

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

---

**FIELD (FOURTH ECHELON) AND DEPOT  
MAINTENANCE MANUAL  
CHARGER, BATTERY PP-1660/G**

---

Headquarters, Department of the Army, Washington 25, D.C.

29 June 1962

---

**WARNING**

**HIGH VOLTAGE**

is used in this equipment.

**DEATH ON CONTACT**

may result if safety precautions  
are not observed.

1. Be careful when working on the 115-volt ac input circuit. Use insulated test probes when making voltage measurements. When working inside the equipment, be extremely careful not to touch any internal parts while the battery charger is energized. Disconnect the ac input cable before performing routine maintenance or attempting to remove any part.
2. The failure of selenium rectifiers can result in the liberation of poisonous fumes and the deposit of poisonous selenium compounds. When a rectifier burns out or arcs over, the odor is strong. Provide maximum ventilation immediately. *Avoid inhaling the fumes.* Do not touch the damaged rectifier until it has cooled.

**DON'T TAKE CHANCES!**

---

		Paragraph	Page
CHAPTER	1. INTRODUCTION		
	Scope . . . . .	1	2
	Associated publications . . . . .	2	2
CHAPTER	2. THEORY		
	Block diagram analysis . . . . .	3	3
	Circuit analysis . . . . .	4	3

THIS PUBLICATION IS A COURTESY QUICK COPY FROM THE UNITED STATES ARMY PUBLICATIONS DISTRIBUTION CENTER, ST. LOUIS, MISSOURI, TO MEET YOUR NEEDS WHILE WE REPLENISH OUR REGULAR STOCK.

C H A P T E R 3 .	MAINTENANCE INSTRUCTIONS		Paragraph
Section I.	General		
	Scope of field and depot maintenance . . . . .	5	
	Tools, materials, and test equipment . . . . .	6	7
II.	Routine maintenance		
	Scope of routine maintenance. . . . .	7	7
	Routine maintenance procedures . . . . .	8	7
III.	Troubleshooting		
	Scope of troubleshooting . . . . .	9	8
	Troubleshooting procedures. . . . .	10	8
	Troubleshooting chart . . . . .	11	9
	Voltage measurements . . . . .	12	10
	Resistance measurements . . . . .	13	11
IV.	Removal and replacement of parts and testing after repair		
	General procedures . . . . .	14	11
	Removal and replacement of parts . . . . .	15	11
	Testing after repair . . . . .	16	13
C H A P T E R 4 .	FINAL TESTING		
	Purpose of final testing . . . . .	17	16
	Test equipment for final testing . . . . .	18	16
	Physical inspection . . . . .	19	16
	Insulation resistance tests . . . . .	20	16
	Function tests . . . . .	21	17
A P P E N D I X .	REFERENCES . . . . .		19

---

## CHAPTER 1

### INTRODUCTION

---

#### 1. Scope

*a.* This manual covers field (fourth echelon) and depot (fifth echelon) maintenance of Charger, Battery PP-1660/G. It includes instructions appropriate to fourth and fifth echelons for routine maintenance of the PP-1660/G; for troubleshooting, testing, and repairing this equipment, and for replacing maintenance parts. The electrical functions of the equipment are described in paragraphs 3 and 4.

*b.* Refer to DA Pamphlet No. 310-4 to determine what Changes to or revisions of this publication are current.

*c.* Forward all comments concerning this manual to the Commanding Officer,

U. S. Army Signal Materiel Support Agency, ATTN: SIGMS-MPP-4, Fort Monmouth, N. J.

*Note:* For applicable forms and records, see paragraph 2, TM 11-6130-227-12.

#### 2. Associated Publications

The operating instructions and operator's (first echelon) and organizational (second echelon) maintenance instructions for the PP-1660/G are contained in TM 11-6130-227-12. TM 11-6130-227-12 also contains the basic issue items list and covers maintenance allocation for this equipment.

## CHAPTER 2

### THEORY

---

#### 3. Block Diagram Analysis (fig. 1)

During fast charging, the contacts of TIME SWITCH M1 are closed and the alternating-current (ac) input is applied directly to the primary winding of transformer T1. During slow charging, the contacts of TIME SWITCH M1 are open and the 115-volt ac input is connected through current-limiting reactor L1 to the primary winding of transformer T1. Transformer T1 has two separate secondary windings. The output of one is connected to rectifier CR1, and the output of the other is connected to rectifier CR2. The full-wave direct-current (dc) outputs of rectifiers CR1 and CR2 are switched by relays K2 through K6 into series or parallel combinations to provide the proper dc output voltages and currents for fast- or slow-charging 6-, 12-, or 24-volt storage batteries.

#### 4. Circuit Analysis (fig. 2)

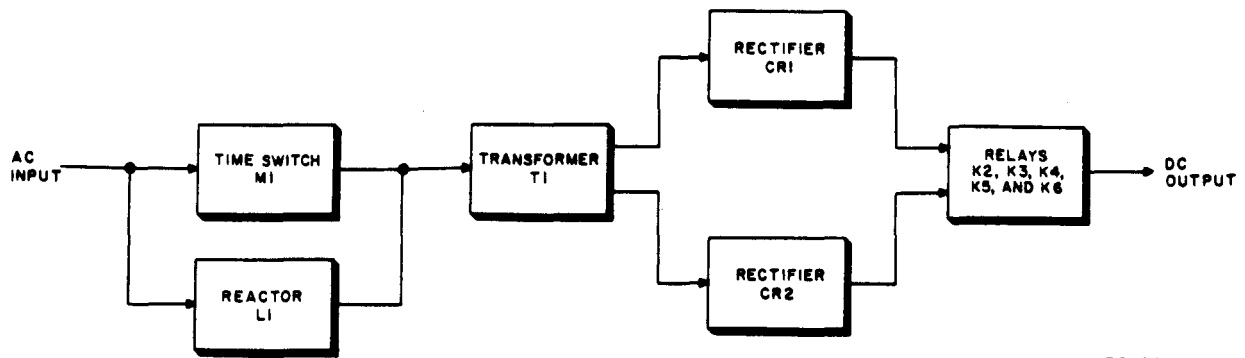
*a. Ac Input Circuit.* One side of the 105- to 125-volt ac input is connected, by means of plug connector P1 and the ac input cable, through either TIME SWITCH M1 or reactor L1 to CHARGE SWITCH S1; the other side of the ac input is connected to terminal 5 of transformer T1. TIME SWITCH M1 is a mechanically operated clock with a normally open electrical contact.

- (1) When TIME SWITCH M1 is in the SLOW CHARGE position, its electrical contact is open. The ac input then is connected through reactor L1 and circuit breaker CB1 to the rotor of CHARGE SWITCH S1, and the ac input circuit is completed through the selected contact of CHARGE SWITCH S1 and the associated tap of the primary winding of transformer T1 (*b* below). Reac-

tor L1 is a choke that limits the input current applied to transformer T1. Circuit breaker CB1 is a thermal type, automatic reset circuit breaker rated at 5 amperes. Connected in series with reactor L1, it opens the input circuit to protect reactor L1 from overload when the input current exceeds this value. After a cooling period, circuit breaker CB1 recloses the input circuit automatically.

- (2) Setting TIME SWITCH M1 to any time interval between 1 and 55 minutes closes its electrical contact and winds the clock mechanism, which holds the contact closed until the expiration of the time interval for which TIME SWITCH M1 is set. When the contact of TIME SWITCH M1 is closed, the ac input is connected, directly to the rotor of CHARGE SWITCH S1 and the input circuit is completed through the selected contact of CHARGE SWITCH S1 and the associated tap of the primary winding of transformer T1 (*b* below).

*b. Transformer T1 Circuits.* Transformer T1 has a multiple-tapped primary winding and two separate, identical, center-tapped secondary windings. Primary taps 1, 2, 3, and 4 are connected to contacts 3, 4, 5, and 6, respectively, of CHARGE SWITCH S1. Thus the setting of CHARGE SWITCH S1 determines the number of effective turns of the primary winding of transformer T1 and consequently the voltage and current of the outputs of the two secondary windings. This arrangement provides a range of transformer outputs that permits the selection of a high, medium, or low charging rate (*c* below). Blower motor B1 is connected across the ac input between contact 5 of CHARGE SWITCH S1 and terminal 5 of the primary winding of transformer T1. The



TM6130-227-45-1

Figure 1. Charger, Battery PP-1660/G, block diagram.

primary winding of transformer T1 acts as an autotransformer so that the voltage applied to blower motor B1 increases as CHARGE SWITCH S1 is advanced from LOW to MED to HIGH and consequently the speed of blower motor B1 increases proportionally. Thus, a larger amount of cooling air is drawn in and expelled by the blower as the charging rate is increased.

c. *Rectifier Circuits.* Transformer T1 has two separate, identical secondary windings whose output voltage is controlled by the position of CHARGE SWITCH S1 (*b* above). The output of secondary winding 6-8 is connected to rectifier CR1, and the output of secondary winding 9-11 is connected to rectifier CR2. Each rectifier is a full-wave, bridge rectifier; this arrangement provides two separate full-wave rectifier circuits. Each rectifier circuit has a maximum output of approximately 12.6 volts at 40 amperes. These outputs are connected to five solenoid relays (K2 through K6) in such a manner that they can be switched into series and parallel combinations (*d* below) to provide proper dc voltages and currents for fast- or slow-charging 6-, 12-, or 24-volt storage batteries. Circuit breakers CB2 and CB3 are connected into the output circuits of rectifiers CR1 and CR2, respectively, to protect the rectifiers from overload when the battery charger is operated in the fast-charge range. Circuit breakers CB2 and CB3 are thermal type, automatic reset circuit breakers. Each is rated at 40 amperes and will open its rectifier circuit when the dc output current of that

circuit exceeds this value. After a cooling period, the circuit breaker will reclose the rectifier circuit automatically. Ammeter M2 is a dc ammeter inserted in one side of the dc output circuit. It indicates the dc output of the battery charger (charging rate) in amperes. Resistor R1 is a meter shunt for ammeter M2.

d. *Switching Circuits.* The switching circuits consist of BATTERY VOLTS switch S2 and solenoid relays K2 through K6, which are energized in various combinations, depending on the position of BATTERY VOLTS switch S2. The 6-volt dc required to energize the coils of the relays is taken from legs B and C of rectifier CR2.

- (1) *6-volt charging.* When BATTERY VOLTS switch S2 is in the 6 position, relays K2 and K6 are energized. The energizing circuit is from center tap 10 of winding 9-11 of transformer T1, through BATTERY VOLTS switch S2 in the 6 position, through the coils of relays K2 and K6 in parallel, through normally closed contacts 3-4 of relay K1, to the negative (-) terminal of rectifier CR2. When relays K2 and K6 are operated, two parallel circuits, using legs B and C of rectifier CR1 and legs A and D of rectifier CR2 as a full-wave, center-tap rectifier, are established. This arrangement produces a dc output of approximately 6.5 volts at 75 amperes maximum. One circuit is from center tap 7 of

winding 6-8 of transformer T1, through contacts 4-3 of relay K6, through ammeter M2 to positive (+) battery connector P3, through the battery under charge to negative (-) battery connector P2, and through circuit breaker CB2 to the negative terminal of rectifier CR1. The other circuit is from the positive (+) terminal of rectifier CR2, through circuit breaker CB3 and ammeter M2 to positive battery connector P3, through the battery under charge to negative battery connector P2, through contacts 4-3 of relay K2, to center tap 10 of winding 9-11 of transformer T1. The coil of relay K1 is connected directly across the dc output of the rectifiers and controls the operation of relays K2 and K6. Relay K1 will operate (open its contacts) when a voltage of 16 to 18 volts passes through its coil. This de-energizes relays K2 and K6 and opens the dc output circuit to prevent damage to the rectifiers in case of overload.

- (2) *12-volt charging.* When BATTERY VOLTS switch S2 is in the 12 position, relays K3 and K5 are energized. The energizing circuit is from center tap 10 of winding 9-11 of transformer T1, through BATTERY VOLTS switch S2 in the 12 position, through the coils of relays K3 and K5 in parallel, to the negative terminal of rectifier CR2. When relays K3 and K5 are operated, two full-wave rectifier circuits, using rectifiers CR1 and CR2 connected in parallel, are established. This arrangement produces a dc output of approximately 12.6 volts at 75 amperes maximum. One circuit is from the

positive terminal of rectifier CR2, through circuit breaker CB3 and ammeter M2 to positive battery connector P3, through the battery under charge to negative battery connector P2, through contacts 3-4 of relay K3 to the negative terminal of rectifier CR2. The other circuit is from the positive terminal of rectifier CR1, through contacts 3-4 of relay K5 and ammeter M2 to positive battery connector P3, through the battery under charge to negative battery connector P2, and through circuit breaker CB2 to the negative terminal of rectifier CR1.

- (3) *24-volt charging.* When BATTERY VOLTS switch S2 is in the 24 position, relay K4 is energized. The energizing circuit is from center tap 10 of winding 9-11 of transformer T1, through BATTERY VOLTS switch S2 in the 24 position, through the coil of relay K4, to the negative terminal of rectifier CR2. When relay K4 is operated, a full-wave rectifier circuit, using rectifiers CR1 and CR2 connected in series, is established. This arrangement provides a dc output of approximately 26 volts at 40 amperes maximum. This circuit is from the positive terminal of rectifier CR1, through contacts 4-3 of relay K4 to the negative terminal of rectifier CR2, through rectifier CR2 to its positive terminal, through circuit breaker CB3 and ammeter M2 to positive battery connector P3, through the battery under charge to negative battery connector P2, through circuit breaker CB2 to the negative terminal of rectifier CR1.

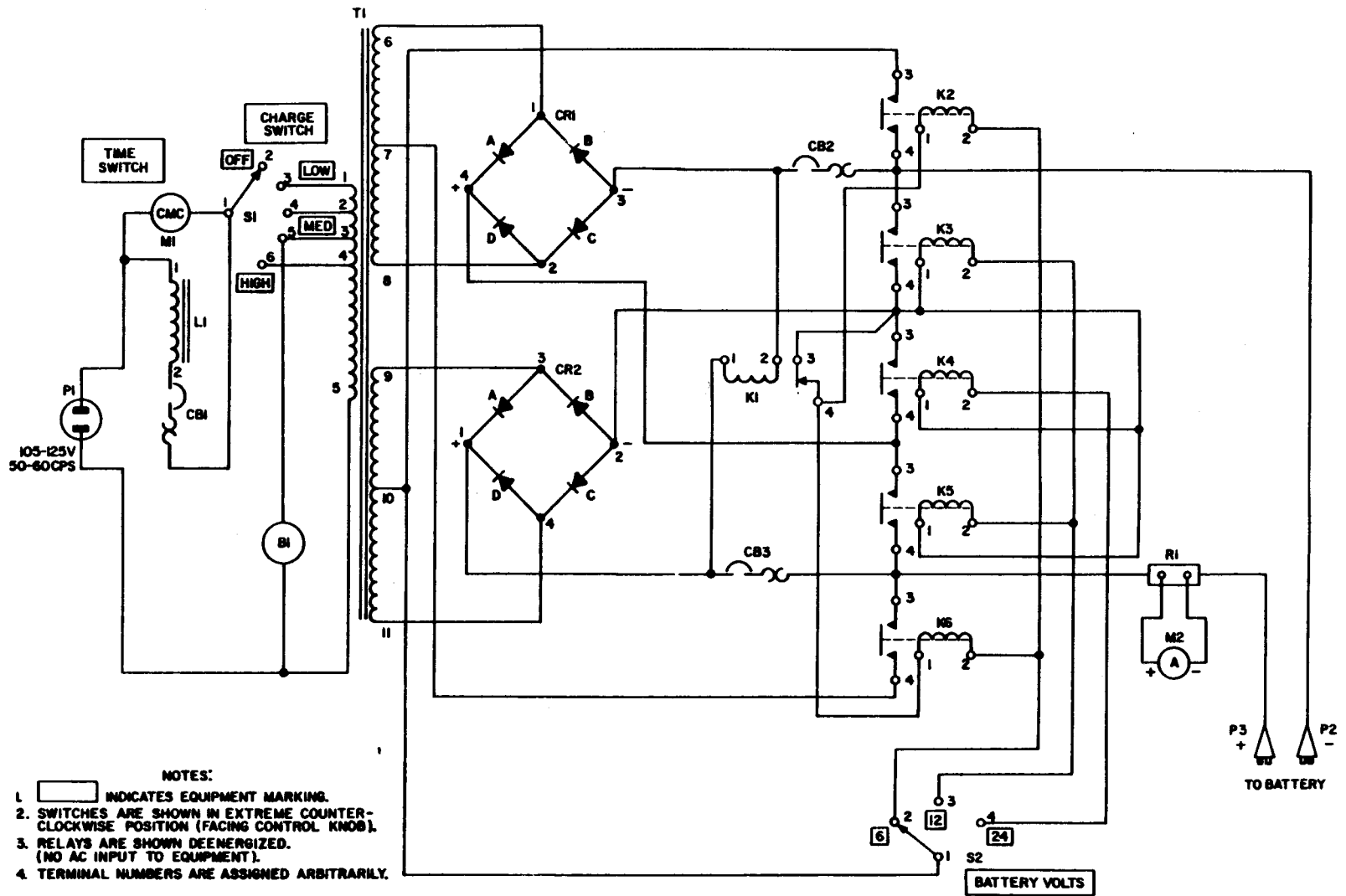


Figure 2. Charger, Battery PP-1660/G, schematic diagram.

# CHAPTER 3

## MAINTENANCE INSTRUCTIONS

---

### Section I. GENERAL

#### 5. Scope of Field and Depot Maintenance

*a. Third Echelon.* No maintenance is performed at third echelon.

*b. Fourth Echelon.* Fourth echelon maintenance of the PP-1660/G consists of the following:

- (1) Routine maintenance (para 7 and 8).
- (2) Troubleshooting (para 9 through 13).
- (3) Replacement of authorized maintenance parts (para 14 and 15).
- (4) Testing performance for return to service (para 16).

*c. Fifth Echelon.* Fifth echelon maintenance

duties are the same as fourth echelon (*b* above) and include also complete overhaul of the equipment and final testing (para 17 through 21) for return to service or to depot stock.

#### 6. Tools, Materials, and Test Equipment

The following tools, materials, and test equipment are required for routine maintenance, troubleshooting, and repair:

*a.* Tool Kit TK-87-A.

*b.* Cleaning Compound (FSN 7930-395-95421).

*c.* Multimeter TS-352/U (TM 11-5527).

### Section II. ROUTINE MAINTENANCE

#### 7. Scope of Routine Maintenance

*a. Duties.* Routine maintenance of the PP-1660/G consists of the following:

- (1) Cleaning the interior of the equipment (para 8 *a*).
- (2) Inspecting interior parts and wiring (para 8 *b*).
- (3) Tightening loose connections and mounting hardware (para 8 *b*).

*b. Intervals.* Perform routine maintenance regularly in accordance with a schedule established on the basis of days or months of use, with consideration for the conditions under which the equipment is operated. For maintenance purposes, a day consists of 8 hours of operation and a month consists of 30 days of 8-hour operation. It is recommended that routine maintenance of the PP-1660/G be performed monthly, or more frequently under adverse operating conditions, such as exist in very hot, humid, or dusty areas.

#### 8. Routine Maintenance Procedures

**Warning:** Place the CHARGE SWITCH in the OFF position and disconnect the ac

**input cable from the ac supply before servicing the PP-1660/G. Never perform routine maintenance with the power on.**

*a. Cleaning.* Remove the cover of the battery charger (para 15a) and clean the interior of the equipment. Use a clean, dry cloth to remove dust and dirt. If necessary, use a cloth dampened with cleaning compound and then wipe thoroughly dry with a clean, dry cloth. If available, vacuum cleaning equipment or dry compressed air may be used to remove loose dust and dirt. If compressed air is used, the pressure must be low enough to prevent damage to the equipment. Be sure the front, bottom, and rear ventilating grilles are thoroughly clean and free of foreign matter that might obstruct the free circulation of air.

**Warning:** Cleaning compound is flammable and its fumes are toxic. Do not use near a flame and provide adequate ventilation.

*b. Inspection.* Inspect all interior parts and wiring carefully for evidence of incipient malfunction or failure.

- (1) See that all parts are mounted securely. Tighten loose mounting hardware and replace any that is missing.
- (2) See that all switch contacts are clean and tight; clean and tighten, if necessary.
- (3) Inspect the transformer, reactor, and rectifiers for evidence of overheating.
- (4) See that the impeller is mounted securely on the hub of the blower motor and that it rotates freely and has adequate clearance.
- (5) See that all wiring is in good condition and that connections are clean and tight. If necessary, clean and tighten connections; replace wiring that shows evidence of deterioration.

### Section III. TROUBLESHOOTING

**Warning:** Be extremely careful when performing troubleshooting with the power on. Use insulated test probes when making voltage measurements. Always disconnect the ac input cable before touching any internal part.

#### 9. Scope of Troubleshooting

Troubleshooting at the field and depot maintenance level includes all the techniques outlined for operator's and organizational maintenance and all additional techniques required to isolate a defective part. The field and depot maintenance procedures are not complete in themselves, but supplement the procedures described in TM 11-6130-227-12.

#### 10. Troubleshooting Procedures

The first step in servicing a defective battery charger is to sectionalize the fault to a major circuit group. The second step is to localize the trouble to an individual circuit that is not functioning properly, and the final step is to isolate the defective part.

*a. Operational Checks.* Most trouble in the PP-1660/G can be sectionalized to the ac input circuits, the transforming circuits, the rectifying circuits, or the switching circuits by systematic checks of the performance of the equipment. Examine the repair tag to see whether the trouble has been sectionalized and localized by first and second echelon personnel. If the trouble has not been localized, check the performance of the equipment in accordance with the equipment performance checklist and the troubleshooting instructions in TM 11-6130-227-12.

*b. Visual Inspection.* Before disassembling the equipment, inspect it. Many defective parts can be identified by sight, touch, or smell. Remove the cover of the case (para 15 a) and inspect all internal parts and wiring carefully for evidence of damage such as the following:

- (1) Loose or broken connections and defective wiring.
- (2) Loose or missing mounting hardware and broken or otherwise physically damaged parts.

**Warning:** The failure of selenium rectifiers can result in the liberation of poisonous fumes and the deposit of poisonous selenium compounds. When a rectifier burns out or arcs over, the odor is strong. Provide maximum ventilation immediately. *Avoid inhaling the fumes. Do not touch the damaged rectifier until it has cooled.*

- (3) Blistered, buckled, or discolored rectifier plates.
- (4) Evidence of overheated transformer, reactor, or blower motor.

*c. Troubleshooting Chart.* Use the troubleshooting chart (para 11) as an aid in determining the probable causes of the symptoms of faulty operation and the corrective measures required.

*d. Tests.* Use Multimeter TS-352/U to perform point-to-point continuity tests and to make voltage and resistance measurements (para 12 and 13) to determine the



condition of individual parts. Refer to the schematic diagram (fig. 2) to identify circuit components and test points and to the wiring diagram (fig. 5) for

point-to-point wiring and connection points.

### 11. Troubleshooting Chart

Symptom	Probable cause	Corrective measure
No dc output in either slow- or fast-charge ranges and blower does not operate.	No ac input -----	Check continuity of ac input cable; repair or replace (para 15c) if defective.
	CHARGE SWITCH S1 defective -----	Replace CHARGE SWITCH S1 (para 15g).
	Primary winding of transformer T1 open.	Check primary winding of transformer T1 (para 12a); if open, replace transformer T1 (para 15j).
No dc output in either slow- or fast-charge ranges but blower operates with CHARGE SWITCH S1 in one MED position.	Primary winding of transformer T1 open.	Check primary winding of transformer T1 (para 12a); if open, replace transformer T1 (para 15j).
Dc outputs in fast-charge range satisfactory but no dc output in slow-charge range.	Reactor L1 defective -----	Check reactor L1 (para 13); replace if defective (para 15k).
	Circuit breaker CB1 defective -----	Check circuit breaker CB1; replace if defective (para 15f).
Dc outputs in slow-charge range satisfactory but no dc output in fast-charge range.	TIME SWITCH M1 defective -----	Replace TIME SWITCH M1 (para 15f).
Dc outputs in both fast- and slow-charge ranges satisfactory but blower does not operate.	Blower motor B1 defective -----	Check continuity of motor winding and check rotor for binding; replace blower motor B1 (para 15b) if defective.
	Transformer T1 defective -----	Check secondary windings of transformer T1 (para 12a); if unsatisfactory, replace transformer T1 (para 15j).
Blower operates with TIME SWITCH M1 and CHARGE SWITCH S1 in any position (except OFF) but no dc output at any setting of BATTERY VOLTS switch S2.	Rectifier CR2 defective -----	Check rectifier CR2 (para 12b); replace rectifier assembly (para 15j) if defective.
	BATTERY VOLTS switch S2 defective	Replace BATTERY VOLTS switch S2 (para 15h).
	Dc output cable defective -----	Check continuity of both dc output cables; repair or replace defective dc output cable (para 15c).
No dc output with BATTERY VOLTS switch S2 in 6 position; outputs with BATTERY VOLTS switch S2 in 12 or 24 position satisfactory.	Relays K2 and K6 defective -----	Check relays K2 and K6 (para 12d and 13); replace (para 15m) if defective.
	Relay K1 defective -----	Check relay K1 (para 12c and 13); replace (para 15m) if defective.
	BATTERY VOLTS switch S2 defective	Replace BATTERY VOLTS switch S2 (para 15h).
Charging rate higher than 40 amperes cannot be obtained in 6-volt fast charging.	Rectifier CR1 defective -----	Check rectifier CR1 (para 12b); replace (para 15j) if defective.
	Transformer T1 defective -----	Check transformer T1 winding 6-8 (para 12a); if defective, replace transformer T1 (para 15j).
No dc output with BATTERY VOLTS switch S2 in 12 position; outputs with BATTERY VOLTS switch S2 in 6 or 24 position satisfactory.	Relay K6 defective -----	Check relay K6 (para 12d and 13); replace (para 15m) if defective.
	Relays K3 and K5 defective -----	Check relays K3 and K5 (para 12d and 13); replace (para 15m) if defective.
	BATTERY VOLTS switch S2 defective	Replace (para 15h) BATTERY VOLTS switch S2.

Symptom	Probable cause	Corrective measure
<p>Charging rate higher than 40 amperes cannot be obtained in 12-volt fast charging.</p> <p>No dc output with BATTERY VOLTS switch S2 in 24 position; output with BATTERY VOLTS switch S2 in 6 or 12 position satisfactory.</p> <p>Charging rate does not increase when CHARGE SWITCH S1 is advanced to MED and HIGH.</p> <p>Battery charger operating but ammeter M2 does not indicate any dc output.</p> <p>Battery charger stops whenever 40-ampere charging rate is exceeded during 6- or 12-volt charging.</p> <p>TIME SWITCH M1 does not return to SLOW CHARGE position.</p> <p>Charging rate does not drop back into slow-charge range when TIME SWITCH M1 returns to SLOW CHARGE position.</p> <p>Maximum charging rate in fast-charge range cannot be obtained.</p>	Rectifier CR1 defective -----	Check rectifier CR1 (para 12b); replace rectifier assembly (para 15j) if defective.
	Transformer T1 defective -----	Check transformer T1 winding 6-8 (para 12a); if defective, replace transformer T1 (para 15j).
	Circuit breaker CB2 defective -----	Replace circuit breaker CB2 (para 15m).
	Relay K5 defective -----	Check relay K5 (para 12d and 13); replace (para 15 m) if defective.
	Relay K4 defective -----	Check relay K4 (para 12d and 13); replace (para 15m) if defective.
	BATTERY VOLTS switch S2 defective	Replace BATTERY VOLTS switch S2 (para 15h).
	CHARGE SWITCH S1 defective -----	Replace CHARGE SWITCH S1 (para 15g).
	Ammeter M2 disconnected or defective.	Check connections of ammeter M2 to shunt resistor R1; replace ammeter M2 (para 15l) if defective.
	Circuit breaker CB2 or CB3 defective	Check circuit breakers CB2 and CB3; replace defective circuit breaker (para 15m).
	Clock of TIME SWITCH M1 defective	Replace TIME SWITCH M1 (para 15f).
TIME SWITCH M1 defective -----	Replace TIME SWITCH M1 (para 15f).	
Reactor L1 defective -----	Check reactor L1 (para 13); replace (para 15k) if defective.	
Rectifiers CB1 and CB2 aged or defective.	Check rectifiers CR1 and CR2 (para 12b); replace rectifier assembly (para 15j) if unsatisfactory.	

## 12. Voltage Measurements

*Warning:* Be extremely careful when making voltage measurements. Use insulated test probes and do not touch any internal part of the battery charger while it is energized.

*a. Transformer T1.* With the battery charger operating in the fast-charge range and the CHARGE SWITCH at LOW (the BATTERY VOLTS switch may be in any position), the voltages shown in the chart below should be obtained between the terminals indicated.

Winding	Terminals	Volts
Primary	1-5	115
	2-5	106.5
	3-5	99.0
	4-5	93.0
Secondary	6-8	15.0
	6-7	7.5

Winding	Terminals	Volts
	9-11	15.0
	9-10	7.5

*Note:* The voltage values given in the chart above are based on a 115-volt ac input. If the ac input voltage is above or below this value, the voltages across the several windings of transformer T1 will vary proportionally.

*b. Rectifiers CR1 and CR2.* With the battery charger operating in the fast-charge range, the BATTERY VOLTS switch at 12, and the charging rate adjusted to 75 amperes, measure the voltage across each leg of rectifiers CR1 and CR2. The difference between the highest and the lowest voltage reading obtained should not exceed 0.3 volt.

*c. Relay K1.* Relay K1 should operate when 16 to 18 volts is applied to its coil (across terminals 1-2) and should release when the voltage is reduced to approximately 13 volts.

d. *Relays K2 Through K6.* Relays K2 through K6 each should operate when a voltage of 28 volts (maximum) is applied to its coil (across terminals 1-2).

### 13. Resistance Measurements

Make all resistance measurements with the equipment deenergized and with the part disconnected from the remainder of the circuit. The approximate resistances

of the winding of reactor L1 and of the coils of relays K1 through K6 are given in the chart below.

Item	Terminals	Resistance (ohms)
Reactor L1	1-2	0.412
Relay K1	1-2	400
Relays K2 through K6	1-2	3.0

## Section IV. REMOVAL AND REPLACEMENT OF PARTS AND TESTING AFTER REPAIR

*Note:* All maintenance parts for Charger, Battery PP-1660/G (TM-11-6130-227-45P) are replaceable at fourth echelon.

### 14. General Procedures

All parts of the PP-1660/G, except transformer T1, are readily accessible when the cover of the case is removed and can be removed and replaced individually without first removing any other parts. Instructions for the removal and replacement of all functional parts are provided in paragraph 15. When removing parts or repairing wiring, tag leads and mark terminals for positive identification before disconnecting any wiring to assure correct reconnection. When wiring is replaced, use wire that conforms with that specified in figure 5.

### 15. Removal and Replacement of Parts

*Note:* Most parts can be reinstalled by remounting them in their original location with the original hardware and reconnecting the leads. Replacement instructions are given only when special procedures or precautions are required.

a. *Cover* (1, fig. 3). Remove four screws from the top and three screws from each side of the cover and carefully lift off the cover. The blower assembly is mounted in the cover; be sure not to strain or break the leads connected to the blower motor (2). When replacing the cover, be sure there is adequate clearance for the blower motor leads.

b. *Blower Assembly* (2 and 3, fig. 3). Remove the two hexagonal nuts that fasten blower motor B1 (2) to the shroud (11). Disconnect the leads at blower motor B1 and lift out the blower assembly. To remove impeller MP3 (3), loosen the set-

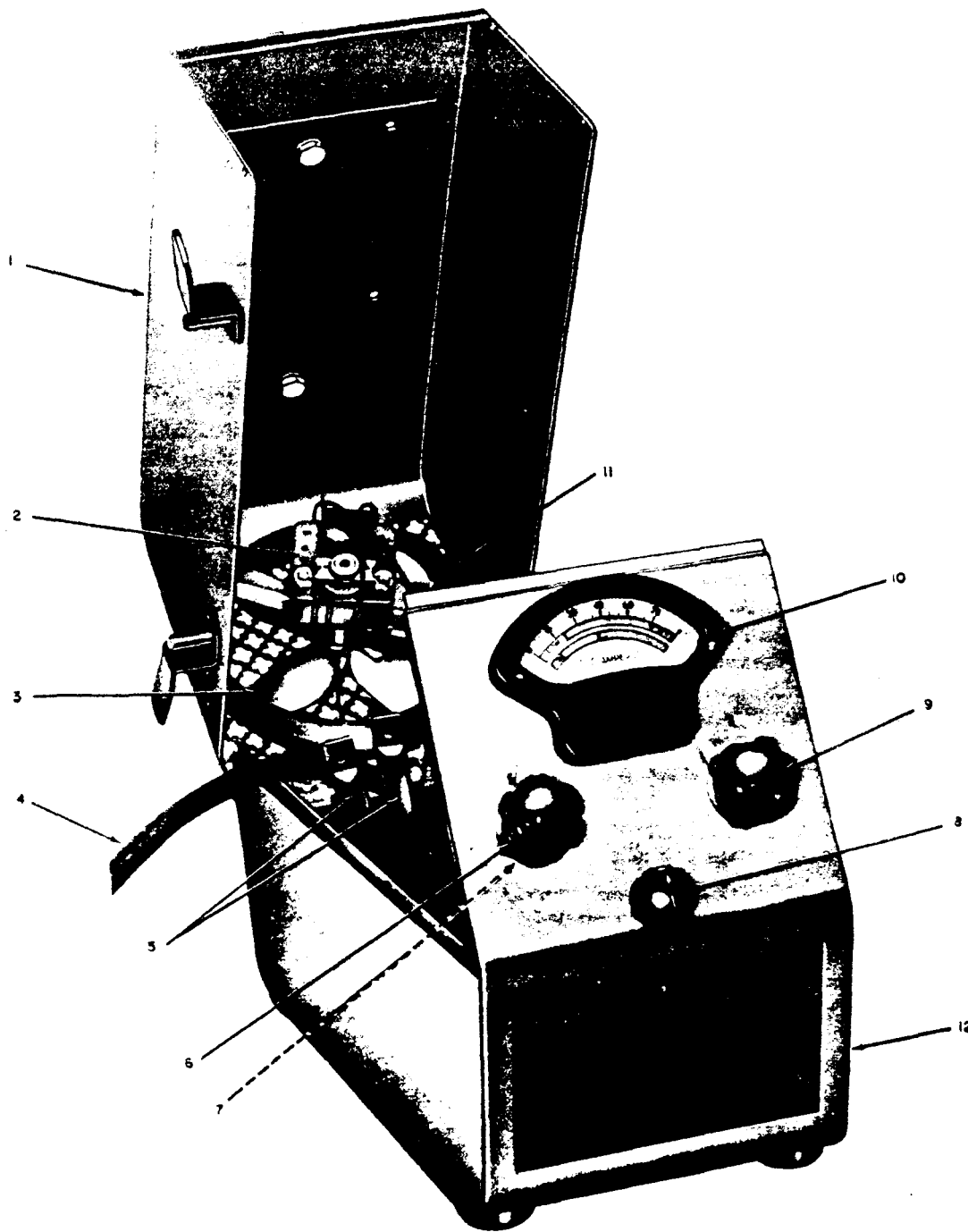
screw in the hub and pull impeller MP3 off the shaft of motor B1.

c. *Ac Input Cable* (4, fig. 3). Disconnect one cable lead from TIME SWITCH M1 (7) and unsolder and disconnect the other cable lead from the solder connection (fig. 5). Release the strain relief bushing (not shown) in the back of the case (12, fig. 3) and pull out the ac input cable. When reinstalling the ac input cable, connect the cable lead with a lug to TIME SWITCH M1 (7). Splice the other cable lead to one lead of blower motor B1 (2) and the black lead from the primary winding of transformer T1 (fig. 5). Solder the connection and tape securely.

d. *Dc Output Cables* (5, fig. 3). The positive (red connector) dc output cable is connected to resistor R1 (5, fig. 4) and the negative (black connector) dc output cable is connected to circuit breaker CB2 (6). To remove either dc output cable, disconnect it, release the strain relief bushing (not shown) in the back of the case (12, fig. 3), and pull out the cable.

e. *Ammeter M2* (10, fig. 3). Disconnect the leads, remove the mounting screws and nuts, and carefully remove ammeter M2 from the front panel from the front. When reconnecting the ammeter leads, be sure to observe correct polarity (fig. 5).

f. *TIME SWITCH M1* (7, fig. 3). Loosen the two setscrews that secure TIME SWITCH knob MP12A (6) and pull the knob off the shaft. Disconnect the leads, remove the locknut, and remove TIME SWITCH M1 from the front panel from the



TM6130-227-45-3

- 1 Cover
- 2 Blower motor B1
- 3 Impeller MP3
- 4 Ac input cable

- 5 Dc output cables
- 6 TIME SWITCH knob MP12A
- 7 TIME SWITCH M1
- 8 BATTERY VOLTS switch knob MP11

- 9 CHARGE SWITCH knob MP12B
- 10 Ammeter M2
- 11 Shroud
- 12 Case

Figure 3. Charger, battery PP-1660/G cover removed.

rear. When reinstalling TIME SWITCH M1, rotate the shaft fully counterclockwise and install TIME SWITCH knob MP12A (6) so that the pointer is at SLOW CHARGE. Be sure to tighten both setscrews.

*g. CHARGE SWITCH S1* (1, fig. 4). Loosen the two setscrews that secure CHARGE SWITCH knob MP12B (9, fig. 3) and pull the knob off the shaft. Disconnect the leads, remove the locknut, and remove CHARGE SWITCH S1 from the front panel from the rear. When reinstalling CHARGE SWITCH S1, rotate the shaft fully counterclockwise and reinstall CHARGE SWITCH knob MP12B (9) so that the pointer is at OFF. Be sure to tighten both setscrews.

*h. BATTERY VOLTS Switch S2* (2, fig. 4). Pull BATTERY VOLTS switch knob MP11 straight forward off the shaft. Disconnect the leads, remove the locknut, and remove BATTERY VOLTS switch S2 from the front panel from the rear. When reinstalling BATTERY VOLTS switch S2, rotate the shaft fully counterclockwise and reinstall BATTERY VOLTS switch knob MP11 so that the engraved pointer is at 6.

*i. Circuit Breaker CB1* (4, fig. 4). Circuit breaker CB1 is mounted on a bracket fastened to the top flange of transformer T1 (14). To remove circuit breaker CB1, disconnect the leads and remove the nuts, lockwashers, and screws that fasten circuit breaker CB1 to its bracket.

*j. Rectifiers CR1 and CR2.* Rectifiers CR1 and CR2 (not shown) are connected together and are removed as an assembly. The rectifier assembly is mounted on top of transformer T1 (14, fig. 4). To remove the rectifier assembly, take out the four screws that secure it to transformer T1, disconnect all leads, and lift the rectifier assembly out of the case. Be careful not to bend or otherwise damage the rectifier plates during removal or replacement of the rectifier assembly.

*k. Reactor L1* (3, fig. 4). Reactor L1 is

mounted in front of transformer T1 (14). To remove reactor L1, disconnect the two pigtail leads from TIME SWITCH M1 (7, fig. 3) and circuit breaker CB1 (4, fig. 4), remove the two mounting screws, accessible from the bottom of the case, and lift out reactor L1.

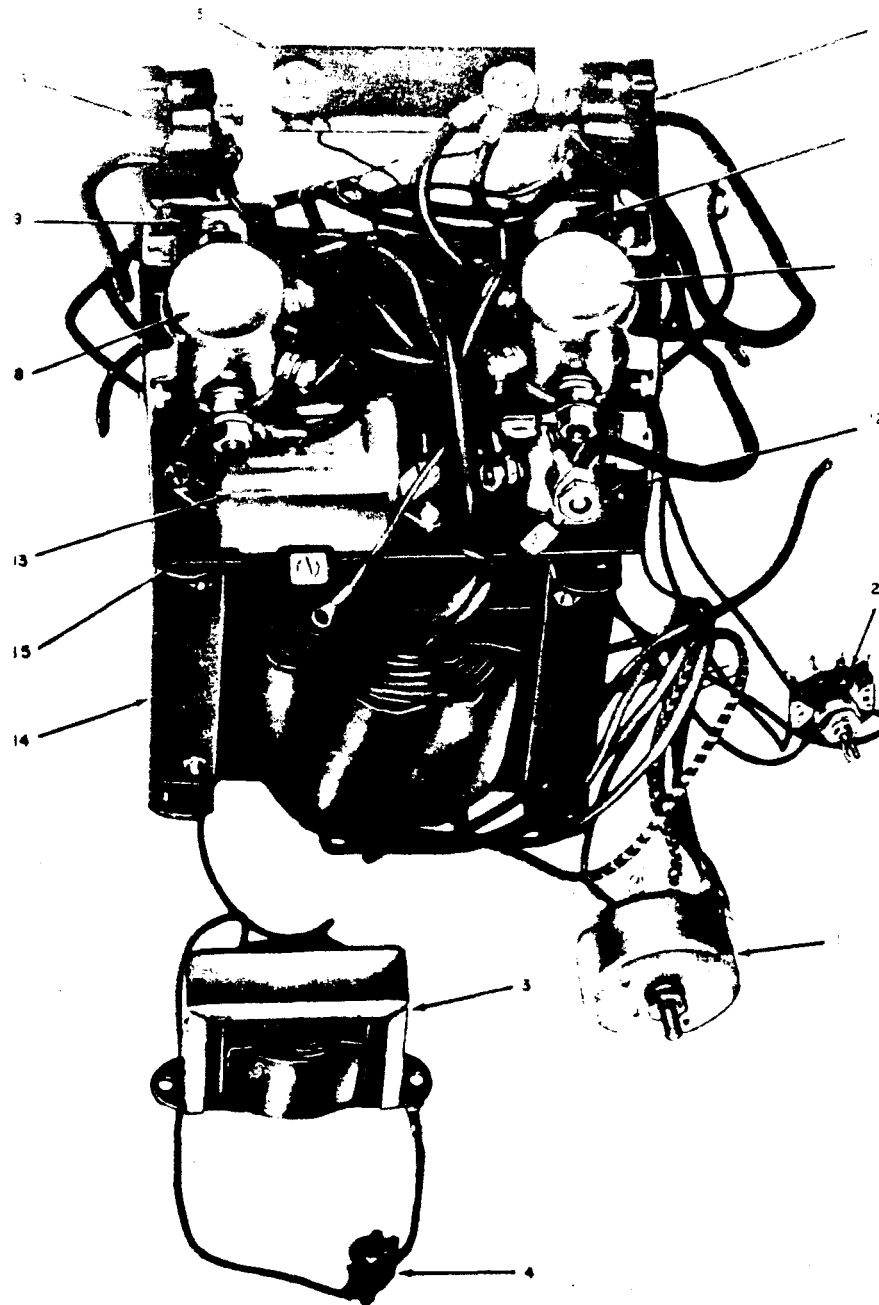
*l. Transformer T1* (14, fig. 4). Remove rectifiers CR1 and CR2 (*j* above) and circuit breaker CB1 (*i* above); it is not necessary to disconnect circuit breaker CB1. Disconnect the 11 pigtail leads of transformer T1, remove the four mounting screws, and lift transformer T1 out of the case. When reinstalling transformer T1, be sure to solder and tape the connection to the ac input cable lead and the blower motor lead (fig. 5) securely.

*m. Subpanel* (15, fig. 4). The subpanel is a U-shaped, sheet-metal chassis on which are mounted relay K1 (13), relays K2 through K6 (8 through 12), and circuit breakers CB2 (6) and CB3 (7). The subpanel is located behind transformer T1 and is fastened to the case by three screws. Parts mounted on the subpanel can be removed individually (without removing the subpanel) by disconnecting their leads and removing the mounting hardware. To remove the subpanel as an assembly, it is necessary first to disconnect all leads connected to parts not mounted on the subpanel (fig. 5).

*n. Resistor R1* (5, fig. 4). Resistor R1 is mounted on the inside of the back of the case by means of the same screw and acorn nut that secure the lower hanger of the ac input cable to the outside of the case. To remove resistor R1, disconnect the leads from its terminals and remove the acorn nut and the screw.

## 16. Testing After Repair

Whenever the battery charger has been repaired, check the overall operation of the equipment. Follow the procedure outlined in the equipment performance checklist (TM 11-6130-227-12).



TM6130-227-45-5

- |                           |                       |                   |
|---------------------------|-----------------------|-------------------|
| 1 CHARGE SWITCH S1        | 6 Circuit breaker CB2 | 11 Relay K5       |
| 2 BATTERY VOLTS switch S2 | 7 Circuit breaker CB3 | 12 Relay K6       |
| 3 Reactor L1              | 8 Relay K2            | 13 Relay K1       |
| 4 Circuit breaker CB1     | 9 Relay K3            | 14 Transformer T1 |
| 5 Resistor R1             | 10 Relay K4           | 15 Subpanel       |

Figure 4. Charger, Battery PP-1660/G, major internal parts (less rectifiers CR1 and CR2) removed from case.

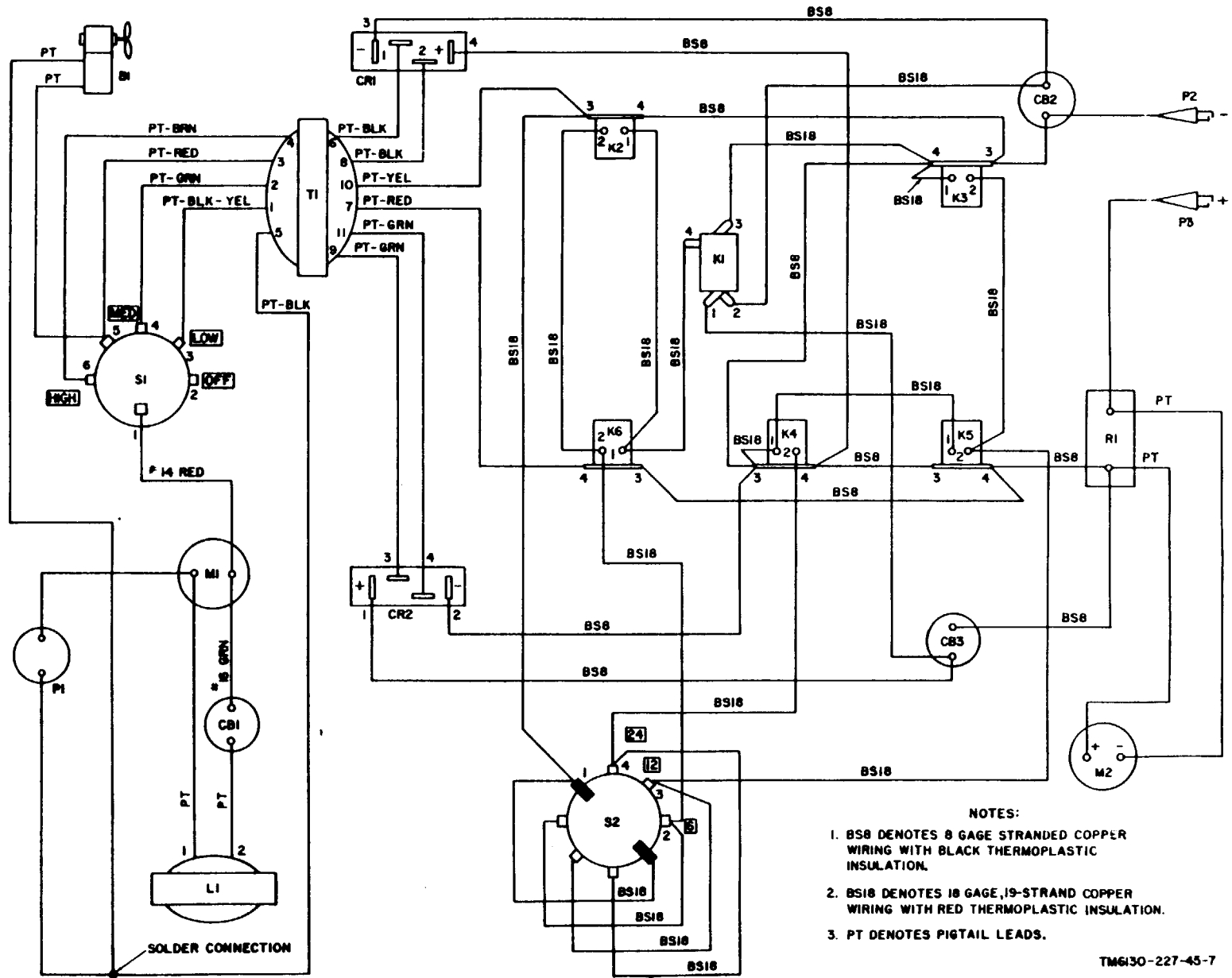


Figure 5

## CHAPTER 4

### FINAL TESTING

---

#### 17. Purpose of Final Testing

The tests outlined in this chapter are designed to measure the performance capability of a repaired equipment. Equipment that meets the standards stated in the tests will give satisfactory performance, equivalent to that of new equipment.

#### 18. Test Equipment for Final Testing

The following test equipment is required for final testing the PP-1660/G:

- a. Ohmmeter ZM-21/U (TM 11-2050A).
- b. Ammeter AN/USM-69.
- c. Ammeter ME-65/U.
- d. Test Set, Generator and Low Voltage Regulator TV-100.
- e. Source of regulated 115-volt, 60-CPS ac, capable of carrying a load of 20 amperes.

#### 19. Physical Inspection

Visually inspect the complete unit. See that the case is in good condition and that all parts are mounted securely, all cables and wiring are in good condition, and all connections are clean and tight. Pay particular attention to the following:

a. Inspect the connections between transformer T1 and CHARGE SWITCH S1 and the connections to BATTERY VOLTS switch S2 to be sure they are correct. Refer to figure 5 for proper connections.

b. Inspect the subpanel assembly to see that the circuit breakers and relays are mounted properly and that all connections are correct (fig. 5).

c. Inspect the rectifier assembly to see that it is fastened securely to transformer T1 and that all bus bar and cable connections are correct (fig. 5) and are in good condition.

d. Inspect the blower assembly to see that the impeller is secure on the shaft of the blower motor and that the blades rotate freely and have adequate clearance.

#### 20. Insulation Resistance Tests

##### a. *Input Circuit.*

- (1) Connect the line binding post of Ohmmeter ZM-21/U to one of the contacts of the ac input cable plug connector and connect the ground binding post of the ZM-21/U to a bare spot on the case of the battery charger.
- (2) Set TIME SWITCH M1 to SLOW CHARGE and set CHARGE SWITCH S1 to LOW.
- (3) Operate the ZM-21/U and read the ohmmeter; the resistance should be not less than 1 megohm.

##### b. *Output Circuits.*

**Caution: Be sure not to allow the connectors of the dc output cables to touch each other during this test or the equipment will be damaged seriously.**

- (1) Connect the line binding post of the ZM-21/U to the connector of the positive dc output cable and connect the ground binding post of the ZM-21/U to a bare spot on the case of the battery charger.
- (2) Set BATTERY VOLTS switch S2 to 6. Operate the ZM-21/U and read the ohmmeter.
- (3) Set BATTERY VOLTS switch S2 to 12 and then to 24. Operate the ZM-21/U and read the ohmmeter with BATTERY VOLTS switch S2 in each position.
- (4) Connect the line binding post of the ZM-21/U to the connector of the negative dc output cable and repeat the procedure outlined in (2) and (3) above.
- (5) The resistance reading obtained in each case ((2), (3), and (4) above) should be not less than 1 megohm.

##### c. *Primary to Secondary of Transformer T1.*

- (1) Connect the line binding post of the ZM-21/U to one of the contacts of



Meter	Reading
<b>AN/USM-69</b>	<b>70 amperes</b>
<b>PP-1660/G ammeter</b>	<b>70 ±4 amperes</b>
<b>TV-100 D. C. VOLTS meter</b>	<b>12.5 volts minimum</b>
<b>ME-65/U</b>	<b>17 ±2 amperes</b>

i. On the TV-100, set the voltage range switch to the 50-volt range and set the BATTERY VOLTS switch on the PP-1660/G to 24.

j. Adjust the carbon pile control of the TV-100 so that the D.C. AMPERES meter indicates 40 amperes, and check for the following meter indications:

Meter	Reading
<b>AN/USM-69</b>	<b>40 amperes</b>
<b>PP-1660/G ammeter</b>	<b>40 ±4 amperes</b>
<b>TV-100 D. C. VOLTS meter</b>	<b>26 volts minimum</b>
<b>ME-65/U</b>	<b>18 ±2 amperes</b>

k. On the PP-1660/G, slowly turn the CHARGE SWITCH counterclockwise, one position at a time, to MED and then to LOW. The charging rate indicated by the PP-1660/G ammeter should decrease with each change in the setting of the CHARGE SWITCH and the AN/USM-69 reading should agree with the PP-1660/G ammeter reading within about ±4 amperes.

l. Return the CHARGE SWITCH to HIGH and set the TIME SWITCH at SLOW CHARGE. The PP-1660/G ammeter should indicate approximately 25 amperes and the TV-100 D. C. VOLTS meter should indicate 15 ±3 volts. After a short time, all meter

indications should drop to 0, indicating the circuit breaker CB1 has opened.

m. Set the CHARGE SWITCH on the PP-1660/G and the load bank switch on the TV-100 to OFF.

n. Disconnect the AN/USM-69 from the PP-1660/G and the TV-100, and disconnect the ME-65/U from the ac input side of the PP-1660/G.

o. Connect the PP-1660/G positive dc output cable to the 24V binding post of the TV-100 and connect the negative dc output cable to the highest range ammeter binding post. Connect the PP-1660/G ac input cable directly to the 115-volt ac supply.

p. On the PP-1660/G, set the TIME SWITCH to 5, the BATTERY VOLTS switch to 6, and the CHARGE SWITCH to LOW.

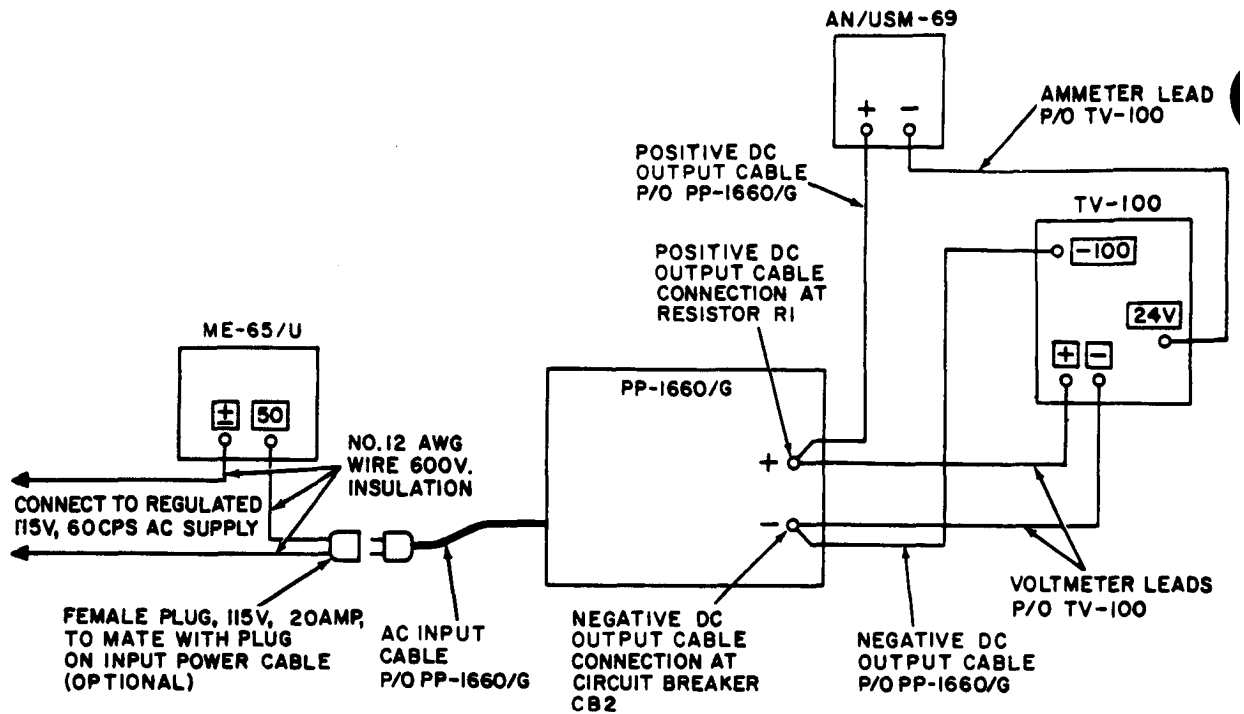
q. Set the TV-100 load bank switch to ON and adjust the carbon pile control so that the D. C. AMPERES meter indicates approximately 150 amperes; the PP-1660/G ammeter pointer may go off-scale to the right.

*Note.* The PP-1660/G ammeter will withstand a 200-percent overload without becoming damaged.

r. After a few seconds, the PP-1660/G ammeter indication should drop sharply, indicating that either circuit breaker CB2 or circuit breaker CB3 has opened, or should drop to 0 indicating that circuit breakers CB2 and CB3 both have opened.

s. After approximately 1 to 2 minutes, the PP-1660/G ammeter indication should increase sharply indicating that circuit breakers CB2 and CB3 have closed.

t. Set the PP-1660/G CHARGE SWITCH and the TV-100 load bank switch to OFF and disconnect the PP-1660/G from the TV-100 and from the ac supply.



TM6130-227-45-6

Figure 6. Charger, Battery PP-1660/G, connections for functions tests.

the ac input cable plug connector and connect the ground binding post of the ZM-21/U to either one of the dc output cables.

- (2) Set TIME SWITCH M1 to SLOW CHARGE and set CHARGE SWITCH S1 to LOW.
- (3) Set BATTERY VOLTS switch S2 to 6. Operate the ZM-21/U and read the ohmmeter.
- (4) Set BATTERY VOLTS switch S2 to 12 and then to 24. Operate the ZM-21/U and read the ohmmeter with BATTERY VOLTS switch S2 in each position.
- (5) The resistance reading obtained in each case ((3) and (4) above) should be not less than 1 megohm.

## 21. Function Tests

a. Set the CHARGE SWITCH on the PP-1660/G and the load bank switch on the TV-100 to OFF.

b. Connect test equipment to the PP-1660/G as shown in figure 6.

c. On the TV-100, rotate the carbon pile control counterclockwise until the knob turns freely and set the voltage range switch to the 10-volt range.

d. On the PP-1660/G, set the TIME

SWITCH at 10, the BATTERY VOLTS switch at 6, and the CHARGE SWITCH at HIGH.

e. On the TV-100, rotate the carbon pile control clockwise until a slight resistance is felt; then place the load bank switch at ON and adjust the carbon pile control so that the D.C. AMPERES meter indicates 70 amperes.

f. Check for the following meter indications:

Meter	Reading
AN/USM-69	70 amperes
PP-1660/G ammeter	70 ±4 amperes
TV-100 D.C. VOLTS meter	6.5 volts minimum
ME-65/U	9.5 ±1 amperes

**Caution:** Be sure to set the TV-100 voltage range switch to the correct range before setting the PP-1660/G CHARGE SWITCH for a higher dc voltage or the TV-100 voltmeter will be damaged seriously.

g. On the TV-100, set the voltage range switch to the 20-volt range and set the BATTERY VOLTS switch on the PP-1660/G to 12.

h. Adjust the carbon pile control of the TV-100 so that the D.C. AMPERES meter indicates 70 amperes, and check for the following meter indications:

## APPENDIX REFERENCES

---

TM 11-2050A	Ohmmeter ZM-21/U
TM 11-5527	Multimeters TS-352/U, TS-352A/U, and TS-352B/U
TM 11-6130-227-12	Operator and Organizational Maintenance Manual: Charger, Battery PP-1660/G
TM 11-6130-227-20P	Organizational Maintenance Repair Parts and Special Tools List: Charger, Battery PP-1660/G
TM 11-6130-227-45P	Field and Depot Maintenance Repair Parts and Special Tools List: Charger, Battery PP-1660/G

By Order of Secretary of the Army:

G. H. DECKER,  
General, United States Army,  
Chief of Staff.

Official:

J. C. LAMBERT,  
Major General, United States Army,  
The Adjutant General.

Distribution:

Active Army:

DASA (6)	Sig Dep (12)
USASA (2)	WRAMC (1)
CNGB (1)	USA Trans Tml Comd (1)
Tech Stf, DA (1) except	Army Tml (1)
CSigO (14)	POE (1)
Tech Stf Bd (1)	OSA (1)
USCONARC (5)	USAEPG (2)
USAARTYBD (1)	AFIP (1)
USAARMBD (2)	AMS (1)
USAIB (1)	Army Pictorial Cen (2)
USARADB (2)	EMC (1)
USAAVNBD (1)	Yuma Test Sta (2)
USA Abn, Elct & SPWAR Bd (1)	USA Strat Comm Comd (4)
USAATBD (1)	USASSA (20)
ARADCOM (2)	USASSAMRO (1)
ARADCOM Rgn (2)	USARCARIB Sig Agcy (1)
OS Maj Comd (3)	USA Sig Msl Spt Agcy (13)
OS Base Comd (2)	Sig Fld Maint Shops (3)
LOGCOMD (2)	Def Log Svc Cen (1)
MDW (1)	USA Corps (3)
Armies (2)	JBUSMC (2)
Corps (2)	Units org under fol TOE (2 cy ea UNOINDC)
Instls (2)	11-7
Ft Monmouth (63)	11-16
USATC AD (2)	11-57
USATC Engr (2)	11-98
USATC Inf (2)	11-117
USATC FA (2)	11-155
USATC Armor (2)	11-157
USAOMC (2)	11-500 (Tins AA-AE) (4)
Svc College (2)	11-557
Br Svc Sch (2)	11-587
GENDEP (2) except	11-592
Atlanta GENDEP (None)	11-597
Sig Sec, GENDEP (5)	11-97

NG: None.

USAR: None.

For explanation of abbreviations Used see AR 320-50.

RECOMMENDED CHANGES TO EQUIPMENT TECHNICAL PUBLICATIONS



THEN...JOT DOWN THE  
DOPE ABOUT IT ON THIS FORM.  
CAREFULLY TEAR IT OUT, FOLD IT  
AND DROP IT IN THE MAIL.

SOMETHING WRONG WITH PUBLICATION

FROM: (PRINT YOUR UNIT'S COMPLETE ADDRESS)

DATE SENT

PUBLICATION NUMBER

PUBLICATION DATE

PUBLICATION TITLE

BE EXACT PIN-POINT WHERE IT IS

PAGE  
NO.

PARA-  
GRAPH

FIGURE  
NO.

TABLE  
NO.

IN THIS SPACE, TELL WHAT IS WRONG  
AND WHAT SHOULD BE DONE ABOUT IT.

TEAR ALONG PERFORATED LINE

PRINTED NAME, GRADE OR TITLE AND TELEPHONE NUMBER

SIGN HERE

