

1976

WHEEL HORSE PRODUCTS, INC.
PRODUCT SERVICE SEMINAR



WHEEL HORSE
lawn & garden tractors

1976

**PRODUCT
SERVICE
SEMINAR**

2

Name _____

Welcome! to the 1976 Product Service Seminars as presented by the Customer Service Department of Wheel Horse Products, Inc.

Your instructor, the local Wheel Horse Field Service Representative, is available to assist you in learning about the WHEEL HORSE product line from a service standpoint.

The time that you will spend together will focus on learning the "ins" and "outs" of servicing WHEEL HORSE lawn and garden equipment, as well as other aspects of effectively servicing the WHEEL HORSE products.

This manual has been designed for you to use as a permanent record of ideas which you have learned while at this service meeting. During the course of these sessions you will be required to effect repairs on both gasoline and battery powered equipment. All exercises are designed to give you help in understanding the individual systems.

With these thoughts in mind - best wishes in this program.

WHEEL HORSE PRODUCTS, INC.
Customer Service Department

Meeting Schedule

The time factor for each meeting is critical. Therefore, your cooperation in adhering to the schedule will be greatly appreciated by both your colleagues and your instructor.

As can be seen in the attached schedule, each day has been broken into several individual segments. Please limit any conversation or discussion to those topic areas currently being covered. This will save valuable time. Any questions which you may have that do not pertain to the seminar can be covered with the instructor on an individual basis after the meeting each day.

Seminar II Manual

Day 1

<u>Time</u>	<u>Scheduled Topic</u>
8:00 - 8:30	Introduction to seminar and coffee
8:30 - 9:30	Written evaluation and review of Sundstrand
9:30 - 10:30	Written evaluation and review of electricity
10:30 - 10:45	Coffee
10:45 - 11:30	Introduce and discuss 1976 product line
11:30 - 12:30	Lunch
12:30 - 1:30	Microfiche/Flat Rate/ Warranty program
1:30 - 2:15	Batteries
2:15 - 2:45	Chargers
2:45 - 3:00	Coffee
3:00 - 3:30	B-145 drive motor repair
3:30 - 5:30	Advanced trouble shooting <ul style="list-style-type: none">- reading and understanding schematics (B-145/C-185)- relating components to schematics and service module- trouble shooting with meter (VOM)

Day 2

<u>Time</u>	<u>Scheduled Topic</u>
8:00 - 8:30	General problems - battery power warranty - Elec-Trak fiche
8:30 - 9:30	Mower motor repair
9:30 - 9:45	Coffee
9:45 - 10:30	Battery power attachments
10:30 - 11:00	Discharge testing
11:00 - 11:30	Review and summation of battery power
11:30 - 12:30	Lunch
12:30 - 2:30	Begin Onan engine
2:30 - 2:45	Coffee
2:45 - 5:00	Onan engine

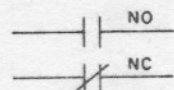
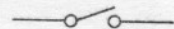
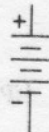
Day 3

8:00 - 11:30	Begin introduction to D-250
11:30 - 12:30	Lunch
12:30 -	Complete D-250

BATTERY POWER TERMINOLOGY

- Coil - An electromagnet, used in the tractor primarily as the actuating means for relays and contactors when power is applied from a control switch.
- Contactor - A contactor is a device operated other than by hand, for repeatedly establishing and interrupting an electric power circuit.
- Energize - The application of power to a relay or contactor coil.
- F W - Field Weakening
- J1-12, P2-3- Typical identification of a plug or jack and its pin or socket under consideration, i.e., P2-3 means plug housing P2, pin number 3. Note that the wire number remains the same after passing through plug and jack connections, P1 mates J1, P2 mates J2, etc.
- N C - Normally closed (switch, relay, contactor).
- N O - Normally open (switch, relay, contactor).
- N O C - Normal Operating Condition. Power disconnect is engaged; Key switch is "ON", brake pedal released, seat switch depressed, and range selector in neutral.
- Open - This can be used to refer to a break in a wire or connection, or the positions a switch may be in so as to stop the flow of current in its attached wires.
- Overspeed - A characteristic of a motor, which results in abnormally high speed. This is usually due to an open motor field or the field circuit.

- Pick up - Used in referring to applying power to the coil of a relay or contactor. Generally the closing of contacts.
- Relay - Used to control the opening and closing of the operating circuit of a device so that the main operating current does not pass through the control switch or other initiating device.
- R T N - "Return to Neutral" relay and circuit.
- Short - A short-circuit is an abnormal connection of relatively low resistance made accidentally between two points of different potential in a circuit.
- S P G - Specific gravity - The ratio of the weight of any volume of a substance to the weight of an equal volume of water taken as the standard unit. Thus, battery electrolyte, with a specific gravity of 1.260, weighs 1.26 times as much as an equal volume of water.
- V A C - Volts alternating current.
- V D C - Volts direct current.
- Transformer - Changes ac voltage from one voltage to another. May step up or step down voltage level.
- Battery power pack - Produces electrical energy by a chemical process.
- Light or Lamp
- Manual Switch or Disconnect. (Shown in open position.)
- Relay or solenoid-operated contacts.
NO - normally open; NC - normally closed.



TWO TOGETHER
ARE A SOLENOID

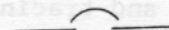
COIL

Actuating coil or relay or solenoid.



Thermal Overload Protector (Circuit Breaker)

- Automatic reset protective device, senses current and/or temperature combinations. Provides a closed circuit until overloaded.



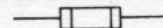
Thermal Overload Protector

- Manual reset.



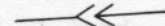
Fuse

- A throw-away protective device in a circuit.



Plug-in Disconnect-

- Eases removal of electrical assemblies.



Motor Armature

- The rotating center member of an electric motor.



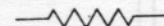
Motor Field

- The fixed outside member of a motor, produces an electro-magnetic field. (This field is produced by magnetic materials in permanent-magnet motors.)



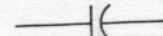
Resistor

- Device to resist the flow of current; measured in ohms. ()



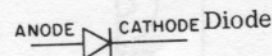
Capacitor

- Two electrodes separated by an insulator or di-electric. This device can be charged and discharged at a controlled rate; also can store energy for short periods of time. Sizes considered in mf. (Microfarads)



Diode

- Allows current to flow only in one direction, from anode to cathode.



Varistor

- An energy absorbing device used to protect switching contacts.



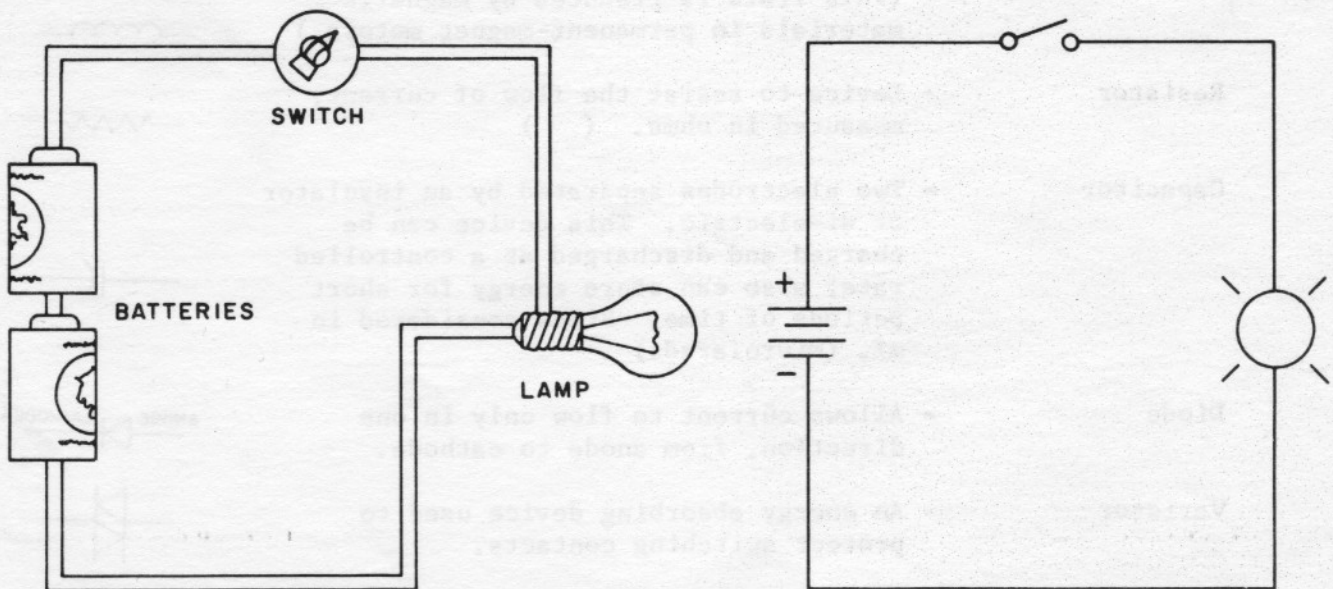
NOTE: Schematic symbols have not been completely standardized. See Elec-Trak Home Owner's Service Manual.

UNDERSTANDING SCHEMATIC DIAGRAMS

All electrical circuits must have closed paths for current flow in order to operate. The closed path is provided by wires and electric or electronic components in most applications. In tracing closed paths from schematics, the task is simplified by starting the path at the power supply (battery, line cord, etc.) and tracing through the associated components and wiring, back to the power supply.

Example 1: Consider a simple flashlight. Electrically, it consists of two batteries in series, a filament or lamp, a switch, and the wiring giving a closed path. Referring to the schematic symbols, the circuit could be represented pictorially and schematically as shown in Fig. TM 1-1.

Notice that in tracing the circuit in the schematic, there is no closed path for current flow until the switch is manually closed.



TM 1-1

WHEEL HORSE BATTERY POWER

Suppose the tractor light circuit requires service. A simplified schematic for the light, with the lift circuit added for instruction, is shown in TM. Fig. 1-2.

Since the trouble is in the headlight circuit, only that closed path need be considered. That path should be visualized from the complete schematic, not redrawn.

The tractor power pack maximum output is approximately 36 volts, but TM Fig. 1-2 clearly indicates that the light system is tapped into a portion of the power pack, namely the bottom two batteries which deliver 12 volts; so, in servicing the system, only those two batteries require attention in the troubleshooting procedure.

Let's assume neither the headlights nor the dash light illuminate. From the schematic of TM Fig. 1-2, list all the faults that could cause this failure.

1.

2.

3.

4.

5.

Since fuses are usually in a readily accessible place, they can usually be inspected quickly. It is good practice to check the fuses as the first step in any troubleshooting procedure.

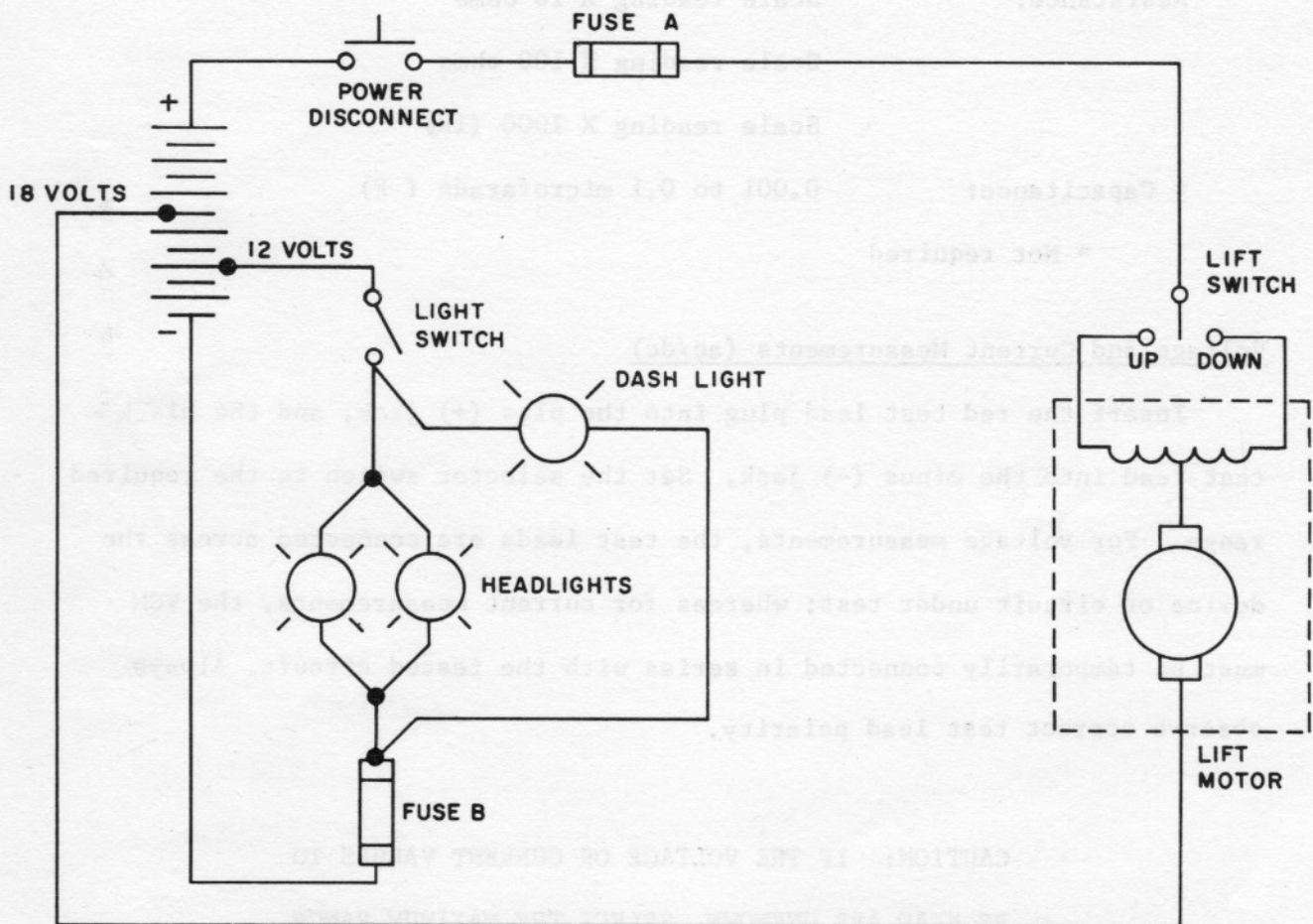
If the lamps are easy to see or remove, a check of one filament could be a second step. Notice that if just one of the filaments is good, that lamp will operate regardless of the condition of the others since they are wired in parallel.

Very weak or discharged batteries would seriously impair drive motor operation since these tapped batteries are also used in the drive motor circuit. The specific gravity of the cells could be checked to verify the state of charge.

If the switch is defective, it may be checked in several ways. One simple method merely bypasses the switch with a length of wire. A "jumper" wire for this purpose can be made for use as a tool by attaching clips to either end of an insulated wire. Several different lengths may be made for different situations. The switch is then tested by clipping the jumper from one switch terminal to the other. If the lights do not operate with the switch turned on, but do with the jumper in place, the switch is defective.

Another procedure that could be used to isolate defective wiring or components utilizes the volt-ohm-milliammeter (VOM). The VOM would be set to measure positive dc volts on a range greater than 12 volts in this case. The negative VOM lead is attached to the negative power pack connection or fuse B, which electrically is at the same voltage. The positive lead is then moved from the positive power pack tap to the next accessible connection encountered as the closed path is traced to the lamps. The 12 volts should be indicated at each check point with the switch on. If the voltage is "lost" between one point and the next, the wire, connection, or component between the points is defective.

It is also possible that the negative wire to the lamps is open, and it may be checked in similar fashion by initially moving the negative VOM lead to accessible points while the positive lead remains on the positive power pack tap. The 12-volt reading should again be indicated for good wiring.



TM1-2

USE OF THE VOLT-OHM-MILLIAMMETER - (VOM)

Your basic tool for troubleshooting electrical malfunctions is the Volt-Ohm-Milliammeter (VOM or multimeter). You will need a VOM rated at 20 ohms/volt, with ranges as follows:

Ranges:

DC Voltage: 0-10-50-250-500-1000V

AC Voltage: 0-10-50-250-500-1000V

DC Current: 0-500 microamps
0-25-500 milliamps

Resistance: Scale reading X 10 ohms

Scale reading X 100 ohms

Scale reading X 1000 (1K)

* Capacitance: 0.001 to 0.1 microfarads (F)

* Not required

Voltage and Current Measurements (ac/dc)

Insert the red test lead plug into the plus (+) jack, and the black test lead into the minus (-) jack. Set the selector switch to the required range. For voltage measurements, the test leads are connected across the device or circuit under test; whereas for current measurements, the VOM must be temporarily connected in series with the tested circuit. Always observe correct test lead polarity.

CAUTION: IF THE VOLTAGE OR CURRENT VALUES TO BE READ ARE UNKNOWN, SELECT THE MAXIMUM RANGE ON THE VOM AND THEN LOWER THE RANGE A STEP AT A TIME UNTIL YOU REACH A RANGE WHERE YOU CAN OBTAIN A READING.

Resistance

To measure resistance, turn the selector switch to the range desired. Short the test leads together and turn the "zero ohm adjust" until you obtain a zero indication on the meter. Measure resistance by connecting the test leads to the resistor, device, or circuit under test.

CAUTION: NEVER ATTEMPT TO MEASURE RESISTANCE
IF VOLTAGE IS PRESENT, OR DAMAGE TO THE METER
MAY RESULT.

False readings are obtained in many resistance measurements due to parallel wiring across the tested part or circuit. To eliminate this possibility, disconnect at least one end of the test part or wire from the rest of the circuitry.

NOTE: Replace the internal VOM batteries if the
"zero ohm adjust" does not move the meter pointer
to zero.

Continuity and Short Testing

The VOM can be used as a continuity and short testing instrument, which are both variations of resistance measurements.

With the VOM "zero adjusted" as outlined in the resistance instructions and the range selector on the X10, with all power removed from the circuit and one end of the wire free, the wire's resistance is measured by connecting the test probes. If the wire is continuous, an indication of zero ohms results. If the wire has a break in it, the indication is infinity (∞) and a loose connection may indicate several thousand ohms.

Should intermittent problems occur, it may be necessary to slightly flex the wires during testing to detect a break.

The same procedure can be used to test several wires connected in series as well as switch and relay contact closures.

Similarly, if shorts are suspected between wiring, components, and body parts, the resistance test can be applied. If no short occurs, infinity (∞) will be indicated. If a positive short exists, zero ohms will be indicated.

Procedures for Testing

Specific Gravity (spg)

Power pack electrolyte is heavier than pure water. If a value of 1.000 is assigned for pure water, the relative weight of an equal volume of any other substance is called the specific gravity of the substance. The electrolyte specific gravity of a new power pack normally varies between 1.110 and 1.275, representing a discharged condition and a charged condition respectively at 80 F. If the spg is higher than 1.275, slightly more ampere hour capacity will result (increasing range), but power pack life will be shortened. While using the power pack after a full charging cycle, the spg gradually decreases to 1.110 when the cells are fully discharged. Continued discharge causing the spg to go lower than the 1.110 point will shorten the power pack life, therefore, deep discharging as well as overcharging should be avoided.

The hydrometer is a direct-reading instrument used to measure the spg. To apply the test it is only necessary to draw a sample of electrolyte from a cell, jiggle the hydrometer to be sure the indicator is floating free, and record the indicated spg. Do not maintain liquid level in the hydrometer by squeezing the bulb as this gives inaccurate readings. The spg readings of the cells of any power pack unit should not vary from each other by more than 0.050. If variations do not exceed this figure and the spg in each cell is above 1.250, the unit is in good condition. Considerable variation in specific gravity readings (0.050 points or more) usually indicates sources of trouble internal to the battery. Specific gravity varies with temperature, so for correct readings the electrolyte temperature should be at 80 F.

Hydrometer Care and Correction

Hydrometers become inaccurate if not cleaned regularly. It is a good practice to flush them out with clean water after use. They should be taken apart and cleaned thoroughly every two months. Broken or leaking hydrometer floats prevent correct specific gravity readings. A good hydrometer will read accurately at electrolyte temperatures of 80 F. For every 10 degrees above 80 F, 0.004 specific gravity must be added, and 1.004 must be subtracted for each 10 degrees under 80 F to get very accurate readings, but this calibration is not necessary when checking cell spg uniformity. Hydrometers will not give an accurate reading when used immediately after water has been added to the cells. Cycling the power pack twice after the addition of water allows the proper mixing necessary for correct readings. Hydrometer readings should be delayed after charging until the electrolyte temperature falls to 80 F, and no reading correction is necessary.

Discharge Testing

Two approved methods of discharge testing are available - the automotive-type post-to-post hand-held tester and the timer-controlled 36-volt discharge tester. Both testers operate in a similar fashion, i.e., they load the battery under test by drawing current, and then measure terminal voltage.

Post-to-post testers normally have scales to indicate the condition of both 6-volt and 12-volt batteries. They are designed to be applied rapidly by holding the polarized probes securely against the posts of the battery under test. Leave battery cables connected for this test. The indication on the appropriate scale gives the battery condition after 3 to 5 seconds as to whether it is good, fair, or poor.

CAUTION: DO NOT HOLD THE TESTER IN PLACE FOR OVER 5 SECONDS. BE CAREFUL HANDLING IT AFTER THE TEST, SINCE ITS RESISTIVE ELEMENT CAN BECOME EXTREMELY HOT IN A SHORT LENGTH OF TIME.

This quick application ability lends itself well to field-checking batteries for shorted or dead cells, but gives no control or indication of long discharging periods. In other words, the post-to-post tester may show all batteries to be "good", but the complaint of reduced range may still go unresolved. More elaborate battery testing may show that a battery cell shorts after 45 minutes of use and is the source of the trouble. The 36-volt discharge tester allows testing 6-volt batteries by attaching the polarized

WORK IT HARD.

leads on the ends of the set of batteries connected in series and starting the tester. The timer of the tester starts immediately and the unit draws a controlled current of 75 amperes until the series terminal voltage reaches 31.5 volts. At that voltage, the timer stops and shuts off the current. For a good power pack, this test takes in excess of 60 minutes. During the test, the voltmeter is used on the 10-VDC scale to measure the terminal voltage of each battery at 15-minute intervals. This is a comparison check and any terminal voltage that differs from the others significantly (0.5 volt or more) indicates a battery that may need replacement.

Either test must be performed only after the batteries have been fully charged, as indicated by a specific gravity measurement of all cells as previously outlined.

The other function that the 36-volt discharge tester performs is that of determining if the entire power pack is capable of supplying a specified number of amperes for a minimum time. The discharge tester is to be used for testing one set of standard or heavy-duty 6-volt batteries only; 6 batteries connected in series.

The tester consists of a 75-ampere load, a voltage sending system, and a means of electrically timing the discharge. This unit will give the ampere-hour capability of a battery pack when discharged at a constant 75-ampere rate, which has been standardized as a test condition for batteries used in systems such as electric vehicles. The ampere-hour rating assigned to a battery is based on a discharge current that would require 20 hours for full discharge.

The output of a battery when discharged from full charge to a discharge measured at 1.75 volts per cell will depend on the previous history of the battery. As a battery is used, its capacity will increase at first and then will begin to decrease. The time of this decrease is also affected by the kind of use experienced over the battery life, by the temperature, and by the care and maintenance of the battery. The accepted test for end of life is when a battery discharges from full charge to 1.75 volts per cell in less than 60 minutes, being discharged at a 75-ampere rate.

This tester is used to indicate when the power pack has reached the minimum performance level, below which one or more batteries in the power pack must be replaced. This level requires a 75-ampere rate of discharge to a series terminal voltage of 31.5 volts (18 X 1.75) in less than 60 minutes. Testing for improper charging and/or dead cells should be performed before applying the discharge test.

Your ELEC-TRAK tractor dealer has the equipment and knowledge required to test batteries and determine their condition.

CHARGER

The heart of the charger is a specially designed transformer. Besides the primary winding on the line or input side of the transormer, the secondary is connected to the power pack to supply charging current, and a third winding connected to capacitor CP2 creates more charging energy per cycle of ac power input.

A more detailed explanation may be appropriate. Line voltage is applied to the primary winding through a normally open switch. When the timer is turned to the proper "start" position the switch is closed, the timer motor starts, and the transformer is put into operation. The timer motor drives a cam which causes the contacts to open once the proper time has elapsed.

- CR4 and CR5 are diodes
- CP2 is the capacitor
- Wires #30 to 44 or 30 to 45 will measure about 45 volts ac when charger is on
- Wires #44 to 45 will measure about 90 volts ac when charger is on
- Wires #2 to 30 will measure about 45 volts dc when charger is on

The secondary winding reduces the line voltage to a usable charging level which is then full-wave rectified by the action of diodes CR4 and CR5. The diodes accept the 60-Hertz sine wave as an input from the secondary winding and output a pulsating positive dc voltage which charges the power pack. The third winding in conjunction with capacitor CP2 allows the charger to supply a higher rate of charge for each cycle of ac power input.

- 120 volt, 15 amp ac input for charger
- Transformer reduces 120 volts ac to 90/45 volts ac
- Capacitor regulates charging rate
- Maximum draw on 120 volts ac is approximately 14 amps
- Timer when set to 1-2 years runs about 18 hours before it shuts off
- Power disconnect must be engaged

Charger Troubleshooting

If the charger is found to be faulty, use the following procedure.

- (1) Remove and insulate the battery cable that goes to the fusible link from the battery positive terminal, thus removing battery pack voltage from the charger and the tractor, or open the power disconnect (where applicable).
- (2) Remove the charger cover, wire #2 and #30 from the charger base, and place the charger near the tractor such that the timer can plug into transformer for operational tests.
- (3) Turn the ac power on and move the timer to the "START" position. Measure the dc voltage across test points indicated.

Transformer Test

To test transformer ac output for proper values, proceed with the following:

- a. Remove one or both diodes from transformer lead test point* 44, 45.
- b. Remove one transformer lead from the capacitor T.P. 42 or 43.

CAUTION: DO NOT ALLOW THE LEAD TO TOUCH ANYTHING ELSE.

* Test Point will be called T.P.

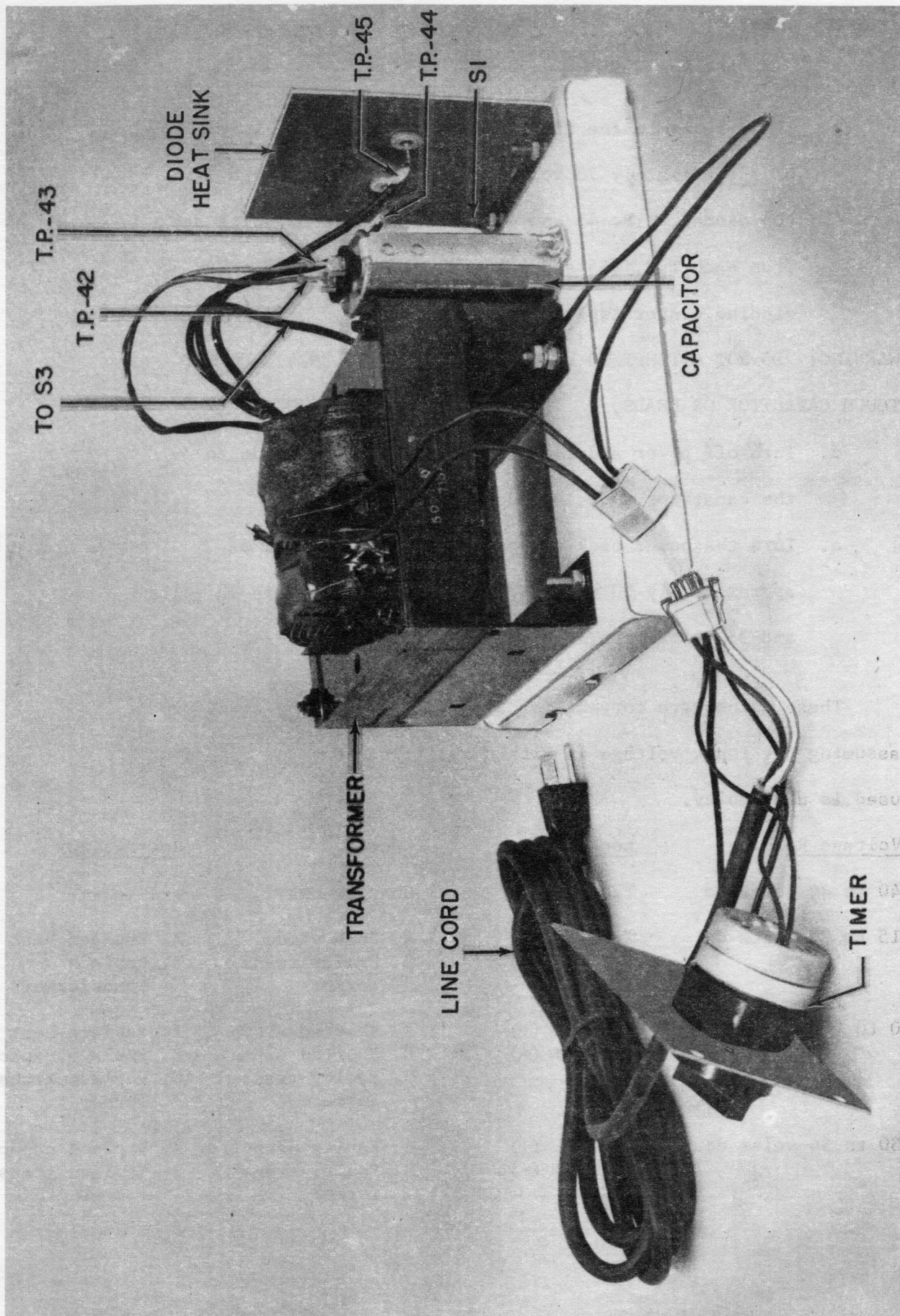
- c. Apply power to the transformer and measure ac voltage of approximately 70 volts ac across leads removed from the diodes, T.P. 45 and 44. Also measure 35 volts ac from each T.P. (45 and 44) to T.P. S3 (the secondary winding center tap).

WARNING: DO NOT ATTEMPT TO MEASURE CAPACITOR VOLTAGE. DO NOT TOUCH CAPACITOR OR LEADS.

- d. Turn off power and reconnect the capacitor leads to the capacitor, T.P. 42 and 43.
- e. Turn the power back on, and measure ac voltage of approximately 90 volts ac and 45 volts ac where 70 volts and 35 volts were measured in C.

These values are correct for a normally operating transformer, assuming the input voltage is within specifications and capacitor used is not faulty.

<u>Voltage Reading</u>	<u>Location</u>	<u>Cause</u>	<u>Correction</u>
40 to 44 volts dc	T.P. S1 (+)	Charger Okay	-----
15 to 20 volts dc	T.P. S1 (+) T.P. S3 (-)	A. Open diode B. Faulty trans- former	A. Replace heat sink. B. Replace transformer
0 to 2 volts dc	T.P. S1 (+) T.P. S3 (-)	A. Shorted diode B. Shorted capacitor C. Faulty trans- former	A. Replace heat sink B. Replace capacitor C. Replace trans- former
30 to 34 volts dc	T.P. S1 (+) T.P. S3 (-)	A. Faulty capacitor B. Faulty trans- former	A. Replace capacitor B. Replace trans- former



TROUBLESHOOTING TECHNIQUES

The mechanics involved in troubleshooting are necessarily long. As you become familiar with logical troubleshooting procedures, experience develops, and familiarity with the circuits increases, and you will find less need to refer to procedure guides, but will work solely from the wiring drawings and schematics.

The troubleshooting sections do not attempt to cover all possible failures, but will serve as guides to step-by-step procedures for solving common problems. Familiarity with these procedures develop logical approaches for failures not listed.

WARNING: BEFORE ATTEMPTING TO SERVICE THE ELEC-TRAK TRACTOR, DISCONNECT THE CHARGER FROM THE LINE VOLTAGE SOURCE AND DISENGAGE THE POWER DISCONNECT. SINCE THE A-60 AND A-65 TRACTORS ARE NOT EQUIPPED WITH A POWER DISCONNECT, THE BATTERY CLAMP MUST BE LIFTED FROM THE POSITIVE POST BEFORE PROCEEDING WITH SERVICING OF THE TRACTOR UNLESS VOLTAGE MEASUREMENTS MUST BE MADE. RESTORE THESE POWER SOURCES AS NEEDED FOR THE SPECIFIC TEST.

Before starting to troubleshoot, visually check for loose wiring, and signs of faulty components; i.e., overheating, pitted relay contacts, binding or loose switches, etc.

NOTE: All continuity tests must be made with the charger line cord disconnected and the power disconnect disengaged. Under no circumstances should continuity measurements be made on connected power pack interconnections. This will result in damage to the VOM.

Most voltage measurements must be made under Normal Operating Conditions (NOC) which call for key "ON", power disconnect engaged, seat switch closed, and brake pedal fully released.

WARNING: TO REDUCE THE LIKELIHOOD OF ACCIDENTS UNDER THESE CONDITIONS, PLACE THE RANGE SELECTOR IN ITS NEUTRAL POSITION OR JACK BOTH REAR WHEELS OFF THE GROUND. THIS WILL PREVENT UNWANTED MOVEMENT OF THE TRACTOR.

Carefully observe polarity when measureing dc voltage.
(+ meter lead to + volts, - meter lead to -volts)

During the troubleshooting procedure, refer to the schematics, wiring diagrams, and appropriate assembly drawings as often as necessary to develop skill in relating these illustrations to the tractor hardware. When a check, test, or measurement step fails, always suspect trouble in the circuit under test; do not proceed to the next step until the previous step produces satisfactory results.

When an open circuit in the control wiring is indicated, careful jumpering of the suspected components can confirm the indication if normal operation is restored with the jumper in place. The circuitry being jumpered can then be systematically reduced until a single wire or component causing the failure has been isolated. This procedure should only be attempted when the necessary wiring schematic is consulted and understood.

TROUBLESHOOTING PROCEDURES

For those who have had relatively little experience in the troubleshooting of the ELEC-TRAK tractor, additional information is offered to clarify some of the terminology and procedures used.

The abbreviation NOC is used often in the Troubleshooting Guide. This stands for "Normal Operating Conditions" and means that the power disconnect should be engaged, the key switch closed, and the range selector (transaxle) in neutral unless directed otherwise.

Indirect or automatic switching is done with relays and contactors. Generally, contactors handle the high-current switching and relays are for much lower currents. Both can be energized or activated by applying voltage to their coil terminals. Contact pairs, found on the relays, are usually combinations of normally-open and normally-closed contacts.

Most electrical troubleshooting is done by tracing the circuitry on the troubleshooting sketch for the appropriate tractor model to find logical voltage and continuity check points, and the procedures given in the troubleshooting charts.

The troubleshooting sketch is a combination schematic drawing and wiring diagram. It shows not only the electric-electronic circuits of the tractor, but the location of wire connections, plug and jack pin identifications, wire number coding, and notes in various areas that aid troubleshooting.

For example, locate fuse FU2 (Fig. TM 1-3) in the lift circuit on the C-185 sketch. Immediately, it is determined that the fuse is a 30-amp slo-blow with two wires connected to one end and one wire to the other. In following the wires, it is shown that the single wire is coded "17" and is terminated in Plug 1 Pin 10 (P1-10). The two wires at the other end are coded "5". They are terminated at the 2 contactor, and the Fuel Level Gage. (Inspection of the fuse in AB145 will verify this information.)

Knowledge of the currents involved in various circuits will often help in identifying wiring if the same code number occurs on several wires.

ALWAYS CHARGE THE POWER PACK AND CHECK ALL FUSES BEFORE BEGINNING A TROUBLESHOOTING PROCEDURE.

If open wiring is suspected, don't ignore the plug and jack connections involved. These connectors may become unlatched from the housing and cause an open connection. Whenever a test involves opening any connections, close the connections before proceeding to the next step.

If multiple failures occur in the same test area, the troubleshooting procedure should be repeated to locate each failure.

As a final word of caution, if any component is replaced or rewired and failures are experienced, carefully recheck the wire coding for correct location.

If a specific problem is not listed, problems listed with similar symptoms may give some insight into possible areas to examine or the procedure to use.

1.8 PARTS REPLACEMENT

Much time can be saved in the replacement of electrical components if wires can be transferred from the old component to the new one-at-a-time. This procedure also reduces the likelihood of an error in rewiring which could result in serious damage.

Besides the "one-at-a-time" wire transfer for printed circuit cards and relays, care should be taken in handling these components and in removing and installing their wires. To prevent damage to the component or the wire connector, removal should be done by grasping the connector and pulling straight away from its terminal, without any rocking motion. Installation should be done in much the same way; i.e., without rocking

which can cause damage to connectors or components.

Wiring connections to the printed circuit cards must make solid contact with the printed circuit card pads. In some cases, this calls for facing the connector a certain way, and in others, the connector must be adjusted or replaced to increase pad contact pressure. Much the same can be said about the connectors used on the relay terminals.

Servicing required on the power disconnect (on tractors so equipped) always requires that at least one of the battery clamps be removed from its post to "open" the series set of batteries. If this is not done, portions of the power disconnect carry voltage and may cause severe arcing to occur.

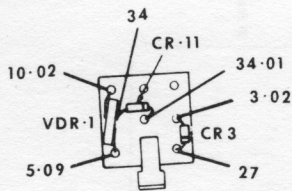
Wire connectors can be divided into two categories: those that can be crimped onto wires with the crimping tool, and those that must be soldered. As a guide, select a connector that will accommodate both the terminal to be engaged and the gage of the wire used. Prepare the wire by stripping sufficient insulation to allow the wire to seat in the connector fully. If crimping is used, close the crimping tool handles completely to assure good contact. If the connector is equipped with an insulator, this should be crimped to hold the wire insulation securely.

The large connectors are easily soldered to the wire with a high wattage soldering iron, but the smaller connectors used in the plug and jack housing must be carefully soldered so as to allow the connector to enter the housing freely. After soldering, the upper connector tabs should be formed around the wire insulation for additional strength.

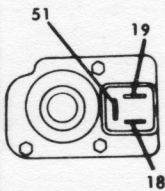
B-145



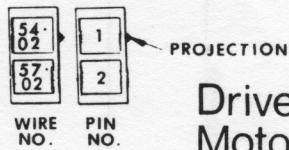
DETAILED WIRING VIEWS — B-145



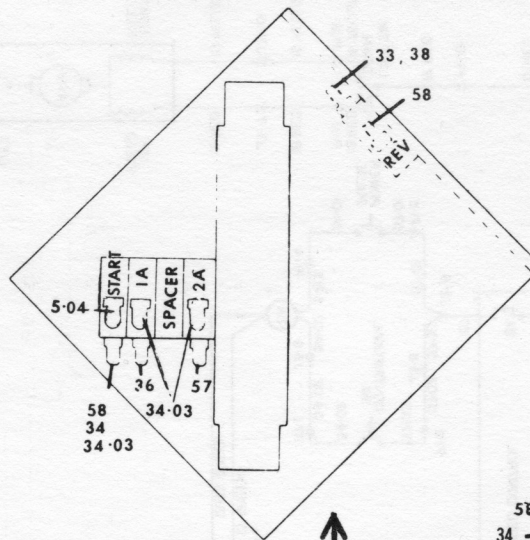
Diode-Varistor (G)



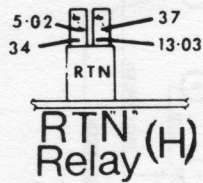
Lift Motor



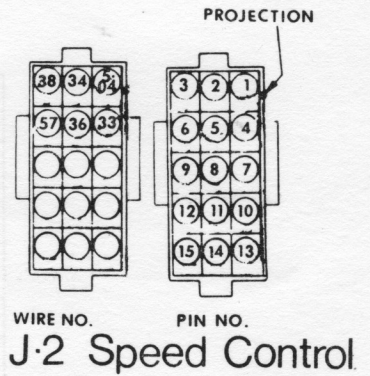
Drive Motor J-7



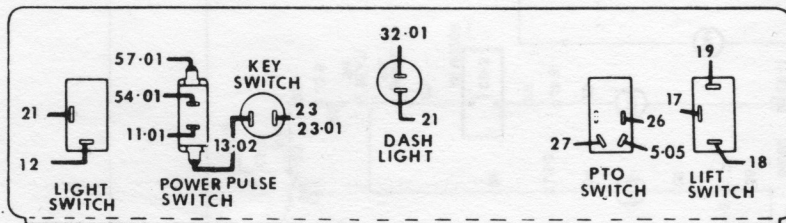
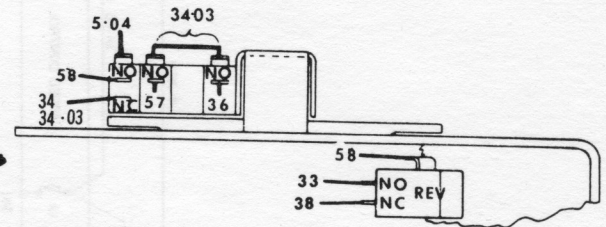
Throttle Control



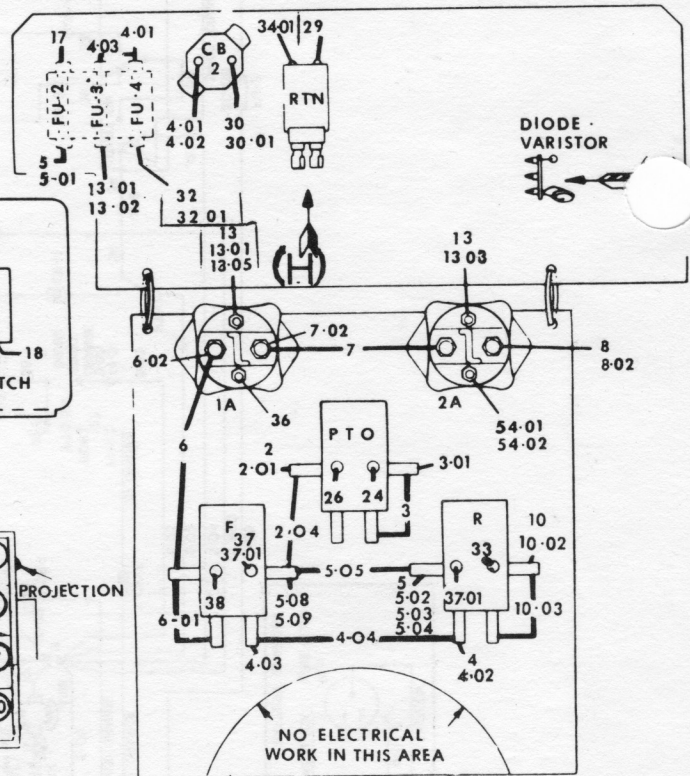
RTN Relay (H)



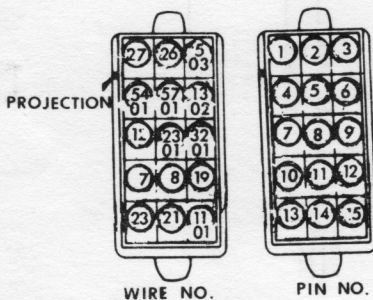
J-2 Speed Control



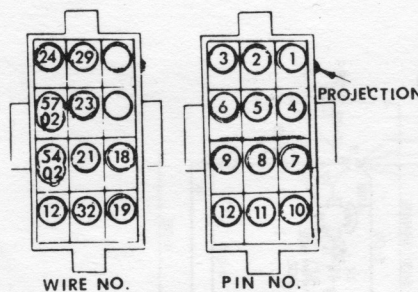
Dash Panel



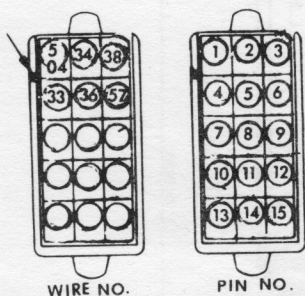
Control Panels



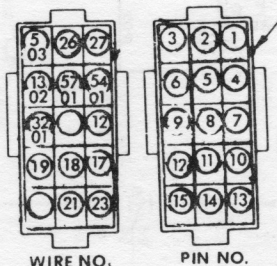
P-1 Dash



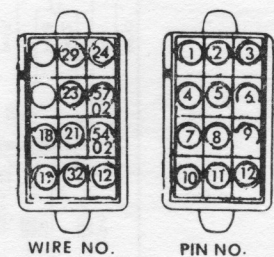
J-3 Chassis



P-2 Speed Control

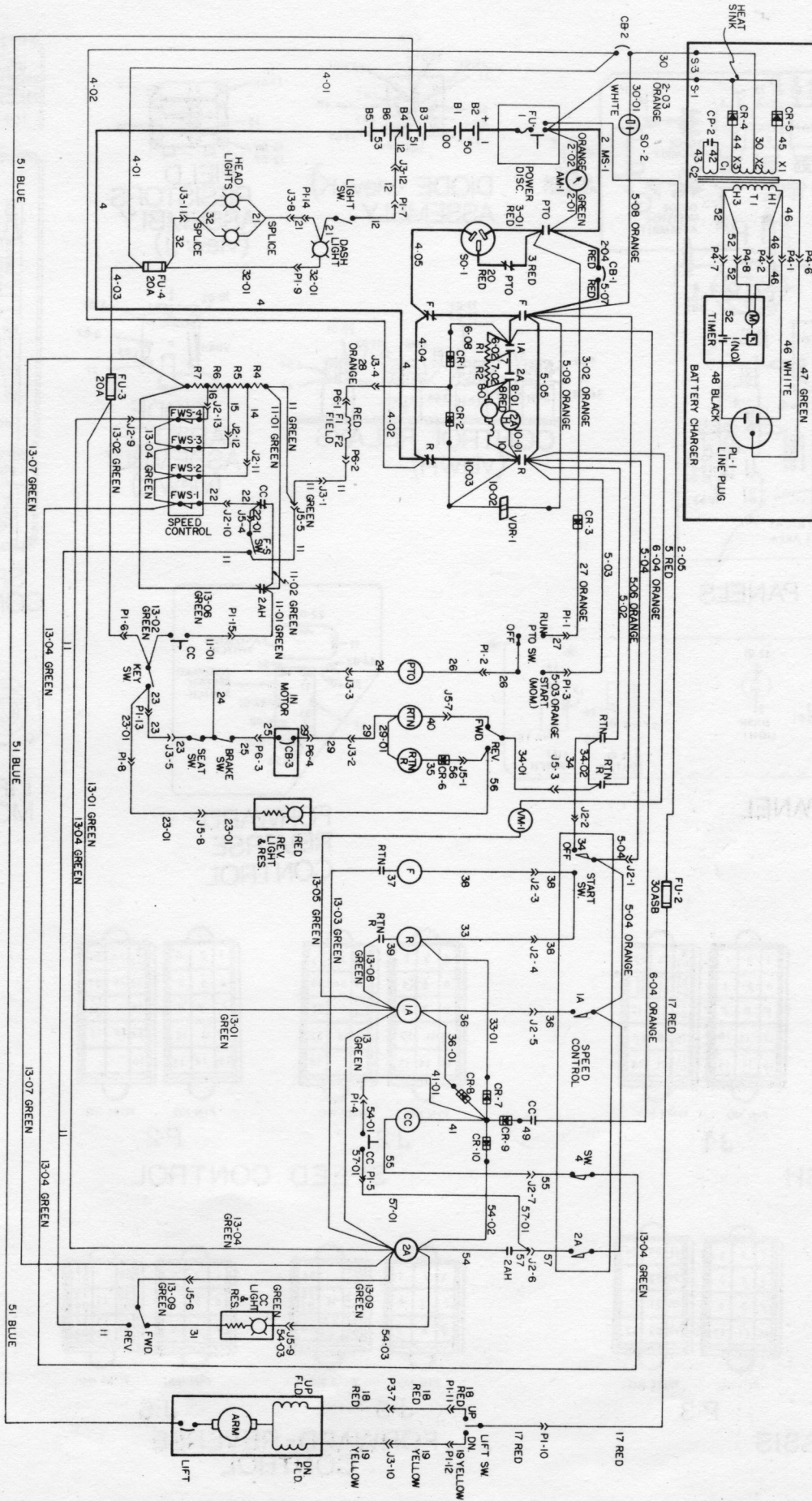


J-1 Dash



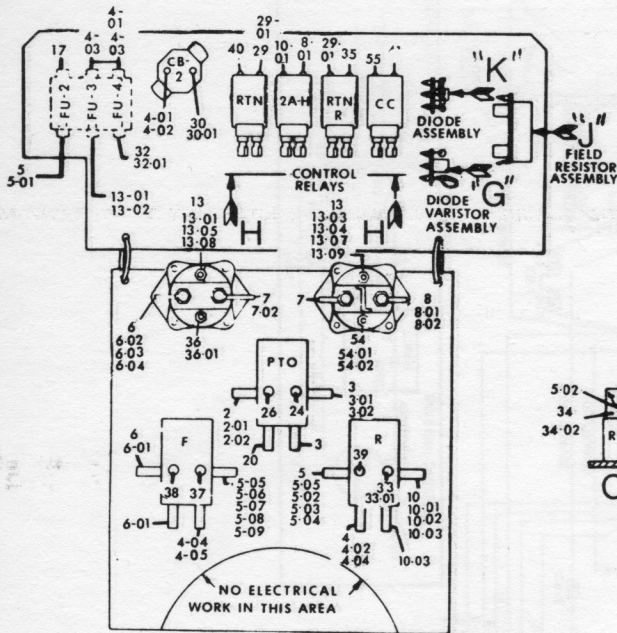
P-3 Chassis

CONNECTION AND WIRING SCHEMATIC

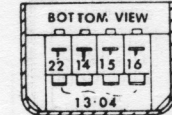
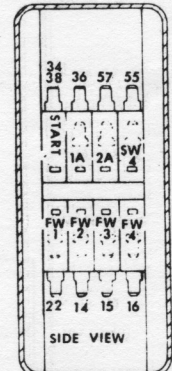
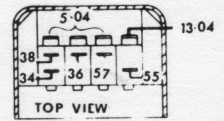
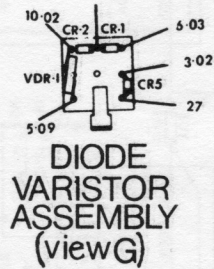
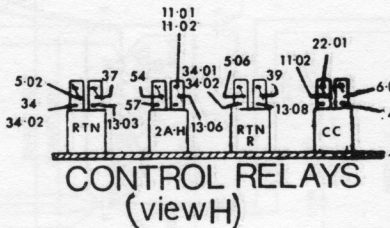
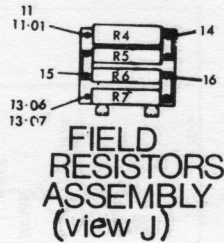
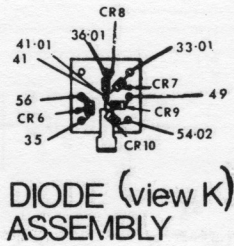


581-0

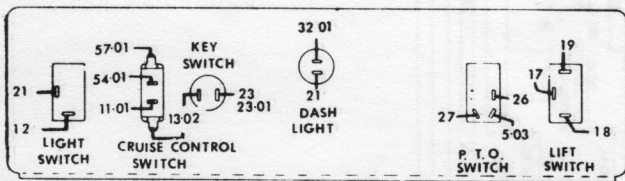
DETAILED WIRING VIEWS — C-185



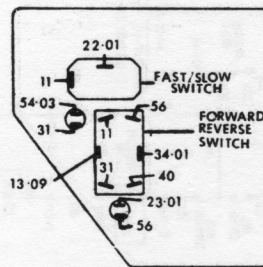
CONTROL PANELS



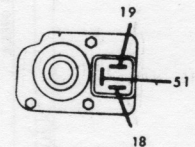
SPEED CONTROL



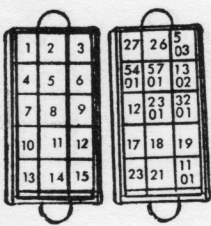
DASH PANEL



FORWARD-
REVERSE
CONTROL



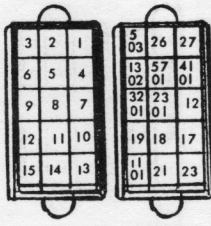
LIFT
MOTOR



PIN NO.

WIRE NO.

P-1

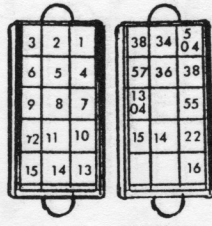


PIN NO.

WIRE NO.

J-1

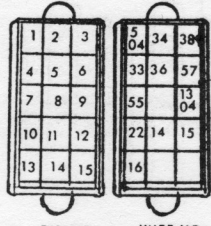
DASH



PIN NO.

WIRE NO.

J-2

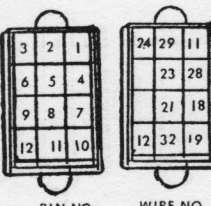


PIN NO.

WIRE NO.

P-2

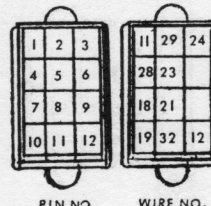
SPEED CONTROL



PIN NO.

WIRE NO.

J-3

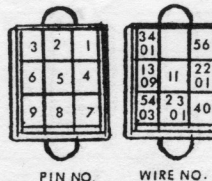


PIN NO.

WIRE NO.

P-3

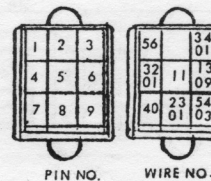
CHASSIS



PIN NO.

WIRE NO.

J-5

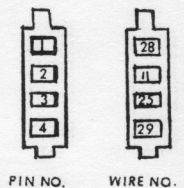


PIN NO.

WIRE NO.

J-5

FORWARD-REVERSE
CONTROL



PIN NO.

WIRE NO.

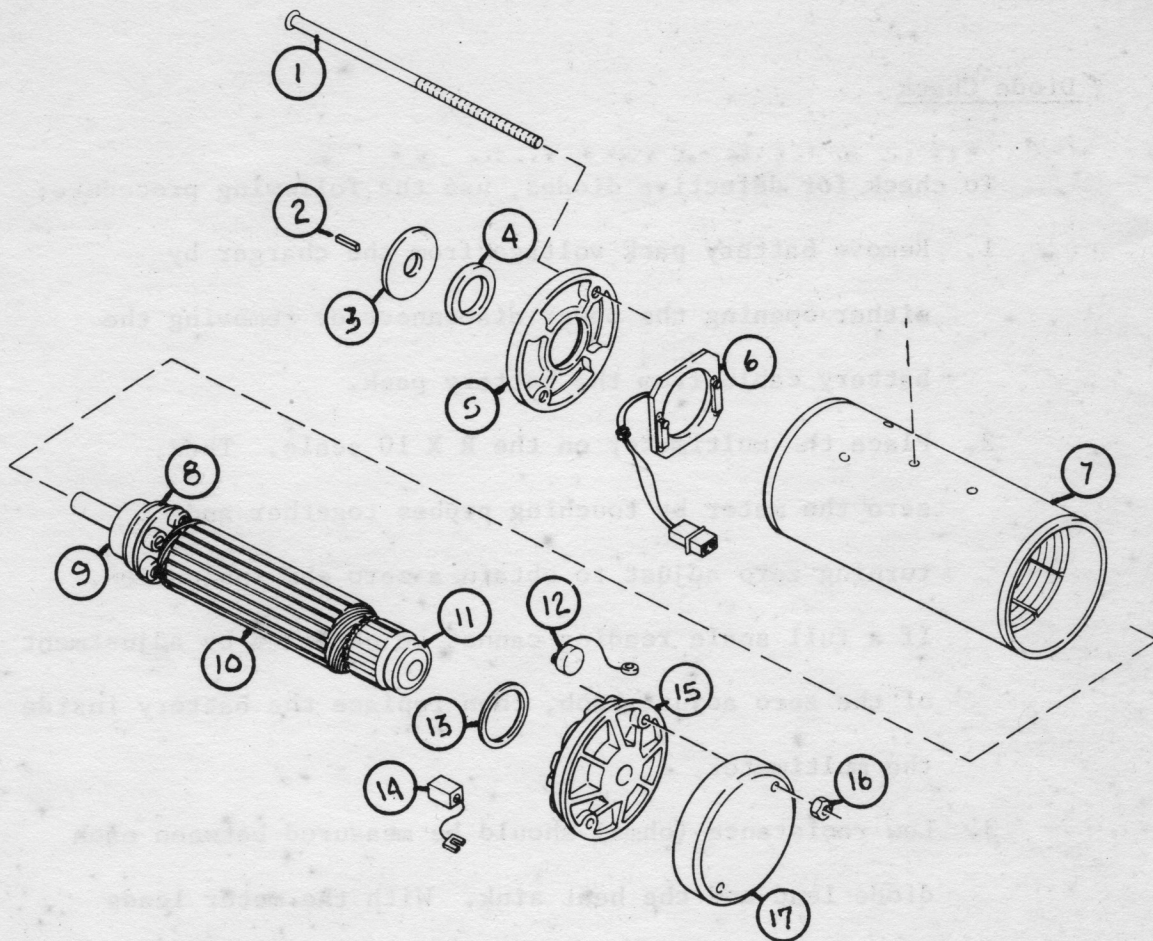
J-6
DRIVE MOTOR

Diode Check

To check for defective diodes, use the following procedure:

1. Remove battery pack voltage from the charger by either opening the power disconnect or removing the battery cable from the battery pack.
2. Place the multimeter on the R X 10 scale. Then, zero the meter by touching probes together and turning zero adjust to obtain a zero ohm indication. If a full scale reading cannot be obtained by adjustment of the zero adjust knob, then replace the battery inside the multimeter.
3. Low resistance (ohms) should be measured between each diode lead and the heat sink. With the meter leads reversed, no reading should be seen. Be sure to measure both diode leads to the heat sink.
4. If zero ohms (full scale) is observed, then one or both diodes are shorted and the heat sink must be replaced.
5. If low resistance is obtained in one direction and (infinity) in the opposite direction, then the diodes are not shorted, but one may or may not be open.
6. If Transformer Test indicates an open diode (15-20 volts output), then clip one diode lead near the insulated transformer wire and retest each diode as in (3) above. A lack of reading in both directions of either diode indicates an open diode. Replace the heat sink.

B-145 motor



- 1.
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- 3.
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- 9.

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- 14.
- 15.
- 16.
- 17.