. It is recommended that 3-6" of free air space be allowed on each side of the charger.

The charger like all electrical equipment should not be mounted where it would be subjected to extreme vibration which could possibly cause a malfunction.

The equipment can be operated in elevated temperatures for some time without harm. If the charger is to be in continuous operation, in temperatures above 50° C (122° F.) it is recommended that the charger be located in an air conditioned room. In temperatures below —25° C (—4 °F.), heaters should be installed.

2–3 **Power Source:** To function properly, the AC supply voltage must be within the limits of plus or minus 10% of the voltage rating stamped on the nameplate, and plus or minus 5% of the frequency rating. If the source voltage is other than rated value, or if the sustained voltage fluctuations are beyond the range of plus or minus 10%, contact the nearest sales office of C&D Batteries, Division of Eltra Corporation.

2–4 **Connections:** Check all internal connections for tightness and possible damage during shipment. The connection diagram furnished with the charger shows the internal connections and all the necessary external connections.

The charger input and output connection points are reached thru the hinged front or removable top panels. The AC input connections are made to the AC terminals on the terminal panel. The DC output connections are located on the terminal panel.

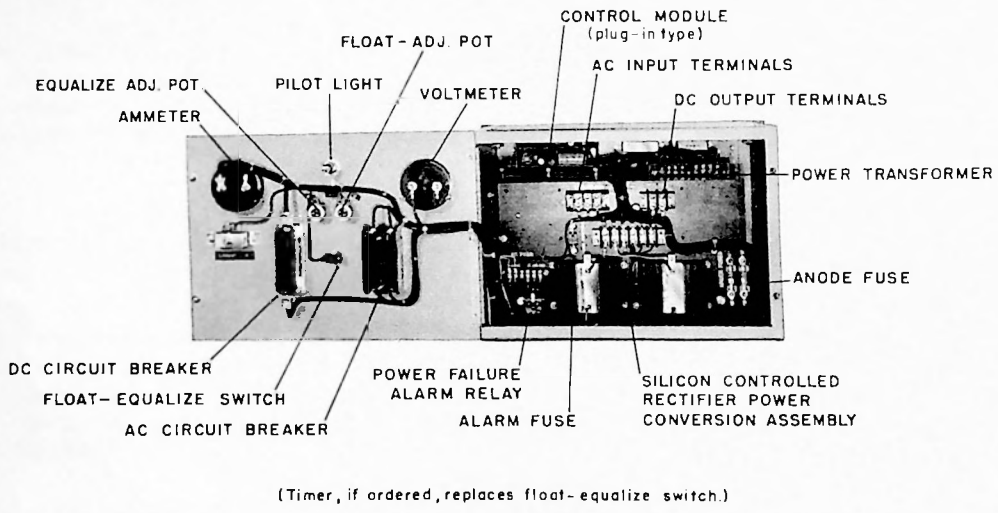
See Section 3 for location of AC and DC terminals for charger being connected.

The recommended procedure for making AC and DC connections to the charger is:

1. Place the AC input circuit breaker in "OFF" position.
2. The battery should remain disconnected, and the DC circuit breaker placed in the "OFF" position.
3. Place "FLOAT-EQUALIZE" toggle switch in the "FLOAT" position.
4. Check the connections on the transformer primary terminal blocks to make sure the connections agree with the incoming AC line voltage. If they do not agree, reconnect as indicated on the terminal blocks and/or as shown on the schematic drawing. **The AC circuit breaker must be changed to one with the proper current and voltage ratings, whenever the AC input is reconnected.**
5. Connect incoming AC leads to the AC terminals located on the terminal panel.
6. Connect DC positive and negative leads from the battery to the respective designated terminal points on the terminal panel. Make sure all connections are tight, and that correct polarity has been observed.
7. Close the AC circuit breaker. This energizes the charger filter capacitors connected across the DC output. The DC voltmeter on the front panel should read at the float voltage and the ammeter should read zero or slightly above.
8. Open the AC circuit breaker; then promptly close the DC circuit breaker.
9. Close the AC circuit breaker. The DC ammeter on the front panel will register and the charger voltage will gradually increase — as the battery charges — to the floating voltage adjustment made at the factory.

SECTION 3 — ARRANGEMENTS

3–1 Internal Arrangement — 847 cabinet series



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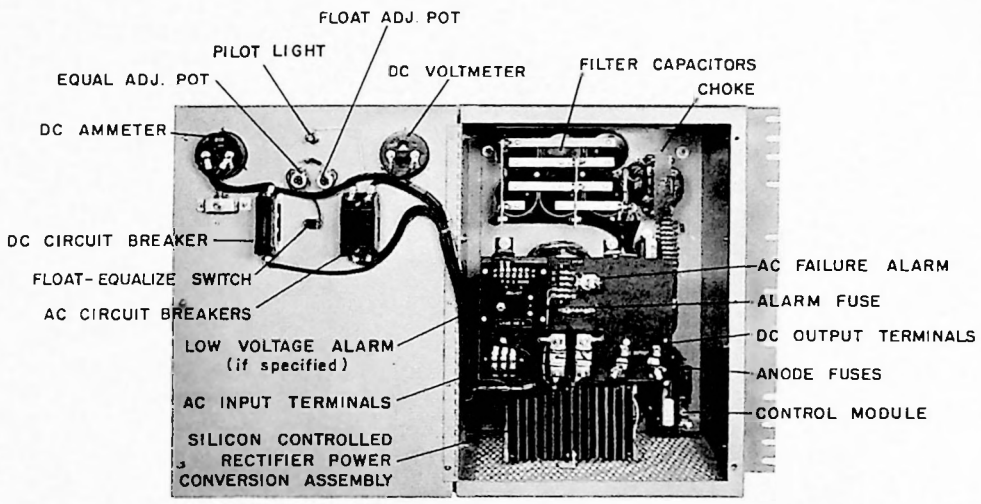
Series 847 cabinet houses most single phase silicon controlled rectifier chargers of up to 400 watts output. Included are the standard models listed below:

ARR24AC3	ARR48AC1	ARR130AC1
ARR24AC6	ARR48AC3	ARR130AC3
ARR24AC12	ARR48AC6	

These chargers may be wall, 19" relay rack or bench mounted. If bench mounted, charger should be elevated approximately 4" above bench surface to allow adequate cooling air to pass thru the charger. Mounting flanges are provided for 23" or 30" relay rack mounting when specified. (See Section 5-1 for dimensions.)

3–2 Internal Arrangement — 751 cabinet series



(Timer, if ordered, replaces float-equalize switch)

5

Series 751 cabinet houses single phase silicon controlled rectifier chargers in the following output classifications:

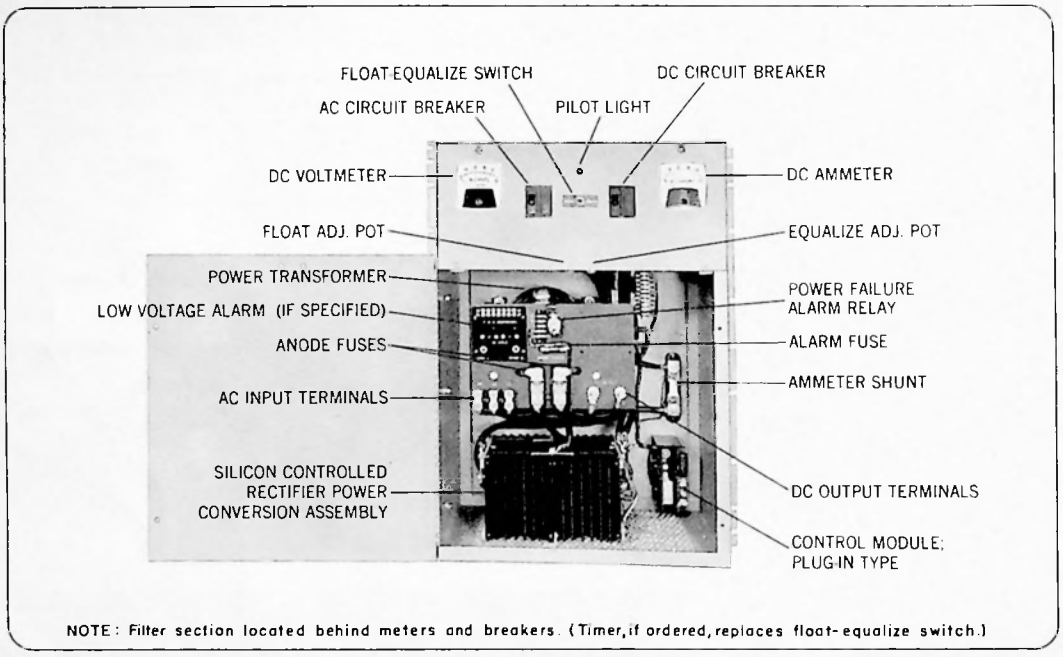
24 volt DC systems (400 to 1200 watts)
48 volt DC systems (400 to 2400 watts)
130 volt DC systems (400 to 3250 watts)

Included are the standard models listed below:

ARR24AC20	ARR48AC9	ARR130AC6
ARR24AC25	ARR48AC12	ARR130AC9
ARR24AC30	ARR48AC16	ARR130AC12
ARR24AC35	ARR48AC20	ARR130AC16
ARR24AC40	ARR48AC25	ARR130AC20
ARR24AC50	ARR48AC30	ARR130AC25
	ARR48AC35	
	ARR48AC50	

Mounting flanges are provided for wall or 19" relay rack mounting. Flanges for 23" or 30" relay rack or floor mounting are available. (See Section 5–2 for dimensions.)

3–3 Internal Arrangement — 752 cabinet series



NOTE: Filter section located behind meters and breakers. (Timer, if ordered, replaces float-equalize switch.)

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Series 752 cabinet houses single phase silicon controlled rectifier chargers in the following output classifications:

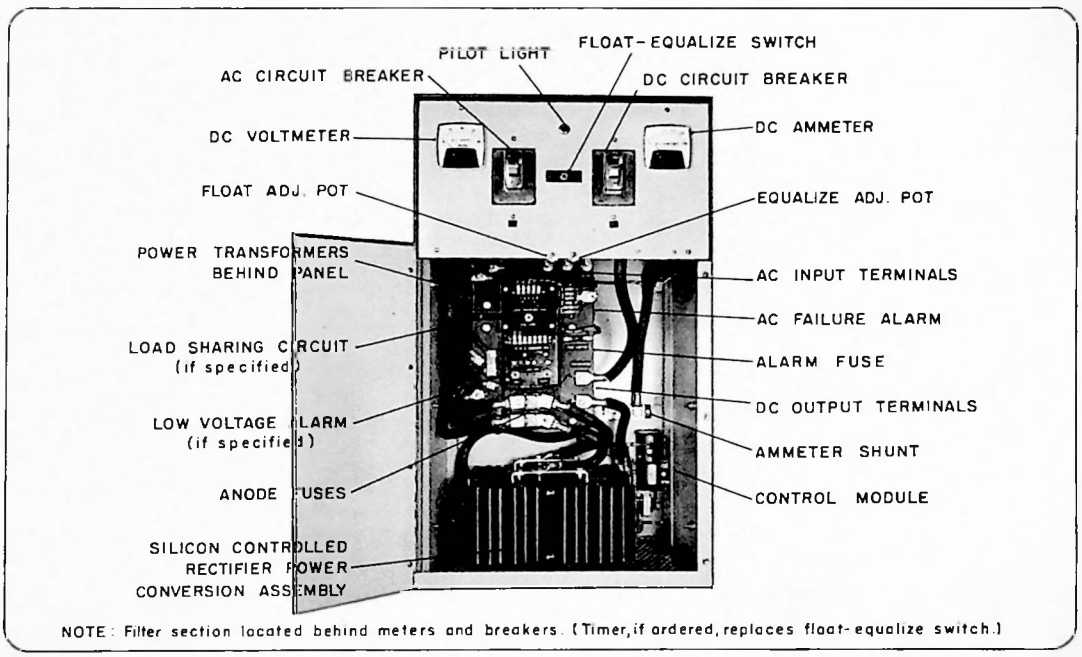
24 volt DC systems (1200 to 2400 watts)
48 volt DC systems (2400 to 4800 watts)
130, volt DC systems (3250 to 4550 watts)

Included are the standard models listed below:

ARR24AC75	ARR48AC75	ARR130AC35
ARR24AC100	ARR48AC100	

Mounting flanges are provided for wall or 23" relay rack mounting. Flanges for 30" relay rack or floor mounting are available. (See Section 5–3 for dimensions.)

3–4 Internal Arrangement — 802 cabinet series



Series 802 cabinet houses single phase silicon controlled rectifier chargers in the following output classifications:

24 volt DC systems (2400 to 4800 watts)
48 volt DC systems (4800 to 9600 watts)

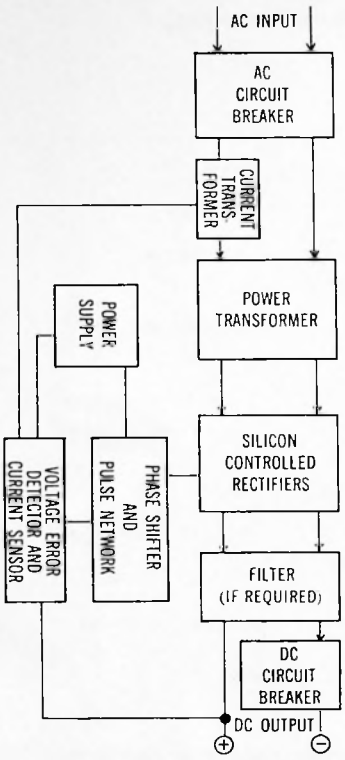
Included are the standard models listed below:

ARR24AC150	ARR48AC150
ARR24AC200	ARR48AC200

Mounting flanges are provided for wall or 23" relay rack mounting. Flanges for 30" relay rack or floor mounting are available. (See Section 5–4 for dimensions.)

SECTION 4—OPERATION

4–1 Principle of Operation



AC input voltage is applied through a circuit breaker to the power transformer. The transformer secondary feeds the rectifier unit, which consists of a full wave bridge utilizing two silicon controlled rectifiers and two silicon diodes. The SCR's, in addition to providing rectification, also serve as phase-controlled elements. The output of the rectifier unit is filtered (optional) and then passes to the DC output terminals.

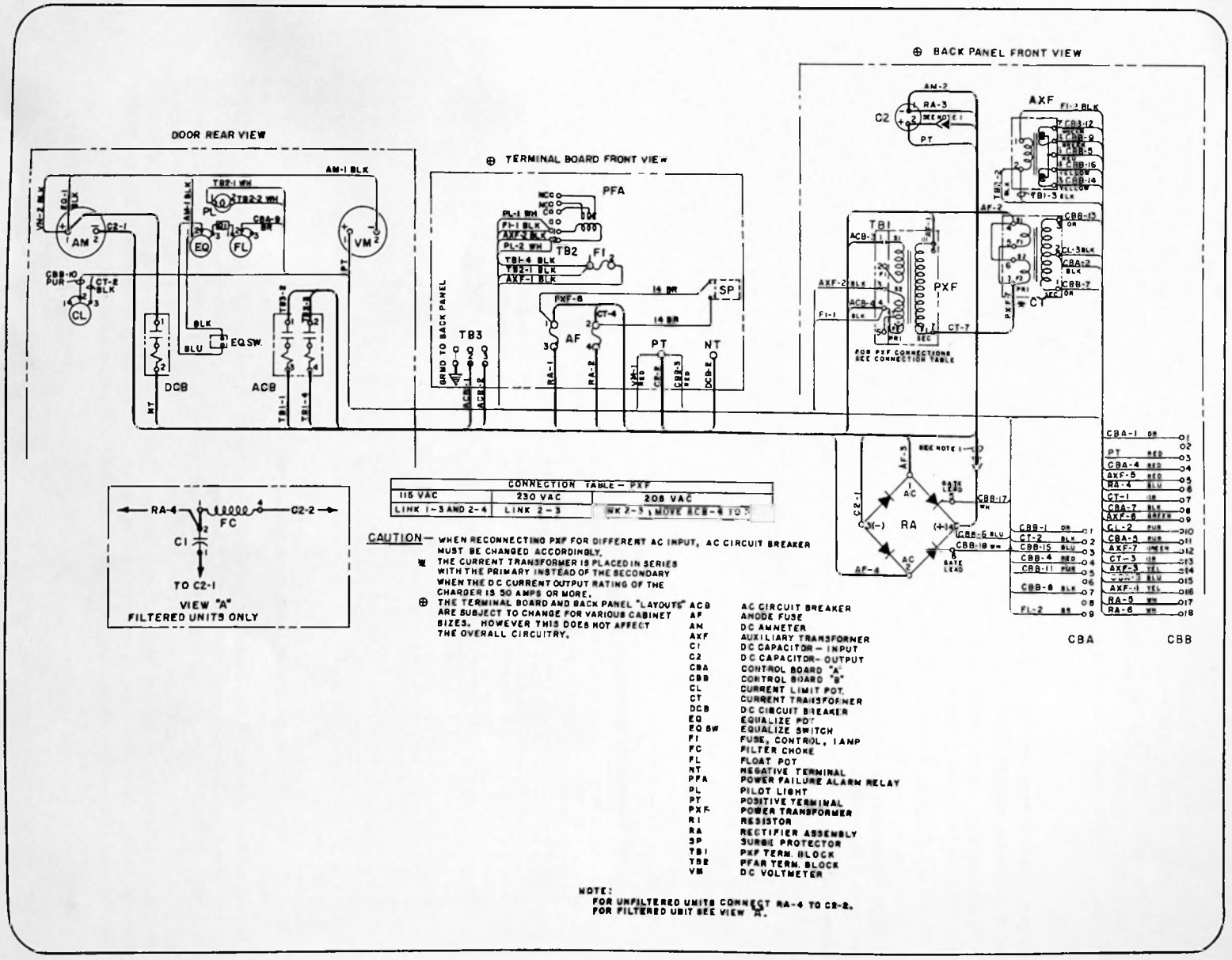
A transistorized sensing circuit compares the output voltage to a constant reference voltage. Error signals thus generated are fed to a phase shift and pulse forming network. This network will produce pulses to fire the SCR's at the instant needed to maintain the desired DC voltage output.

The current sensing circuit develops a signal voltage proportional to the AC input current, which in turn is proportional to the output current. An increase in the output current above the current limiting setting will cause the current limit signal to override the error voltage developed in the error detector, and thus control the phase shifter. This limits the output current to 115% of rated output, even down to short-circuit of the DC output terminals.

4–2 Description of Operation

1. Circuit breaker ACB is in series with the AC input to the ARR. ACB provides overload and short circuit protection for the ARR and furnishes the AC disconnect.
2. Power transformer PXF isolates the AC and DC circuits and also changes the AC voltage.
3. Auxiliary voltage transformer AXF has its primary winding in parallel with the PXF primary on chargers operating on 115VAC. or connected to a tap on the PXF primary on 230VAC. chargers. Its two secondaries provide power for the control circuit.
4. Current transformer CT is in series with the SCR circuit and the secondary winding of PXF in chargers with a rating of 40ADC and under. Above 40ADC. CT is in series with the primary winding of PXF across the AC input. In both cases its secondary windings provide power for the current limit circuit.
5. The SCR's and silicon diodes SR form the rectifier unit. The SCR's also control the DC output of the charger.
6. The anode fuses AF protect the rectifier unit against fault currents and also control the DC output of the charger.
7. Surge protector SP prevents high voltage spikes from appearing across the rectifier unit.
8. The ripple filter, when required, consists of capacitors C1 & C2 and filter choke FC.
9. DC circuit breaker DCB is provided to protect the charger against external faults and also to allow connecting the battery to the charger without arching due to capacitors charging.
10. A DC ammeter and voltmeter are provided.
11. An AC power failure alarm is also provided.

Typical Wiring Diagram



CONNECTION TABLE – PXF		
115 VAC	230 VAC	208 VAC
LINK 1-3 AND 2-4	LINK 2-3	MK 2-3 , MOVE ACB-4 TO 5

CAUTION— WHEN RECONNECTING PXF FOR DIFFERENT AC INPUT, AC CIRCUIT BREAKER MUST BE CHANGED ACCORDINGLY.

* THE CURRENT TRANSFORMER IS PLACED IN SERIES WITH THE PRIMARY INSTEAD OF THE SECONDARY WHEN THE DC CURRENT OUTPUT RATING OF THE CHARGER IS 50 AMPS OR MORE.

⊕ THE TERMINAL BOARD AND BACK PANEL "LAYOUTS" ARE SUBJECT TO CHANGE FOR VARIOUS CABINET SIZES. HOWEVER THIS DOES NOT AFFECT THE OVERALL CIRCUITRY.

ACB	AC CIRCUIT BREAKER
AF	ANODE FUSE
AM	DC AMMETER
AXF	AUXILIARY TRANSFORMER
C1	DC CAPACITOR – INPUT
C2	DC CAPACITOR– OUTPUT
CBA	CONTROL BOARD "A"
CBB	CONTROL BOARD "B"
CL	CURRENT LIMIT POT.
CT	CURRENT TRANSFORMER
DCB	DC CIRCUIT BREAKER
EQ	EQUALIZE POT
EQ SW	EQUALIZE SWITCH
FI	FUSE, CONTROL, 1 AMP
FC	FILTER CHOKE
FL	FLOAT POT
NT	NEGATIVE TERMINAL
PFA	POWER FAILURE ALARM RELAY
PL	PILOT LIGHT
PT	POSITIVE TERMINAL
PXF	POWER TRANSFORMER
RI	RESISTOR
RA	RECTIFIER ASSEMBLY
SP	SURGE PROTECTOR
TB1	PXF TERM. BLOCK
TB2	PFAR TERM. BLOCK
VM	DC VOLTMETER

NOTE:
FOR UNFILTERED UNITS CONNECT RA-4 TO C2-2.
FOR FILTERED UNIT SEE VIEW "A".

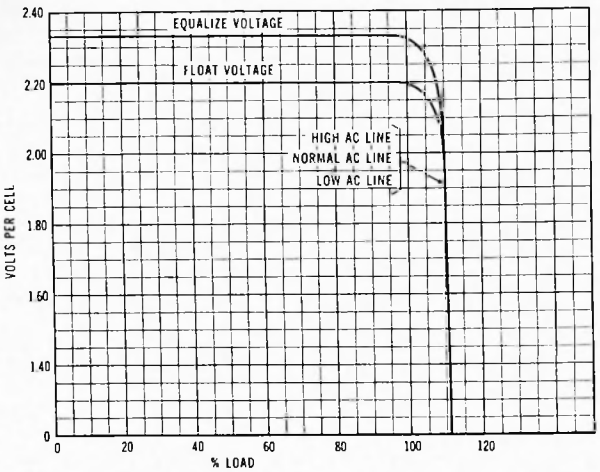
4–3 Regulation and Current Limiting

Output: Float voltage can be adjusted 10% above or below nominal float setting.

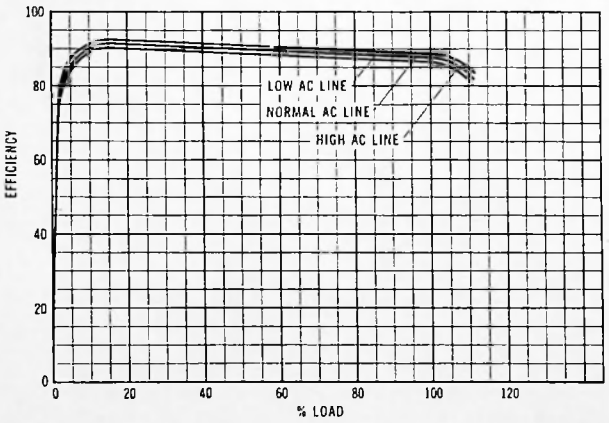
Equalize voltage can be adjusted 10% above or below nominal equalize setting.

Float or equalize voltage regulation is ± ½% from no load to full load, with ± 10% variations in the normal input voltage, and 5% variations in frequency.

Current-Limiting: Factory set at 115% of rated output. Optional settings to 135%.



4–4 Efficiency



Typical efficiency curve for a C & D AutoReg silicon controlled rectifier charger, plotted against load in percentages.

4–5 Float Voltage Adjustment

Access to the controls (if not mounted on instrument panel) is had by opening the front hinged panel. The float potentiometer controls the floating voltage of the battery when the toggle switch is in the "FLOAT" position. In order to correctly adjust the floating voltage, the battery should be in a fully charged condition with some load connected, although load is not required. Adjust the float potentiometer to the float voltage desired. This will be between 2.15 and 2.25 volts per cell depending upon the type of battery and whether the service is communications or other. See battery instructions. Keep toggle switch in "FLOAT" position normally.

4–6 Equalizing Charge Voltage Adjustments

The potentiometer for this adjustment is marked "EQUALIZE". Move the toggle switch to the "EQUALIZE" position then adjust the d-c voltage as desired. Equalizing charge voltages may range from 2.20 to 2.33 volts per cell depending upon the maximum limiting voltage of the connected load equipment. For the length of equalizing charges see the battery instructions. Always return the toggle switch to the "FLOAT" position at the end of the equalizing charge.

4–7 Equalizing Charge Timer

When ordered as optional equipment, this is mounted on the front of the charger replacing the "FLOAT-EQUALIZE" charge switch. To put the battery on equalizing charge, turn the timer from its zero or normal position to the desired number of hours between zero and 24. When the pointer returns to zero, the equalizing charge is stopped and the battery returns to floating voltage automatically.

4–8 Control Circuit Operation

Description of Operation (See schematic – page 12)

Secondary #1 of AXF supplies AC voltage to a full-wave rectifier composed of diodes D1, D2, D3 and D4. This DC voltage is then filtered by C1 & C2 and regulated by R1, Z1, & R2, Z2, to supply the plus and minus DC supply for the circuit.

Secondary #2 of AXF supplies AC voltage to the pulse generator of the firing circuit. This part consists of saturable reactors SR1 & SR2, diodes D5, D6, D7 & D8, resistor R3 and the collector-emitter circuit of the control transistor Q3. A pulse is generated every half cycle at the moment that the SR with terminal 2 positive with respect to terminal 1 saturates. When it saturates, it sends a high current flowing through the SR, through either diode D7 or D8, depending on which SR saturates, and through R3. The voltage drop that this current produces across R3 makes the junction of R4 & R5 more negative, turning transistor Q1 off, this in turn makes transistor Q2 turn on. This allows capacitor C4 to discharge producing a fast rising pulse in the primary of pulse transformer T1. This pulse is reflected in the secondary and applied to the gates of the SCR's, turning on the SCR with a forward bias. During the half-cycle that one SR is conducting the other one, which has terminal 1 positive with respect to terminal 2, is being reset by a current flowing through it, through either diode D5 or D6, depending on the SR being reset, through the control transistor Q3 and then back to Secondary #2 of AXF. The amount of current through the SR determines how far it is reset in its hysteresis loop. The more it is reset, the later it will saturate in the next half-cycle and the later the SCR will turn on resulting in lower output.

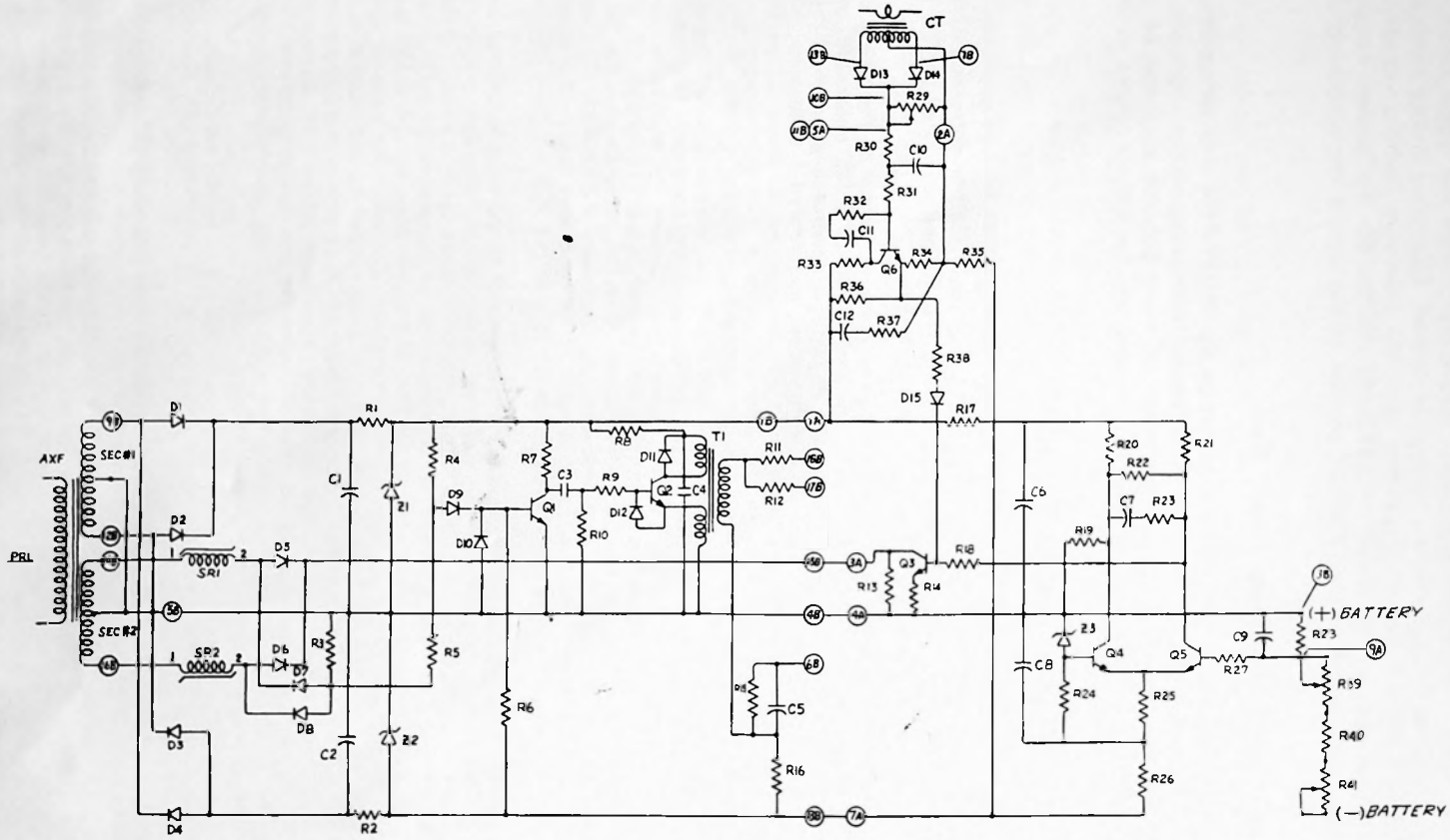
The amount of resetting current through Q3 is proportional to the base to emitter voltage on transistor Q3. This voltage is controlled by a network which senses, samples, amplifies and then feeds to Q3 any changes in output voltage. This network is made up of a voltage divider of a reference Zener Z3 and a differential amplifier which consists of transistors Q4 & Q5, resistors R20, R21, R25, & R26. Accurate error voltage sensing is possible because Q4 & Q5 emitter currents have a constant sum and hold both emitters constant. Z3 holds the base of Q4 also at a constant potential. The voltage across R28, which is proportional to the output voltage, approximately equals Zener Z3 voltage thus holding the base of Q5 at almost the same potential as the base of Q4. If now the output voltage decreases the voltage across R28 decreases proportionately, Q5 is turned on more, turning Q3 more off, allowing less resetting current through the SR's, firing the SCR's sooner and thus rising the output voltage maintaining a constant output voltage. The opposite occurs if the output voltage increases.

The current limit circuit is fed by the CT, whose primary is in the power circuit, and has a current proportional to DC output current flowing through it. Its secondary coil provides AC input for the current limit rectifier circuit.

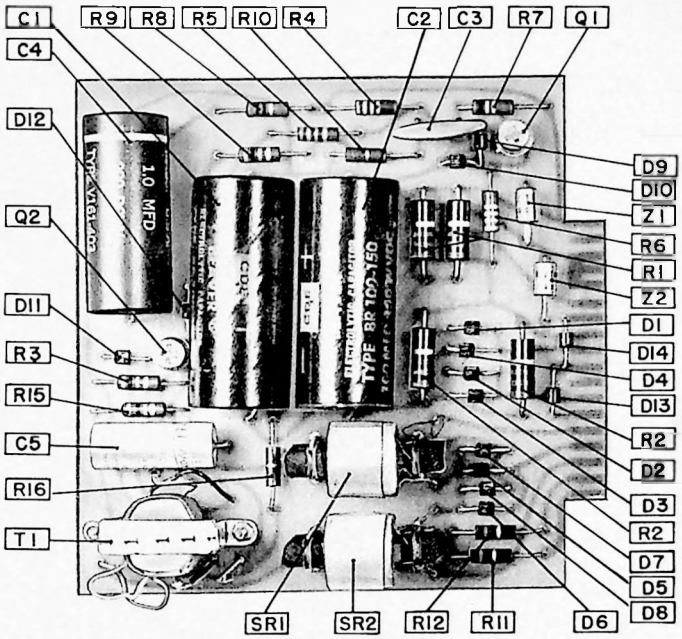
Diodes D13 & D14 form a full-wave, center-tapped rectifier providing DC voltage for use in the current limit control circuit.

Rheostat R29 provides a constant load for the CT and is also used to control the current limit value of the charger by providing the turn on voltage for transistor Q6 for a given value of load current. Q6, being an NPN transistor, will turn on as its base becomes more positive than its emitter. The emitter is connected through D15 to the base of the control transistor Q3. When Q6 turns on it feeds a signal to Q3 turning it more on and thereby reducing the output voltage and current.

Control Circuit Schematic Diagram



Control Module Boards



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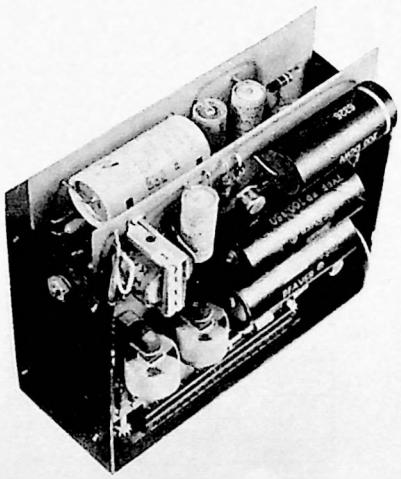
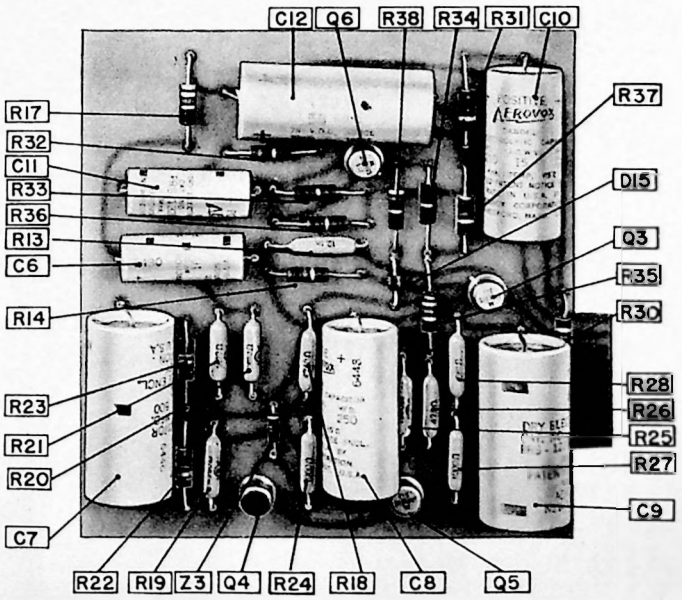
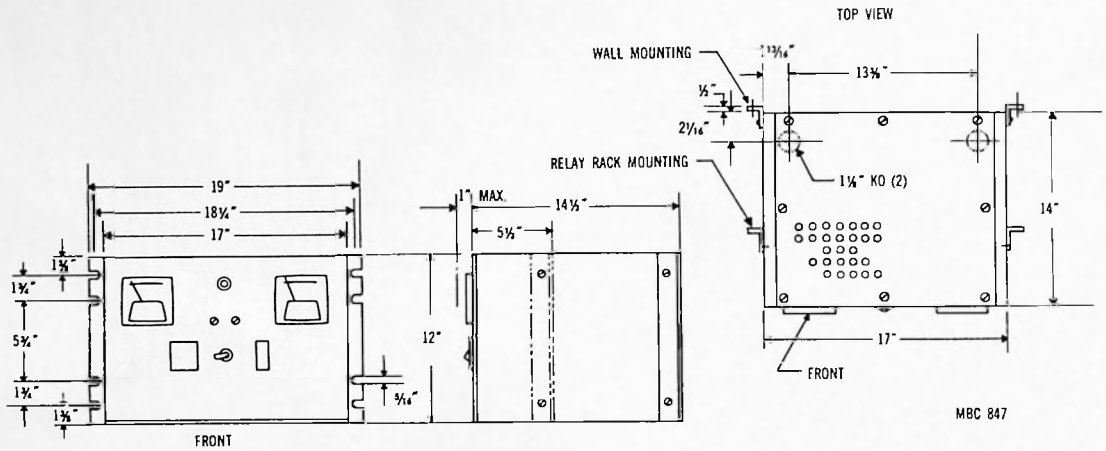
Control Module Assembly





SECTION 5 — DIMENSIONS

5–1 MBC 847 Cabinet Series



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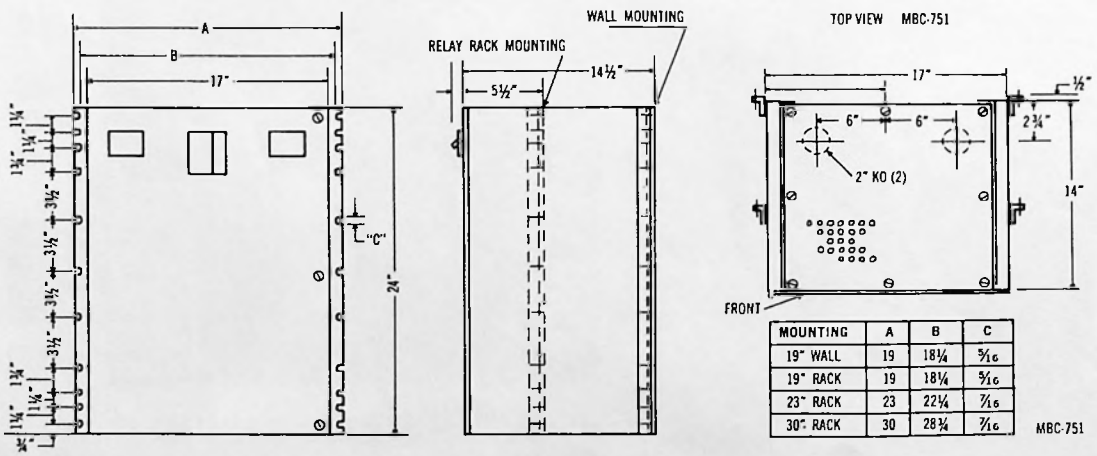
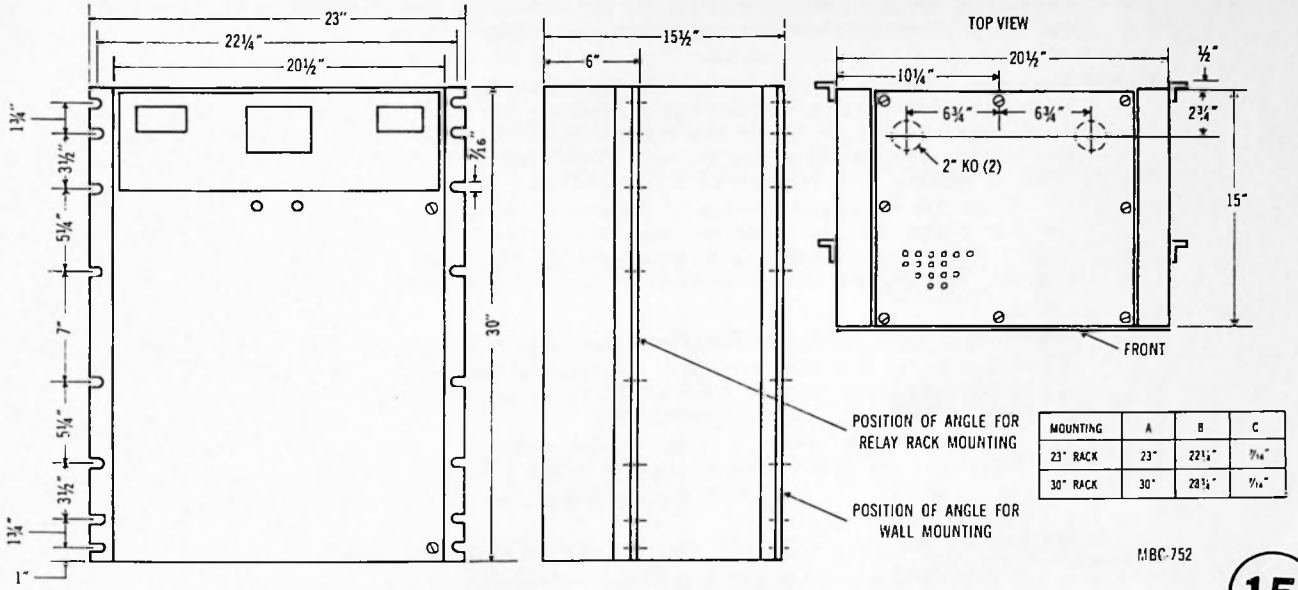
5–2 MBC 751 Cabinet Series



MOUNTING	A	B	C
19" WALL	19	18¼	5⁄16
19" RACK	19	18¼	5⁄16
23" RACK	23	22¼	7⁄16
30" RACK	30	28¾	7⁄16

MBC-751

5–3 MBC 752 Cabinet Series



MOUNTING	A	B	C
23" RACK	23"	22⅛"	5/16"
30" RACK	30"	29⅛"	5/16"

MBC-752

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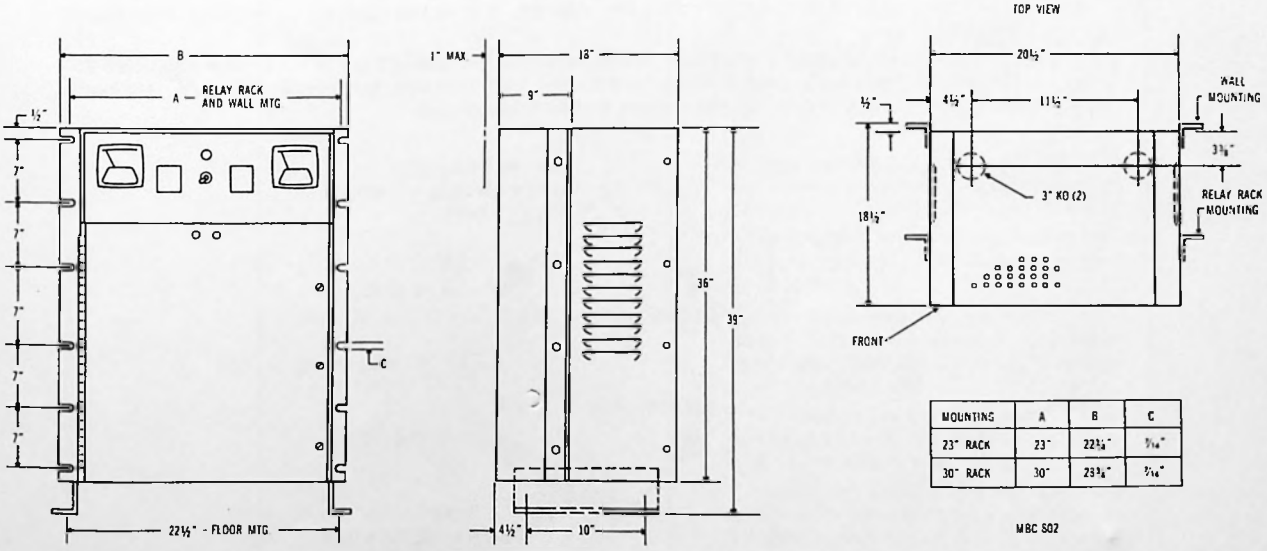
5–4 MBC 802 Cabinet Series



MOUNTING	A	B	C
23" RACK	23"	22⅛"	5/16"
30" RACK	30"	29⅛"	5/16"

MBC 802

SECTION 6 — MAINTENANCE

6–1 **Cleanliness:** Keep charger and surrounding area clean, dry, and free from trash and dirt. Depending on dust conditions, blow out the interior at regular intervals to prevent dirt accumulating on heat radiating surfaces and contacts.

6–2 **Replacing Fuses:** A blown DC fuse may be caused by a defective rectifier or silicon controlled rectifier, or by a reversed battery. Before you try to replace a fuse, open the AC circuit breaker and disconnect the battery from the charger. Next, check the polarity of the battery connections to the charger. They should be POSITIVE of charger to POSITIVE of battery, and NEGATIVE to NEGATIVE.

Close the AC circuit breaker. If the panel voltmeter reads zero, one or more of the rectifier diodes may be defective. (See next section.) If normal DC voltage is shown, open the AC circuit breaker and replace the DC fuse; then reconnect the battery to the charger. The DC ammeter should now indicate charger output.

6–3 **Replacing Silicon Controlled Rectifiers and Silicon Diodes**

A. If it is found that one or more of the diode(s) and/or SCR(s) are defective, the following procedure may be followed for replacing the defective piece(s).
Note: Use figure "A" for terminology.

1. Open AC and DC breakers (if not already open).
2. Disconnect the external leads going to points 1 through 6 of the stack.
3. Loosen the hardware used for mounting the stack to the back panel and remove the stack from the cabinet.
4. Remove the diode(s) and/or the SCR(s) that were found defective by:
   a) disconnecting diode(s) and/or SCR(s) connections to applicable points 1 through 6.
   b) The defective pieces may now be removed.

To replace the defective piece(s) simply reverse procedures 1 through 4.

NOTE: If a torque wrench is available, tighten Diode(s) and/or SCR(s) with 14 to 38 inch-pounds of force. If no wrench is available use caution when mounting piece(s), to avoid damage to case or threads.

B) A complete rectifier assembly may be ordered, if it is not desired to replace individual piece(s).

When installing a new rectifier stack, observe the correct polarities. The negative to the black terminals, and the positive to the red marked terminals. The AC (anode) connections are made to the yellow marked terminals.

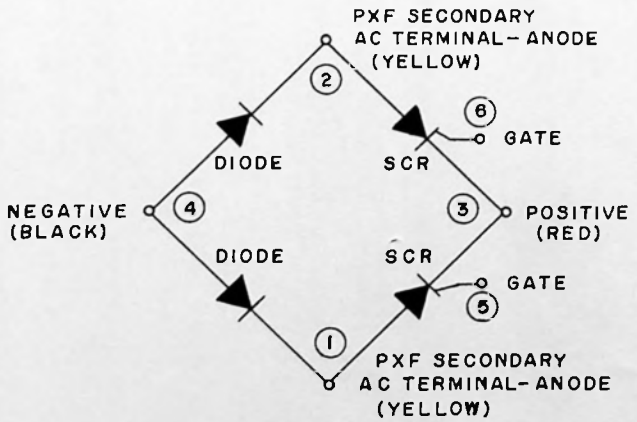


figure "A"

6–4 **Panel Voltmeter:** Every 6 months, check the floating voltage as shown on the charger panel voltmeter, using a portable standard voltmeter. If necessary, adjust the panel voltmeter to agree with the standard by using the zero adjustment.

6–5 **Servicing Capacitor in Filter Circuit:** Capacitor trouble can be spotted by a ruptured or broken can; an open capacitor will look normal. To check capacitors, first open the AC circuit breaker and disconnect the battery from the charger. All capacitors in the charger will then bleed to zero voltage. Second, isolate the capacitor to be tested, and with a voltohmeter on its highest scale, apply the test prods to the capacitor terminals. If good, it will show a definite meter deflection, followed by a decay to zero. If bad, it will show meter deflection but no decay, or will show no deflection at all.
Replace faulty capacitors with the same rating stamped on the original. See parts list on the charger layout drawing received with the charger.
Filter capacitors are connected parallel and polarities must be observed. The red dot indicates positive.

6–6 **Trouble Shooting**

SYMPTOM	CHECK LIST	NOTES
No Output Current	1. Check setting of float and equalize potentiometers.	See Instruction note #1.
	2. Check for low input AC voltage.	Input voltage should be ± 15% of rated voltage.
	3. Charger connected for higher input voltage.	Check against connection diagram and change to connection for low input voltage.
	4. Circuit breakers closing mechanism might be defective.	With the AC and the batteries connected to the charger, put the voltmeter across each breaker. If voltage is read, breaker is defective.
	5. If ammeter has internal shunt ammeter might be open.	Check with ohmmeter.
	6. DC breaker could have tripped.	a. Reclose and observe operation. Should it trip again due to higher than rated output current, check SCR's. (See instruction Note #2). b. If SCR's are O. K. check current transformer. (See instruction note #3); also check current limit potentiometer setting. (See instruction note #1). c. Replace printed circuit boards. Do not attempt repair. Return to the factory. d. If the breaker trips again and everything is normal, the breaker might be defective.
	7. AC breaker tripped.	a. Reclose and observe operation. Should it trip again due to higher than rated output current, proceed as in step #6. b. If it trips but no or small output current is observed, check power diodes. (See instruction note #2). c. If diodes are O.K., check for possible shorts between terminals, cables, or a short to the ground. d. Check power transformer for possible shorts between turns, coils, and to ground.

6–6 Trouble Shooting—Cont.

SYMPTOM	CHECK LIST	NOTES
No Output Current (cont.)	8. Anode Fuses open.	Replace with similar rated fuses.
	9. Control Fuse open.	Replace with similar rated fuse.
	10. Auxiliary Transformer defective.	See instruction note #4.
	11. SCR's opened.	See instruction note #2.
	12. Diodes opened or shorted.	See instruction note #2.
	13. Current Limit Potentiometer defective.	See instruction note #1.
	14. Loose or broken connections.	Look for signs of overheating or corrosion.
	15. Printed circuit boards defective.	Replace — Do not attempt to repair. Return to the factory.
Low Output Voltage	16. Check setting of float and equalize potentiometers.	See instruction note #1.
	17. Low input AC voltage.	Input voltage should be ± 15% of rated voltage.
	18. Auxiliary Transformer defective.	See instruction note #4.
	19. DC Filter Capacitors (if any) shorted.	See instruction note #5.
	20. Loose or broken connections.	Look for signs of overheating or corrosion.
	21. One SCR or one Diode open, or both.	See instruction note #2.
	22. Current Transformer defective.	See instruction note #3.
	23. Current Limit Potentiometer defective or misadjusted.	See instruction note #1.
	24. Printed circuit boards defective.	Replace — Do not attempt to repair. Return to the factory.
High Output Voltage	25. Check setting of float and equalize potentiometers.	See instruction note #1.
	26. Charger connected for lower input voltage.	Check against connection diagram and change to connection for higher voltage.
	27. Loose or broken connections.	Look for signs of overheating or corrosion.
	28. SCR shorted.	See instruction note #2.
	29. Auxiliary Transformer defective.	See instruction note #4.
	30. Printed circuit boards defective.	Replace — Do not attempt to repair. Return to factory.
High Output Current	31. Current Limit Potentiometer defective or misadjusted.	See instruction note #1.
	32. Current Transformer defective.	See instruction note #3.
	33. High current due to high voltage.	Go through steps 25 to 30.

INSTRUCTION NOTES

#1 — POTENTIOMETER CHECK

To increase output voltage, turn float and/or equalize potentiometer clockwise; to decrease the output voltage, turn them counterclockwise.

To increase output current, turn the current limiting potentiometer counterclockwise; to decrease the output current turn the current limiting potentiometer clockwise.

To check a potentiometer, first disconnect at least two of the leads connected to it, and with an ohmmeter check its resistance; also check whether or not the resistance between the slider arm and one of the other terminals varies as the adjustment is turned.

#2 — CHECKING OF DIODES AND SILICON CONTROLLED RECTIFIERS (SCR s)

First disconnect at least one connection to each diode, and then check with an ohmmeter. A good diode will show low resistance from anode to cathode, and very high resistance from cathode to anode. An open diode will show high resistance both ways, and a shorted diode will show low or no resistance both ways.

Check SCRs for shorts in the same manner the diodes are checked. A high resistance reading both ways does not necessarily mean the SCRs are open.

To check for open SCRs, de-energize the charger and pull the printed circuit boards out. Connect a 100 ohm resistor from anode to gate of one SCR and turn the charger back on. If the SCR is O.K. the charger will produce output current. Repeat this procedure for the other SCR.

#3 — CHECKING THE CURRENT TRANSFORMER

First make sure all the leads and cables connected to the current transformer are making good contact, and there are no shorts. If the connections are all good, then disconnect the leads to terminals 1 and 3, and with an ohmmeter check the resistance between terminals 1 and 2, and between 2 and 3 on the current transformer. Both readings should be 150 ohms ± 10%. Also check for shorts between the coils, and from the coils to ground.

#4 — CHECKING THE AUXILIARY TRANSFORMER

Place the AC circuit breaker in the on position energizing the charger. Use an AC voltmeter to check the voltages at the auxiliary transformer. The voltage between terminals 3 and 5, and between terminals 4 and 5 should be 10.5 volts —15%. Voltage between terminals 5 and 6, and between terminals 5 and 7 should be 45 volts —15%.

#5 — CHECKING DC FILTER CAPACITORS

First disconnect at least one terminal of the capacitor to be tested from the circuit. Then with an ohmmeter set to it's highest scale, apply test prods to the capacitor terminals. A good capacitor will show an appreciable meter deflection followed by a decay to zero. A defective capacitor will show meter deflection, but no decay; or the meter will show no deflection whatever.

SECTION 7 — MISCELLANEOUS

7–1 Sample Specifications

Design: The battery charger shall have full wave rectification with silicon controlled rectifiers and silicon diodes. The plug-in type control circuit shall contain sensing, reference and firing modules. The charger must have adjustable float and equalize voltage potentiometers; also a toggle switch to select float or equalize operation. Voltmeter and ammeter shall have 2% accuracy at full scale. AC and DC circuit breakers will be supplied. Semi-conductor transient voltage protection shall be provided for control circuit and rectifiers.

Regulation: The DC charging voltage must be kept within ± ½% from no load to full load, with AC line variations of ± 10% and frequency variations of ± 5%. For lead antimony cells, set float adjustment at 2.15 volts per cell; set equalize adjustment at 2.33 volts per cell. For lead calcium cells, set float adjustment at 2.20 volts per cell.

Cabinet: Battery chargers must be convection cooled, and housed in a sturdy steel cabinet with wall mounting brackets. All components should be readily accessible from the front. Paint the cabinet inside and out with ASA-16 gray paint, after first priming the surface.

Ambient Temperature: The charger shall be capable of continuous operation at current limiting, in an ambient temperature of 40° C.

Charger Output Rating: The battery charger is to automatically recharge a 24-cell, 160-A.H. battery in 12 hours after a 100% discharge, and carry a 2.5-amp constant load.

7–2 Optional and Special Equipment

DC low voltage alarm relay	—	Filtering to 100 millivolts
DC high voltage alarm relay	—	Remote control relay
DC high-low voltage alarm relay	—	Exact load sharing
Over-voltage control	—	Special input voltages
Ground detector lights	—	50-cycle operation
Ground detector switches	—	Audible alarm
Zero to 24-hour equalize timer	—	Load disconnect control
Filtering to 30 millivolts	—	Battery eliminator

SECTION 7 — MISCELLANEOUS

How to Determine Charger Size

The charger rating needed to assure satisfactory performance of the installation may be calculated from the following formula:

$$A = L + \frac{1.1C}{H}$$

Choose the next highest rating of battery charger above the answer derived.

Where—

A = DC output rating of charger in amperes.
L = Constant load on system.
C = Calculated number of ampere-hours discharged from battery.
H = Number of hours recharge time available.

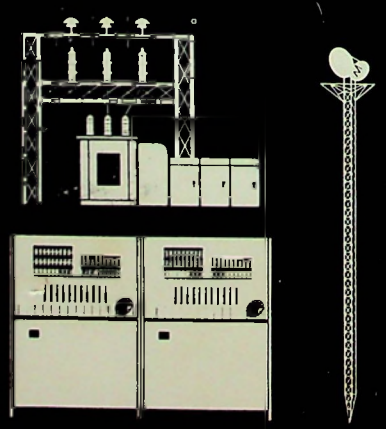
Proper Float and Equalize Voltages

Type	Cell voltages	
	Float	Equalize
Lead antimony	2.15	2.33
Lead calcium	2.17 2.20	2.33 Not required
Nickel-cadmium	1.43	1.55
Nickel-iron	1.5-1.55	1.6-1.65

C&D BATTERIES
DIVISION OF ELTRA CORPORATION
Washington & Cherry Streets, Conshohocken, Pa.

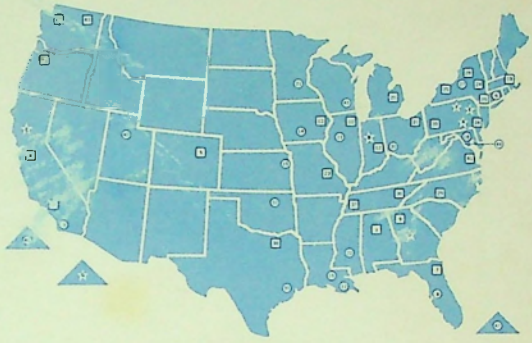
C&D LEAD-CALCIUM STATIONARY BATTERIES

C&D lead-calcium batteries cost less per year than any other type of stationary batteries. In addition, they require only 1/10 to 1/50 as much float current as lead antimony batteries to maintain in fully charged condition. C&D lead-calcium batteries will never require equalizing charges . . . if maintained between 2.20 to 2.25 volts per cell. Water additions are reduced 80%—only once every 3 to 5 years under average conditions.



SERVICE FROM COAST TO COAST

C&D has sales and service centers in major cities throughout the country. Technically trained representatives will make occasional checks on your Value Assured AutoReg SCR chargers, at your convenience, to make sure you are receiving maximum performance. They can also give you the story on the complete line of C&D industrial batteries.



Plants—
☆ Conshohocken, Pa.
☆ Attica, Indiana
☆ Santa Rosa, Calif.
☆ Conyers, Ga.
☆ Pennsburg, Pa.
☆ Esbach, Pa.
☆ Mexico City (Affiliate)

1 Birmingham, Alabama
2 Los Angeles, California
3 San Diego, California
4 San Francisco, California
5 Denver, Colorado
6 New Haven, Connecticut
7 Jacksonville, Florida
8 Tampa, Florida
9 Atlanta, Georgia
10 Chicago, Illinois
11 Peoria, Illinois
12 Indianapolis, Indiana
13 Bettendorf, Iowa
14 Des Moines, Iowa
15 Kansas City, Kansas
16 Baton Rouge, Louisiana
17 New Orleans, Louisiana
18 Baltimore, Maryland
19 Boston, Massachusetts
20 Detroit, Michigan
21 St. Paul, Minnesota
22 Jackson, Mississippi
23 St. Louis, Missouri
24 Albany, New York
25 Buffalo, New York
26 New York, New York
27 Rochester, New York
28 Syracuse, New York
29 Charlotte, North Carolina
30 Cincinnati, Ohio
31 Cleveland, Ohio
32 Tulsa, Oklahoma
33 Portland, Oregon
34 Philadelphia, Pennsylvania
35 Pittsburgh, Pennsylvania
36 Knoxville, Tennessee
37 Memphis, Tennessee
38 Dallas, Texas
39 Houston, Texas
40 Salt Lake City, Utah
41 Richmond, Virginia
42 Seattle, Washington
43 Spokane, Washington
44 Washington, D.C.
45 Milwaukee, Wisconsin
46 Honolulu, Hawaii
47 San Juan, Puerto Rico

NOTE: ☐ Representative owned and operated service stations.

Wherever you may be located, there is a qualified C&D sales and service representative to serve you. Contact him for all industrial battery or charger requirements.

Gentlemen:

This postage prepaid card is provided for your convenience.

When the charger has been installed please notify us by mailing this card with the information requested.

On receipt of this information our Field Representative will be notified and will call as soon as practical for our field inspection.

We appreciate this opportunity to serve your requirements.

Very truly yours,

C&D BATTERIES
DIVISION OF ELTRA CORPORATION

NOTICE

C & D Invoice No. _____

THIS WILL ADVISE THAT A C & D CHARGER

Model No. _____ Serial No. _____

has been received and will be put in service at the following location:

Company Name _____

Address _____

City _____ State _____

Reported by _____ Date _____

Remarks _____

_____

(Please Print)

First Class
Permit No. 2
(Sec. 34.9, P.L. & R.)
Conshohocken, Pa.

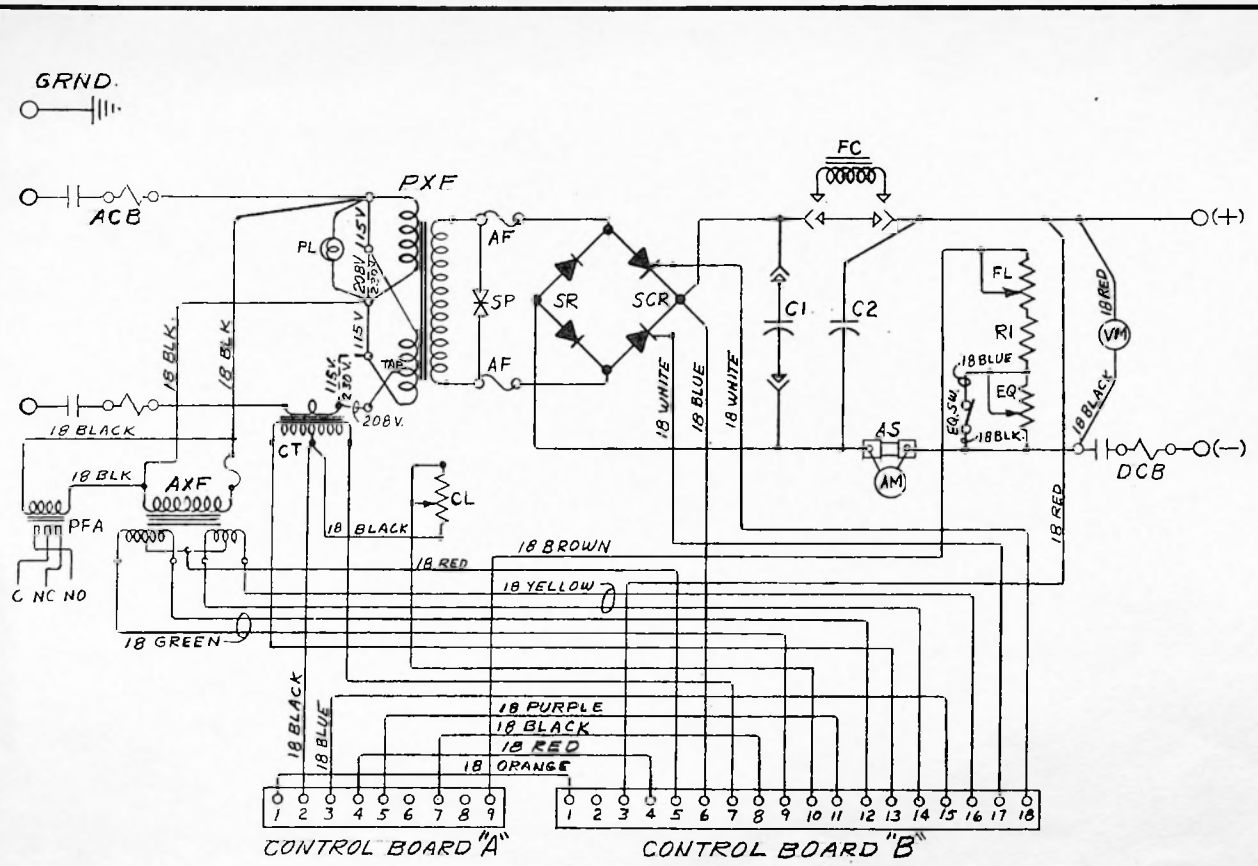
BUSINESS REPLY CARD
No Postage Stamp Necessary If Mailed In United States

Postage will be paid by

C&D BATTERIES
DIVISION OF ELTRA CORPORATION
WASHINGTON & CHERRY STREETS · CONSHOHOCKEN, PENNA.

Attention:
Headquarters Sales

C&D BATTERIES
DIVISION OF ELTRA CORPORATION
WASHINGTON & CHERRY STREETS · CONSHOHOCKEN, PENNA.



LEGEND

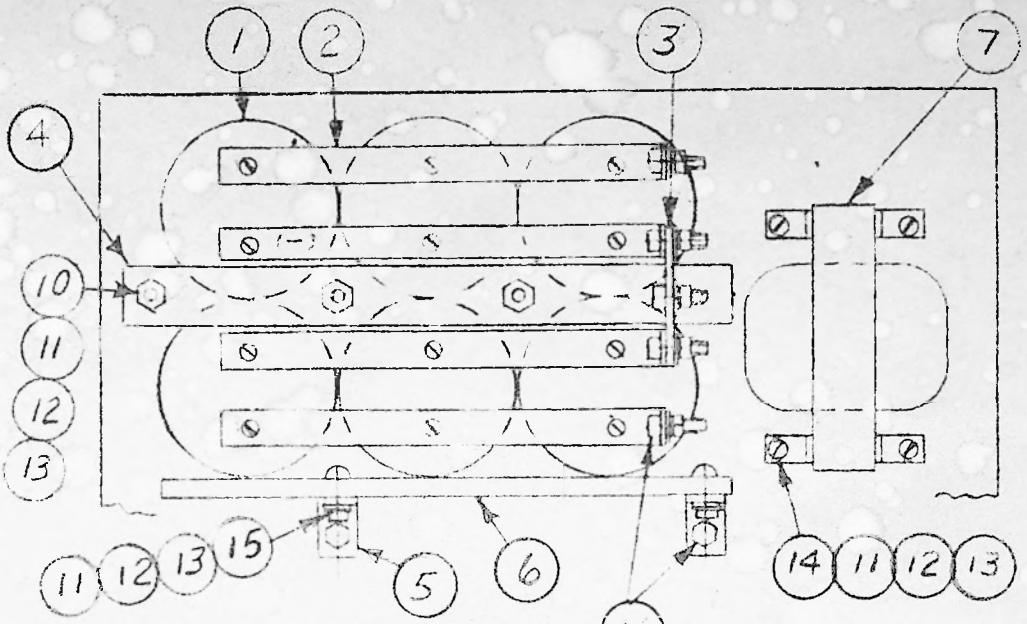
ACB	A.C. CIRCUIT BREAKER
AF	ANODE FUSE
AM	AMMETER
AS	AMMETER SHUNT
AXF	AUX. TRANSFORMER
C1 (OPT.)	CAPACITOR - FILTER
C2	CAPACITOR - FILTER
CL	CURRENT LIMIT POT.
CT	CURRENT TRANSFORMER
DCB	D.C. CIRCUIT BREAKER
EQ	EQUALIZE POT.
EQ. SW.	EQUALIZE SWITCH
FI	FUSE
FC	FILTER CHOKE (OPT.)
FL	FLOAT POT.
PFA	POWER FAILURE ALARM
PL	PILOT LIGHT
PXF	POWER TRANSFORMER
RI	RESISTOR
SCR	SILICON CONTROLLED RECT.
SP	SURGE PROTECTOR
SR	SILICON RECTIFIER
VM	VOLTMETER

NO.	DATE	BY	REVISION
A	1-27-66	BS	REVISED PRI. CIR FOR 208V. TAP

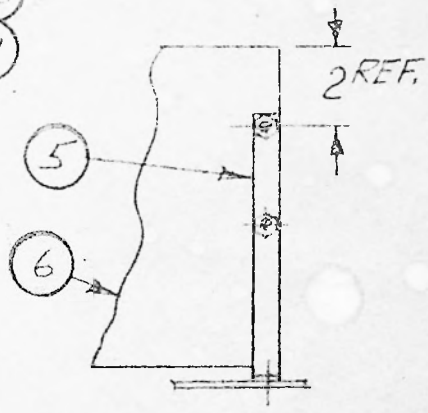
C&D BATTERIES
DIVISION OF ELTRA CORPORATION
CONSHOHOCKEN, PENNA.

DIAGRAM, SCHEMATIC
1Ø 115/208/230 VAC S.C.F. CHGRS.
50-200 AMPS D.C.

DRAWN BS	APPROVED
CHECKED RMa	DRAWING NO. KBC-1251
DATE 4-20-65	
SCALE	



ITEM	PART NO	QTY	DESCRIPTION
1	JC-59	6	CAPACITOR 7800 MFD
2	JA-29	4	BUSBAR
3	JA-41	1	BUSBAR CONN.
4	JA-344	1	BAR CAP MTG.
5	JA-327	2	BRACKET
6	JA-540	1	PLATE SUPPORT
7	T-714	1	CHOKE, FILTER
8			
9			
10	JH-508	4	#10-32 x 9½ ROD
11	JH-493	16	#10 FLAT WASHER
12	JH-483	16	#10 STAR LOCKWASH
13	JH-450	16	#10-32 HEX NUT
14	JH-452	4	#10-32 x ½ RD HD MS
15	JH-454	4	#10-32 x ¾ RD HD MS
16	JH-102	7	¼-20 x ¾ HEX HD MS
17	JH-138	12	¼ FLAT WASHER
18	JH-1125	7	¼ STAR LOCKWASH.
19	JH-136	7	¼-20 HEX NUT.



NO	DATE	BY	REVISION

C&D BATTERIES
A DIVISION OF ELTRA CORPORATION
CONSHOHOCKEN, PENNA.

ARRANGEMENT, FILTERING 30 MV ARR 24 AC 100

DRAWN JH	APPROVED
CHECKED	DRAWING NO.
DATE 5-17-60	JA-599
SCALE 3/8	

C&D BATTERIES
DIVISION OF ELTRA CORPORATION
WASHINGTON & CHERRY STS. . CONSHOHOCKEN, PA. 19428 - 215-828-9000 . TELETYPE 828-0626

Service Warranty

This battery charger was produced under strict quality control Supervision, carefully inspected and thoroughly tested before shipment from the factory.

GUARANTY: We warrant this equipment to be proper materials and first-class workmanship. As the sole and exclusive remedy in discharge of this warranty, we agree to repair or replace, f.o.b. Conshohocken, Penna., any equipment, or parts, of our manufacture which prove defective in material or workmanship within one year from date of shipment, provided the buyer returns the defective items to our works, prepaid, for our inspection. We undertake no responsibility for work done, or expense incurred in connection with repair or replacement except on specific authority from our General Sales Office in Conshohocken, Penna. It is agreed that we shall have no liability for general and special damages or for negligence, and there are no warranties, either express or implied by the parties or by law, other than those expressly provided herein.

AFTER ONE YEAR from the date of purchase, a reasonable charge will be made for service calls and all parts necessary to insure proper charger performance.

AutoReg
C&D BATTERIES DIV. ELTRA CORP.

AutoReg

C&D BATTERIES DIV. ELTRA CORP.

QUALITY ASSURANCE CERTIFICATION

The C & D Charger, Type ARR 24 A/C 100 F3

as shipped to KLRN Television

under purchase order number 624

has been fabricated with the best techniques and practices known within our trade. All materials and processes including applicable Inspection Procedures meet specified requirements and that the electrical and mechanical test reports of the materials used herein are on file along with all individual relative Quality Control and Inspection Histories.

I Certify all the above conditions as stated to be true and correct within the limit of my knowledge and as attested to by my Final Inspector's signature.

Date 1/19/67

John J. Greene

Quality Control Supervisor
C & D Batteries
Division of ELTRA Corp.

Final Inspection

By E. J.