OPERATION
AND
MAINTENANCE MANUAL
WITH
PARTS LIST

MODEL: E 4-51, E 4-57

SERIAL NUMBER: 94535 & UP

YEAR: January, 1990

MANUAL NUMBER: ME-450-03

- IMPORTANT -

READ AND FOLLOW INSTRUCTIONS GIVEN IN SAFETY & OPERATIONS AND THOSE SECTIONS RELATED TO YOUR SERVICE AND REPAIR RESPONSIBILITIES

TAYLOR-DUNN
Commercial and Industrial Vehicles Since 1949

2114 W. Ball Rd., Anaheim, CA 92804 (714)956-4040 Fax (714)956-0504
Mailing Address: P.O. Box 4240, Anaheim, California 92803

TABLE OF CONTENTS

Model E

SECTION 1
Page 1

INSPECTION, SAFETY AND INTRODUCTION

ARRIVAL INSPECTION CHECKLIST

Visual inspection should be made to determine that the tractor has remained in good condition during transit. If any damage is found, the details should be noted on the delivery receipt immediately. After delivery the tractor should be most carefully checked for HIDDEN DAMAGE. Any concealed damage not noted on the delivery receipt should be reported, in writing, to the carrier within 48 hours.

The following checklist has been prepared to aid you during arrival and inspection of your vehicle.

a. Open all packages and examine any accessories which may be shipped detached from vehicle.

b. Examine wiring for visible evidence of damage, check all connections to insure that none have loosened during transit.

c. Check all battery connections and electrolyte level in each cell.

d. Inspect battery charger in accordance with manufacturers installation instruction.

e. Check tires for damage and proper inflation. Check wheel lugs to insure tightness.

f. Examine entire vehicle for damage such as dents or cracks.

g. Check operation of controls to see that they are working freely

Upon completion of the visual inspection, an operational test should be made after reading the remainder of Section 1 and operating instructions contained in Section 3.

NOTE: Occasionally you may receive a "Power Traction" equipped vehicle with the oil level below the oil level point. This is a perfectly normal situation and is not harmful to the unit. It occurs during vehicle transit when oil drains from the chain case into the drive axle housing. A short period of normal operation will restore the chain case oil level to the proper point. To hurry the process, drive the vehicle in reverse for a few minutes then check level before proceeding with normal operation.

SECTION 1
Page 2

INSPECTION AND INTRODUCTION
INTRODUCTION

This vehicle is primarily designed as a rider type electric tractor, for use in warehouse and industrial plants on smooth floors. It is not designed for outside use, over rough ground or up steep ramps. Its compact design and short turning radius are ideally suited for narrow aisles. The Standard Model (E 4-51) operates at 6 mph with a normal draw bar pull of 300 pounds. The heavy duty model (E 4-57) operates at 6 mph with a normal draw bar pull of 500 pounds. The frame is constructed of heavy steel plate. All components are ruggedly designed and mounted to main frame. Access panels are provided at strategic points for ease of maintenance and service.

MODEL NO.

The following Model Numbers are covered by this manual.

E 4-51 and E 4-57

SERIAL NO. BEGINNING WITH 94318

The serial number of your unit is stamped into the angle frame member, between the battery compartment and control console 4 inches from the left side. The Model Number and Serial Number are on a nameplate attached to the dash panel. When ordering parts or referring to your unit, please use these numbers. Replacement parts can be purchased directly from your local authorized dealer.

SECTION 2
Page 1

WARRANTY

Taylor-Dunn Manufacturing Company warrants each new Taylor-Dunn vehicle for ninety days (90) according to the following terms:

Warranty will be based on dealer's policy at the time of sale. All warranty work must be performed by an authorized Taylor-Dunn dealer. It is preferable to return to the dealer from whom the vehicle was purchased. Always verify the warranty effectivity before authorizing work on the vehicle. Proof of purchase may be required to verify warranty status. Any exceptions to the warranty policy must be obtained by the dealer from Taylor-Dunn Manufacturing Company in Anaheim, California **PRIOR** to warranty work performance.

Individual operating habits and usage may contribute extensively to the need for maintenance service and possibly affect your warranty. Consult your authorized Taylor-Dunn distributor for advice on proper maintenance and care of your vehicle. Proper maintenance and care will be very helpful in keeping your overall operating cost at a minimum.

To assure warranty coverage, it is the owner's responsibility to maintain all components in proper adjustment and to service the vehicle as specified in the Taylor-Dunn Vehicle Operators Manual.

Thank You,

TAYLOR-DUNN MANUFACTURING COMPANY
2114 W. Ball Road
Anaheim, CA 92804

Phone: 714-956-4040
FAX 714-535-8029

SECTION 3
Page 1

OPERATING INSTRUCTIONS

The controls on your Taylor-Dunn vehicle have been designed and located for convenience of operation and efficient performance. Before driving your vehicle for the first time, familiarize yourself with each of the controls. Read the following instructions and with power OFF, operate each control. By following this suggestion you will attain a "feel" for their operation prior to traveling under power for the first time.

STEERING
The steering wheel and steering system is similar to automotive types. Turn the steering wheel to the right (or clockwise) for a right turn and left (or counterclockwise) for a left turn.

BRAKE-AUTOMATIC (DEADMAN)
The foot treadle is a combination brake and accelerator. It is designed for right foot operation and pivots near the center. Applying pressure with your heel controls the braking action. The greater the pressure applied with your heel the greater the braking action.

A heavy spring control is incorporated with the treadle linkage and automatically returns the treadle to a brake applied position whenever the foot is removed. (Refer to Safety Interlock for additional instructions.)

ACCELERATOR PEDAL
The same foot treadle is the accelerator control. Applying toe pressure to depress the treadle turns power on to the drive motor, the amount the treadle is depressed. Full power when fully depressed, and minimum power when partially depressed.

SAFETY INTERLOCK & BRAKE PRESSURE RELEASE (Foot Control)
The pedal located on the left floor board controls the electric safety interlock. Power to the drive motor remains disconnected until the pedal is depressed. Releasing the pedal immediately shuts off all power to the drive motor.

A second function of the pedal is to hold the automatic deadman brake spring pressure in a released position while operating the tractor. This feature has been added to reduce fatigue from constant heavy treadle pressure. To release spring pressure first depress accelerator treadle to full "ON" position, next depress interlock pedal with left foot. Return accelerator treadle to "OFF" position. You will be able to feel the ease with which the accelerator now operates. Removing the left foot from the pedal immediately resets the brake spring pressure for positive braking action.

SECTION 3
Page 2

STANDARD OPTIONAL ACCESSORIES

HORN BUTTON
The horn button is located to the right of the steering wheel. Depressing button sounds horn. Releasing button will immediately silence horn.

LIGHT SWITCH
The light switch that controls (optional) headlamps and taillamps is located in the control console. It is labeled for On-Off positions.

BATTERY CHARGER
Refer to Section 16 for proper instructions to operate your battery charger.

SPECIAL ACCESSORIES
Refer to the appropriate section of this manual for separate operating instructions pertaining to any special feature or accessory your vehicle may have.

VEHICLE OWNER AND OPERATOR'S GUIDELINES

OPERATING YOUR VEHICLE

To put your vehicle into operation, turn key lock clockwise. Select direction you wish to travel by moving forward/reverse switch into position. Slowly depress treadle until vehicle is moving at the desired speed. Steer vehicle as required utilizing the treadle to control your speed as desired.

CAUTION: **DO NOT hold vehicle at a standstill on a hill or incline using accelerator only. Continued "stalled" condition as described will damage motor and electrical controls. Use either your foot brake or hand brake to hold the vehicle on a hill safely.**

CAUTION: **When you leave your vehicle always place forward/reverse switch in neutral position. Lock and remove key.**

DRIVE SAFELY AND ENJOY YOUR TAYLOR-DUNN VEHICLE

SECTION 3
Page 3

OPERATING RESPONSIBILITIES FOR TRACTORS
OPERATING RULES AND PRACTICES

OPERATOR QUALIFICATIONS

Only trained and authorized operators should be permitted to operate this Tractor. Operators should be qualified as to visual, auditory, physical, and mental ability to safely operate the equipment.

OPERATORS' TRAINING

(a) The tractor owner, lessee, or employee of the tractor operator shall conduct an operators' training program for the tractor operators.

(b) Successful completion of the operators' training program shall be required by the owner, lessee, or employer of the operator before operation of the tractor by any operator.

(c) An effective operator's training program should center around user company's policies, operating conditions, and their Taylor-Dunn tractor by any operator.

(d) The tractor owner, lessee, or employer of the tractor operator should include in the operators' training program the following:

(1) Careful selection of the operators, considering physical qualifications, job attitude and aptitude.

(2) Emphasis on safety of stock, equipment operator, and other employees.

(3) General safety rules contained in ANSI B 56.8-1988 and the additional specific rules determined by the tractor owner, lessee, or employer of the carrier operator in accordance with the standard, and why they were formulated.

(4) Introduction of equipment, control locations and functions, and explanation of how they work when used properly and when used improperly; and ground and floor conditions, grade, and other conditions of the environment in which the tractor is to be operated.

(5) Operational performance tests and evaluations during, and at completion of the program.

(6) Rules of the employer and any applicable labor contract governing and dealing with discipline of employees for violation of employer's rules, and including safety rules.

OPERATOR RESPONSIBILITY

Operators of Personnel and Burden Carriers shall abide by the following safety rules and practices.

SECTION 3
Page 4

OPERATING RESPONSIBILITIES continued

GENERAL

(a) Safeguard the pedestrians at all times. Do not drive tractor in a manner that would endanger anyone.
(b) Riding on the tractor by persons other than the operator is not authorized. Do not put any part of the body outside the outer perimeter of the tractor.
(c) When a tractor is left unattended, stop carrier, place directional controls in neutral, check for brake application, turn off power, turn off the control or ignition circuit, remove the key, and block the wheels if machine is on an incline.
(d) A tractor is considered unattended when the operator is 25 ft. (7.6 m) or more from the tractor which remains in his view, or whenever the operator leaves the tractor and it is not within his view. When the operator of a tractor is dismounted and within 25 ft. (7.6 m) of the tractor still in his view, he still must have controls neutralized, and brakes set to prevent movement.
(e) Maintain a safe distance from the edge of ramps and platforms.
(f) Use only approved tractors in hazardous locations.
(g) Report all accidents involving personnel, building structures, and equipment.
(h) Operators shall not add to, or modify, the tractor.
(i) Fire aisles, access to stairways, and fire equipment shall be kept clear.
(j) Operators and personnel shall be warned of the hazards of long hair and loose clothing.

TRAVELING

(a) Observe all traffic regulations, including authorized plant speed limit. Under normal traffic conditions keep to the right. Maintain a safe distance, based on speed of travel, from the tractor or vehicle ahead; and keep the tractor under control at all times.
(b) Yield the right of way to pedestrians, ambulances, fire trucks, or other tractors or vehicles in emergency situations.
(c) Do not pass another tractor or vehicle traveling in the same direction at intersections, blind spots, or at other dangerous locations.
(d) Keep a clear view of the path of travel, observe other traffic and personnel, and maintain a safe clearance.
(e) Slow down and sound the audible warning device at cross aisles and other locations where visibility is obstructed.
(f) Ascend or descend grades slowly.
(g) Use extra caution when operating on grades. Never turn on any grade, ramp, or incline; always travel straight up and down.

SECTION 3
Page 5

TRAVELING

(h) Under all travel conditions the tractor shall be operated at a speed that will permit it to be brought to a stop in a safe manner.

(i) Make starts, stops, turns, or direction reversals in a smooth manner so as not to shift the load, overturn the tractor, or both.

(j) Do not indulge in stunt driving or horseplay.

(k) Slow down when approaching, or on, wet or slippery surfaces.

(l) Do not run tractor onto any elevator unless specifically authorized to do so. Approach elevators slowly, and then enter squarely after the elevator car is properly leveled. Once on the elevator, neutralize the controls, shut off power, and set brakes. It is advisable that all other personnel leave the elevator before a tractor is allowed to enter or leave.

(m) Avoid running over loose objects on the roadway surface.

(n) Prior to negotiating turns, reduce speed to a safe level, turning hand steering wheel or tiller in a smooth, sweeping motion.

LOADING

(a) Handle only stable or safely arranged loads. When handling off-center loads which cannot be centered, operate with extra caution.

(b) Handle only loads within the capacity of the tractor recommended by the manufacturer.

(c) Handle loads exceeding the dimensions used to establish tractor capacity with extra caution. Stability and maneuverability may be adversely affected.

OPERATOR CARE OF MACHINE

(a) At the beginning of each shift during which the tractor will be used, the operator shall check the tractor condition and inspect the tires, warning devices, lights, battery, controller, brakes, and steering mechanism. If the tractor is found to be in need of repair, or in any way unsafe, or contributes to an unsafe condition, the matter shall be reported immediately to the designated authority, and the tractor shall not be operated until it has been restored to safe operating condition.

(b) If, during operating the tractor becomes unsafe in any way, the matter shall be reported immediately to the designated authority, and tractor shall not be operated until it has been restored to safe operating condition.

(c) Do not make repairs or adjustments unless specifically authorized to do so.

(d) Do not operate a tractor with a leak in the battery.

(e) Do not use open flames for checking electrolyte level in storage batteries.

SECTION 3
Page 6

OPERATING RESPONSIBILITIES continued
MAINTENANCE PRACTICES

INTRODUCTION

Tractors may become hazardous if maintenance is neglected. Therefore, maintenance facilities, trained personnel, and procedures must be provided.

MAINTENANCE PROCEDURES

(a) Maintenance and inspection of all tractors shall be performed in conformance with the manufacturer's recommendations and the following practices.

(b) A scheduled preventive maintenance, lubrication, and inspection system shall be followed.

(c) Only qualified and authorized personnel shall be permitted to maintain, repair, adjust, and inspect tractors.

(d) Before leaving the tractor, stop, place directional controls in neutral, apply the brake, turn off power, turn off the control circuit, and block the wheels if tractor is on an incline.

(e) Before undertaking maintenance or repair on tractor, raise drive wheels free of floor or disconnect battery, and use chocks or other positive carrier positioning devices.

(f) Block chassis before working under it.

(g) Operation to check performance of the tractor shall be conducted in an authorized area where safe clearance exists.

(h) Before starting to operate the tractor:

1) Have operator in the operating position.
2) Depress treadle to operate brake.
3) Place directional controls in neutral.
4) Switch key (clockwise) to "on" position.
5) Check functioning of directional speed controls, steering, warning devices steering, warning devices, and brakes.

(i) Avoid fire hazards and have fire protection equipment present in the work area. Do not use an open flame to check level of electrolyte. Do not use open pans of fuel or flammable cleaning fluids for cleaning parts.

(j) Properly ventilate work area.

(k) Brakes, steering mechanisms, control mechanisms, warning devices, lights, guards, and safety devices shall be inspected regularly and maintained in a safe operating condition.

(l) Special tractors or devices designed and approved for hazardous area operation shall be inspected to ensure that maintenance preserves the original approved safe operating features.

(m) The tractor should be checked for leaks and condition of parts. Action shall be taken to prevent the use of the tractor until the leak has been corrected.

SECTION 3
Page 7

MAINTENANCE PRACTICES continued

(n) The tractor manufacturer's capacity, operation and maintenance instruction plates, tags, or decals shall be maintained in legible condition.

(o) Batteries, motors, controllers, limit switches, protective devices, electrical conductors, and connections shall be inspected and maintained in conformance with good practice.

(p) Tractors shall be kept in a clean condition to minimize fire hazards and facilitate detection of loose or defective parts.

(q) Modifications and additions which affect capacity and safe machine operation shall not be performed by the customer or user without manufacturer's prior written authorization; where authorized modifications have been made, the user shall ensure that capacity, operation, warning and maintenance instruction plates, tags, or decals are changed accordingly.

(r) Care shall be taken to assure that all replacement parts are interchangeable with the original parts and of a quality at least equal to that provided in the original equipment.

SECTION 4
Page 1

MAINTENANCE GUIDE CHECKLIST

This checklist is provided for your convenience as a guide for servicing your vehicle. If followed you will enjoy a good running and trouble free unit. It has been set up for average normal use. More frequent service is recommended for extreme or heavy usage. If desired your Taylor-Dunn dealer will gladly perform these services for you as he has expert service men in the field for this purpose. Do not hesitate to call your Service Manger if any questions arise.

CAUTION: When performing maintenance on any part of the electrical system, turn key to off position and remove from switch, disconnect main battery leads and place Forward/Reverse switch in neutral.

MAINTENANCE	REFER SECTION	EVERY WEEK	EVERY MONTH	EVERY 3 MONTHS	EVERY YEAR
Check and fill batteries. If necessary fill with distilled water only.	16	X	X	X	X
Adjust Motor Mount & Chain (Refer to chart Page 11).	11		X	X	X
Lubricate all Zerk Fittings.	5		X	X	X
Lubricate all moving parts without Zerk Fittings. Use all purpose engine oil.	5		X	X	X
Wash off batteries with water (Use soda if necessary)	16		X	X	X
Check all wire connections. Be sure they are all clean and tight.	7 14		X	X	X
Check service and adjust brake (deadman type).	13		X	X	X
Check steering chain adjustment.	10		X	X	X
Check rear axle differential oil level (refer to lubrication diagram).	5 11		X	X	X
Check brake lining for wear, Adjust brake band when necessary	11		X	X	X
Check motor brushes. Blow out carbon dust. (Replace as necessary).	11			X	X

SECTION 4
Page 2

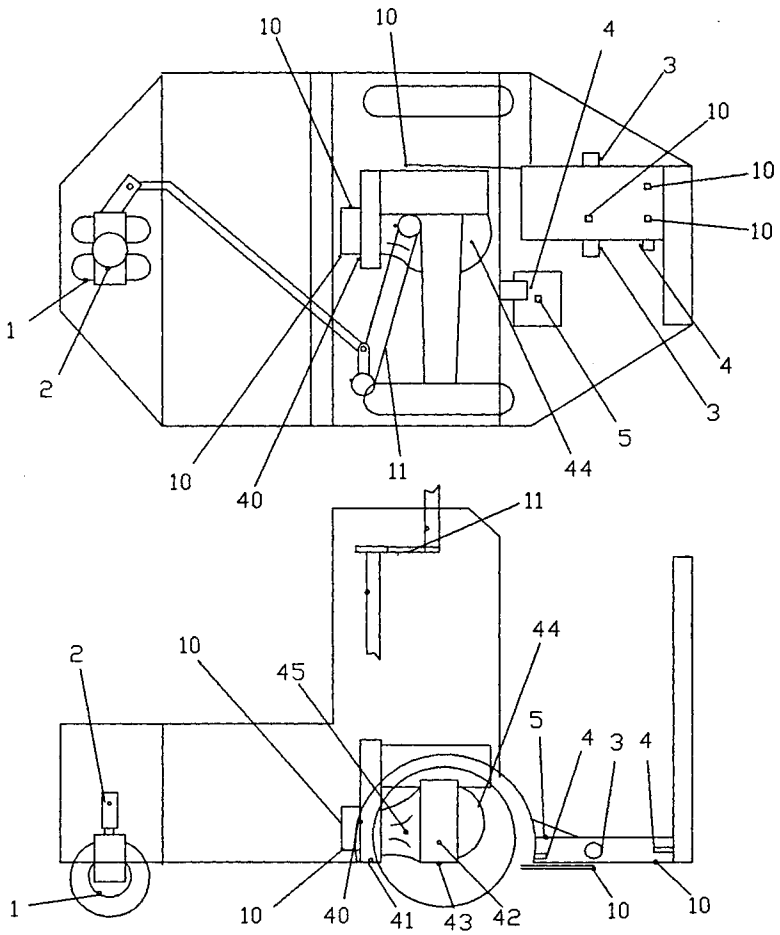
MAINTENANCE GUIDE CHECKLIST continued

MAINTENANCE	REFER SECTION	EVERY WEEK	EVERY MONTH	EVERY 3 MONTHS	EVERY YEAR
Check and adjust front wheel bearings and fork spindle bearings.	10			X	X
Drain differential and refill with SAE 30 oil (refer to Lubrication diagram)	5 11				X
Repack front wheel bearings and front fork spindle bearings (Use wheel bearing grease)	5 10				X

Speed control service is covered in Section 14

SECTION 5
Page 1

LUBRICATION DIAGRAM



A. SUPER LITHIUM GREASE

1. FRONT WHEEL HUB
2. FRONT WHEEL SPINDLE
3. TREADLE PIVOT
4. BRAKE LEVER
5. BRAKE LOCK PIN (LUBE BY HAND)

NOTE: 45 NOT USED IN THIS CONFIGURATION

NOTE: PLUG 40 ADDED FOR EASE IN REFILLING GEAR CASE TO PROPER LEVEL. GEAR CASE OIL LEVEL IS MAINTAINED BY RECIRCULATION FROM DIFFERENTIAL DURING OPERATION.

B. LIGHT OIL

10. CLEVIS PINS-MECHANICAL LINKAGE
11. CHAIN

C. "POWER TRACTION"
USE SAE 30 OIL
PROPER OIL LEVEL CHECK AT PLUG 42

TO CHANGE OIL-USE 2 QTS

a. REMOVE DRAIN PLUGS 41 & 43
b. REMOVE LEVEL PLUGS 40 & 42 AND FILL PLUG 44
c. DRAIN OIL & REPLACE 41 & 43
d. ADD OIL BY 44 TO LEVEL OF 42
e. ADD OIL BY 40 TO LEVEL OF 40
f. REPLACE PLUGS

SECTION 6
Page 1

*TROUBLE SHOOTING PROCEDURES

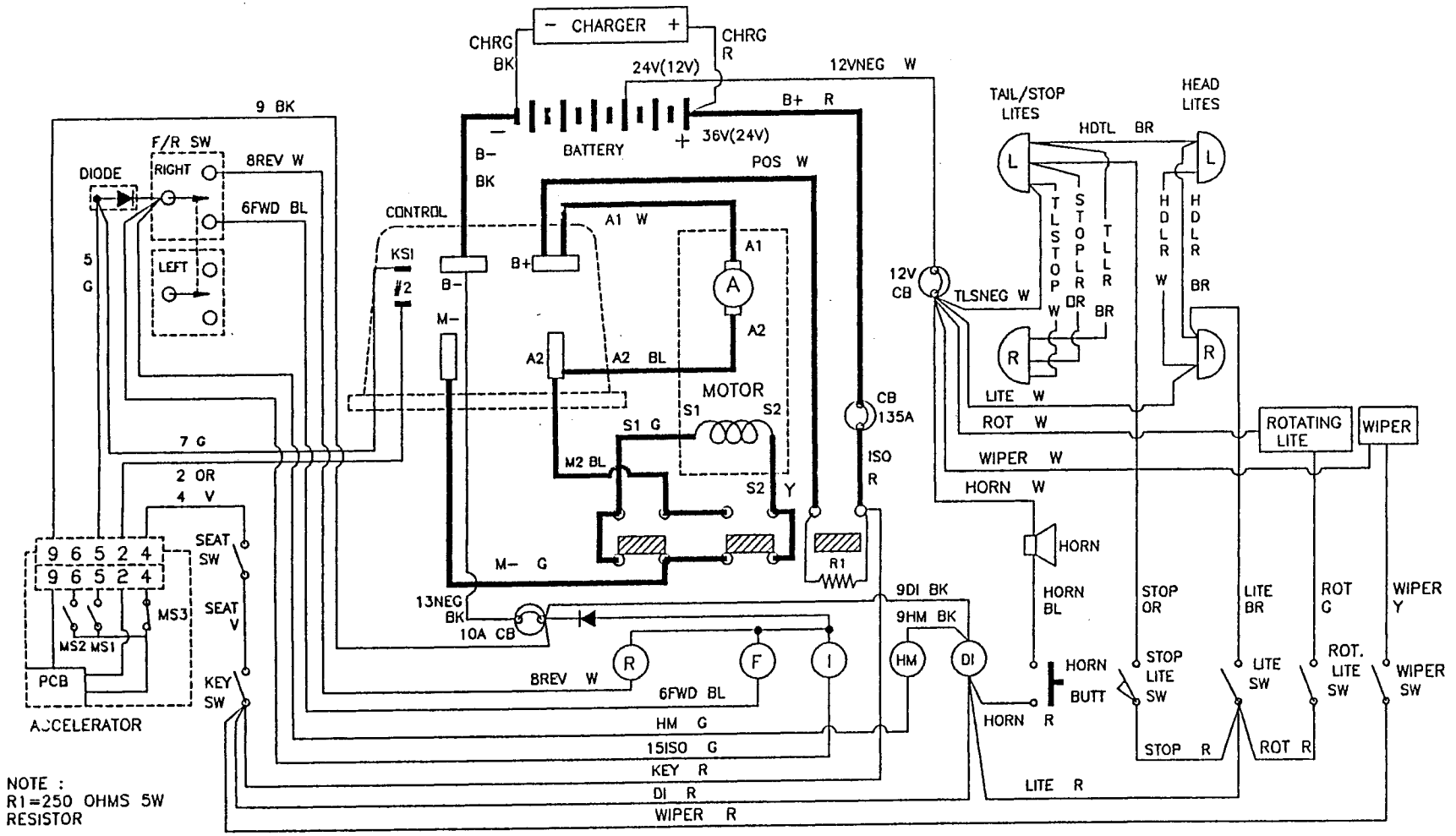
SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
1. Steering:		
a) Pull in one direction	1. Check for bent fork	Replace or straighten
b) Hard Steering	1. Bearing not seated or tight	Reseat and loosen or tighten
c) Sloppy or loose	2. Loose wheel bearing	Adjust
2. Brakes:		
a) Soft brakes	1. Check for worn lining	Adjust or replace when 1/16 or less of lining left
	2. Alignment of brake band	Realign
	3. Oil on brake lining	Find oil source and correct, wash brake band
	4. Dirt on brake lining	Clean
	5. Bind in linkage	Loosen or realign
	6. Weak spring	Replace
b) No Brakes	1. Broken band	Replace
	2. Broken Connection in linkage	Replace
	3. Broken axle	Replace
3. Drive axle:		
a) No power	1. Disconnect batteries for recharging	Recharge or replace
	2. Check motor brushes for contact	Clean or replace
	3. Poor contact on forward/reverse switch or contacts	Repair or replace
	4. Check for loose wire	Tighten or replace
	5. Check continuity through motor	Repair or replace
	6. Blown fuse	Replace
	7. Defective speed control	See Section 14

SECTION 6
Page 2

TROUBLE SHOOTING PROCEDURES

SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
b) Erratic operation	1. Motor brushes	Clean or replace
	2. Check motor commutator for burning or wear	Turn or replace
	3. Check for loose wiring	Tighten
	4. Badly worn drive sprockets	Adjust or replace
c) Lack of power or slow operation	1. Dragging brake	Re-adjust
	2. Tight front wheel bearings	Re-adjust
	3. Speed controller	See Section 14
	4. Loose connection in wiring	Tighten
	5. Partially burned out or thrown lead.	Replace or re-solder
	6. Weak batteries	Replace
	7. Bind or drag on differential	Repair
	8. Deadman automatic brake linkage not properly adjusted	Re-adjust
d) Thump or grinding	1. Motor bearing	Replace
	2. Loose motor on base	Tighten & adjust
	3. Worn sprockets	Replace sprocket and chain
	4. Defective bearing in differential	Replace
	5. Defective gears in differential	Replace
	6. Slack drive chain	Adjust (refer Section 11)

Trouble shooting for solid state speed control is covered in Section 14.



TAYLOR–DUNN 2114 WEST BALL ROAD ANAHEIM, CALIFORNIA 92804	SCHEMATIC	BK = BLACK, BL = BLUE, BR = BROWN, G = GREEN, HM = HR.METER R = RED, V = VIOLET, W = WHITE, Y = YELLOW, OR = ORANGE I = ISOLATOR, F = FORWARD, R = REVERSE, CB = CIRCUIT BREAKER, DI = DISCHARGE INDICATOR HDLR = HEADLITE LEFT TO RIGHT, HDTL = HEADLITE TO TAIL LITE, TLLR = TAIL LITE LEFT TO RIGHT, STOPLR = STOP LITE LEFT TO RIGHT, TLSNEG = TAIL/STOP LITE NEGATIVE, TLSTOP = TAIL LITE TO STOP LITE

SECTION 7
Page 1

SECTION 8
Page 1

PARTS ORDERING PROCEDURE

Parts may be purchased from your local authorized Taylor-Dunn dealer.

When ordering parts, be sure to specify the complete model number and serial number of the unit. Also specify the full Taylor-Dunn part number, description of part, and quantity of parts required. You will find a complete listing of part numbers and descriptions in the following pages of this manual. When ordering parts for the drive motor, also include the specifications found on the motor nameplate. Be sure to give complete shipping and billing address on all orders. Example:

1 - Part number 18-054-00 Sleeve steering adjustment, 22-1/2"
1 set of 4 - Part number 70-104-00 Motor brushes for G.E. motor, 6 H.P., 36 Volt, Specification 5BC48JB754
Above parts are for Model E 4-51 Tractor, Serial Number 16790

Parts ordered under warranty must be placed with your authorized Taylor-Dunn dealer. Be sure to include original invoice number, date of shipment of vehicle, and vehicle serial number.

NOTE: On contracts with National Federal Government Agencies, Defense General Supply Agency, and United States Post Office Department, orders for all warranty parts must be placed directly with the Taylor-Dunn factory in Anaheim, California.

TAYLOR-DUNN MANUFACTURING COMPANY
2114 W. BALL ROAD
ANAHEIM, CALIFORNIA 92804

PHONE: 714-956-4040

FAX: 714-535-8029

SECTION 9
Page 1

SUGGESTED SPARE PARTS LIST

FIG. I.D.	T-D PART NO.	DESCRIPTION	QUANTITY PER VEHICLE
REFER TO FIGURE NO. 3 FRONT AXLE, FORK & STEERING			
3-5	87-074-00	Grease Fitting 1/4 " -28 Straight	6
3-7	45-307-00	Grease Seal	1
3-11	13-904-00	Tire, Wheel, Hub Bearings	1 or 2
3-14	45-308-00	Grease Seal	2
3-15	87-071-00	Grease Fitting (3/16" Drive)	6
3-32	80-400-10	Ball Bearing -3/4"	4
3-35	30-400-00	Link - Master #40	5
REFER TO FIGURE NO. 5 POWER TRACTION DRIVE AXLE			
5-3	41-997-00	Drain and Level Plug (1/8" pipe)	1
5-11	41-163-11	Axle Assembly with Axle, Retainer Ring, Retainer Plate, and Bearing (14-1/8" Long) Left Side	1
5-11	41-162-11	Axle Assembly with Axle, Retainer Ring, Retainer Plate, and Bearing (11-5/8" Long) Right Side	1
5-13	45-042-00	Gasket (Housing to Differential Carrier)	1
5-42	80-702-00	"O" Ring - Drive Pinion Bearing Retainer	1
5-45	41-996-00	Plug - (Level) 1/2" with Recessed Top	1
5-50	45-021-00	Gasket Gear Case to Pinion Bearing Assy	1
5-57	41-989-00	Plug (Filler Level and Drain) 1/4 N.P.T	1
5-63	45-331-00	Oil Seal - Gear Case to Pinion	2
5-64	41-532-61	Brake Drum (Splined)	1
5-66	41-661-61	Full Brake Band for 6" Drum	2
5-73	85-060-20	Compression Spring 5/8" OD x 2-1/2" Long	1
5-83	45-002-00	Gasket - Gear Case Cover	1
5-86	45-506-00	Oil Seal (GE Motor)	1
5-87	70-054-00	Motor, 6.7 HP/10 HP 24/36 GE 5BC49JB399	1
5-98	13-959-10	Tire Cast Iron Wheel 17 x 4-1/2 x 12-1/8 Solid Xtra Cushion All Service Tire (five 1/2 " Holes on 4-1/2" Bolt Circle)	2
5-98	13-952-10	Tire Cast Iron Wheel 16 x 4 x 12-1/8 Solid Cushion Tire (Five 1/2 " Holes on 4-1/2 " Bolt Circle	2
5-106	45-044-00	Gasket - Rear Axle Bearing	2
5-122	80-703-00	"O" Ring Motor Mount Seal	1

SECTION 9
Page 2

SUGGESTED SPARE PARTS LIST

FIG. I.D.	T-D PART NO.	DESCRIPTION	QUANTITY PER VEHICLE
		REFER TO FIGURE NO. 7 MECHANICAL CONTROL LINKAGE	
7-5	88-180-15	Hex Head Cap Screw (Pivot Screw) 5/8" x 1-3/4" NC	1
7-7	87-071-00	Grease Fitting - 3/16" Drive	3
7-8	96-772-00	Pin Clevis 3/8" x 1	3
7-9	96-762-00	Clevis - 3/8" Cast	3
7-13	86-520-00	Rod End, 3/8 " Spherical Bearing	1
7-17	85-280-00	Spring, 1-3/8 OD x 7-3/4" Long (extension)	1

SECTION 10
Page 1

MAINTENANCE PROCEDURES
REFER TO SECTION 3
FRONT AXLE, FORK, STEERING AND TIRES

Your front axle and wheel assembly consists of a ruggedly designed fork mounted with 2 roller bearings. The front wheel is mounted on a 3/4" axle and turns on 2 roller bearings. Grease fittings are provided at bearing points for proper lubrication.

The front wheel is a rugged design with solid rubber tire molded directly to the wheel ring for long trouble free life.

The steering linkage consists of a steering wheel and shaft mounted on ball bearings. Mechanical advantage for smooth easy steering is obtained through roller chain and sprockets between the steering shaft and jack shaft. An automotive type drag link is provided between the jack shaft and fork for reliable trouble free steering. Heavy spherical bearing rod ends provide smooth operation and also serve as the drag link adjustment. The roller chain will require an occasional adjustment for proper tension. Refer to Service and Adjustment instruction in this section of the manual.

Refer to maintenance guide and lubrication diagram for normal care of your front wheel and steering assembly.

SECTION 10
Page 2

SERVICE AND ADJUSTMENT continued
FRONT AXLE, FORK, STEERING AND TIRES

ADJUSTMENT OF WHEEL BEARINGS

1. Adjust wheel bearings by holding one axle nut and tightening the other until drag is felt on wheel. Then back off nut approximately 1/4 turn.

REMOVAL OF WHEEL & AXLE ASSEMBLY

1. Remove axle nut by holding nut on one end of axle and unscrewing nut on opposite end.
2. Slide axle from fork & wheel, being careful to catch spacers and wheel as they come free.
3. Wheel bearings may be flushed, cleaned and repacked without removing from hub, unless severely damaged or embedded with foreign material.
4. To remove wheel bearings and seals:
   A. Pull seals from hub.
   B. Remove taper roller bearings.
   C. If necessary, press bearing races from hub with suitable press or with flat punch by hitting back and forth one side to other.

RE-ASSEMBLY OF WHEEL & AXLE

1. Press bearing races into hub with suitable press, taking care that they are seated against stops within the hub.
2. Generously lubricate wheel bearings with wheel bearing grease and insert into grease bearing races.
3. Press or tap seals into place. (Proper position is when face of seal is flush with end of hub).
   NOTE: It is recommended that new seals be installed whenever bearings are removed from wheel hub, or whenever seals are worn or damaged. Worn or damaged seals allow dirt and foreign matter to enter wheel bearings, shortening bearing life.
4. Install wheel & hub assembly into fork by pushing axle through one side of fork, inserting one spacer then sliding axle through wheel bearings. Insert other spacer and slide axle through remainder of fork assembly.
5. Install locknut.
6. Adjust wheel bearings as outlined above.
7. Wheel hub has one zerk fitting for grease lubrication.

ADJUSTMENT OF FORK SPINDLE BEARINGS

1. Adjust by tightening nut until drag is felt on spindle bearings. Loosen about 1/4 turn or until spindle rotates free but does not have any play in bearings.
   NOTE: Any excessive play in spindle bearings can lead to bearing failure due to shock effect when vehicle encounters bumps or uneven terrain.

SECTION 10
Page 3

SERVICE AND ADJUSTMENT continued
FRONT AXLE, FORK, STEERING & TIRES

REMOVAL OF FORK & SPINDLE

1. Remove battery.
2. Remove locknut & bolt to release rod end at fork arm.
3. Remove dust cap.
4. Remove lock nut on spindle out of housing.
5. Slide fork and spindle out of housing.
6. Remove bearings and dust seals.
7. A puller is required to remove bearing races from fork collar.

RE-ASSEMBLY OF FORK & SPINDLE

1. Press outer bearing race into fork collar.
   NOTE: Bearing races may be pressed into position by using a 1/2" X 6" bolt. Place a bar of suitable size over bolt. Slide bearing race over bar and pass this assembly through fork collar. Place other bearing race onto bar and tighten nut on bolt until the bearing races go into position in fork collar.
2. Generously pack bearings with wheel bearing grease. Assemble one dust seal and bearing in lower part of housing. (Refer to figure 3 for proper location.) Slide fork spindle through housing and insert upper bearing and washer.
3. Tighten spindle nut.
4. Adjust fork spindle bearings as previously outlined.
5. Replace dust cap on fork spindle.
6. Replace the rod end, bolt and locknut. Tighten locknut to 25 ft. lb.
7. Replace battery.
   NOTE: There is one zerk fitting located on the fork spindle bearing housing which requires lubrication every 1 to 3 months. Refer to Lubrication Diagram and Maintenance Guide Section.

REPLACEMENT OF ROD ENDS

1. Remove locknut & bolt to release rod end from steering arm.
2. Loosen sleeve clamp.
3. Either measure position of rod end or count number of threads exposed from sleeve. Remove rod end by unscrewing from sleeve.
   NOTE: One end will be left hand thread and the opposite rod end will be right hand thread. Install new rod end and position same as the one removed.
4. Replace bolt & locknut. Before tightening securely, try steering action by turning wheel until it stops. If necessary adjust rod end in sleeve so that wheel will travel equally in both directions from straight ahead position.
5. Tighten sleeve clamps and tighten rod end stud locknuts to 25 ft. lb.

SECTION 10
Page 4

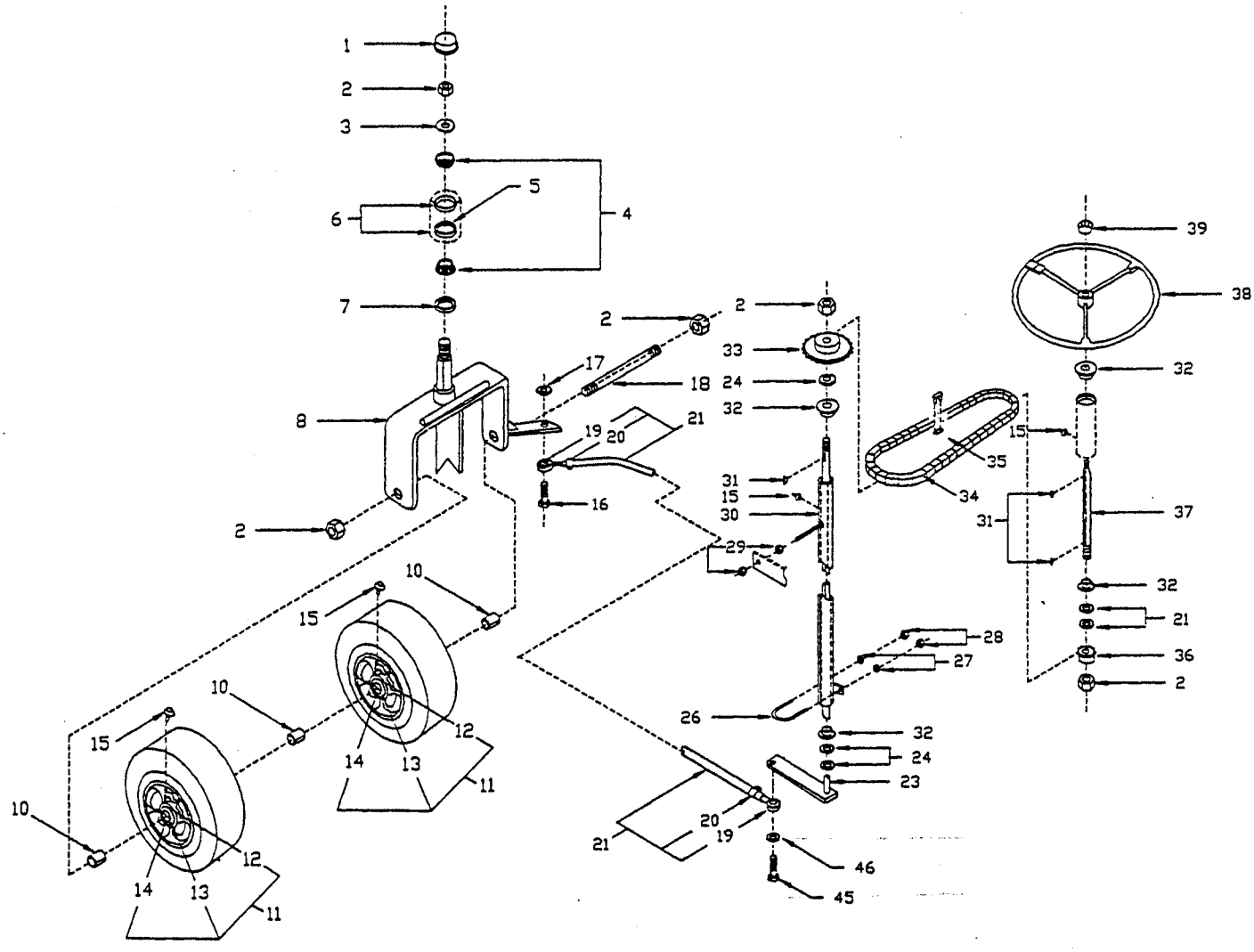
SERVICE AND ADJUSTMENT continued
FRONT AXLE, FORK, STEERING & TIRES

ADJUSTMENT OF STEERING CHAIN

1. Loosen inner nut on adjustment stud located on upper portion of jack shaft tube.
2. Adjust outer nut to remove chain slack and apply a slight tension to chain.
   WARNING: DO NOT apply excessive tension to chain as undue bearing and chain wear will result.
3. Re-tighten inner nut to lock adjustment stud in position.

SECTION 10
Page 5

FRONT FORK AND STEERING DIAGRAM
FIGURE NO. 3



SECTION 10
Page 6

FIGURE NO. 3
FRONT AXLE, FORK & STEERING

FIG. I.D.	T-D PART NO.	DESCRIPTION	QTY.
3-1	92-105-00	DUST CAP	1
3-2	88-229-81	LOCK NUT 3/4 " NC, HEX	4
3-3	88-228-60	WASHER 3/4" FLAT	1
3-4	80-011-00	BEARING - TAPERED ROLLER 1-1/4"	2
3-5	87-074-00	GREASE FITTING 1/4" -28 STRAIGHT	1
3-6	80-102-00	BEARING RACE FOR 1-1/4" TAPERED BEARING	2
3-7	45-307-00	GREASE SEAL (SINGLE)	1
3-8	14-084-10	FORK FOR 8" X 2.50 TIRE AND WHEEL (DUAL)	1
3-10	16-406-00	SPACER, WHEEL 3/4 " ID X 7/16" LONG	2
3-11	13-904-00	TIRE,WHEEL, HUB, BEARINGS - 8 X 2-1/2	2
3-12	80-105-00	BEARING RACE FOR 3/4" TAPERED BEARING	2
3-13	80-015-00	BEARING, TAPERED ROLLER 3/4	2
3-14a	13-904-50	Washer, flinger	4
3-14b	13-904-51	Seal, Foam	4
3-14c	13-904-52	Cup, retainer	4
3-15	87-071-00	GREASE FITTING (3/16" DRIVE)	2
3-16	88-180-15	HEX HEAD CAP SCREW 5/8" X 1-3/4" NC	1
3-17	88-189-82	NUT 5/8" - THIN PATTERN FLEXLOCK	1
3-18	15-010-00	AXLE BOLT 3/4" X 9-1/4" (DUAL)	1
3-19	86-521-98	ROD END - SPHERICAL BEARING - 5/8 NF LEFT HAND	1
3-19A	86-521-99	ROD END - SPHERICAL BEARING - 5/8 NF RIGHT HAND	1
3-20	86-510-00	CLAMP - BALL JOINT	2
3-21	~~18-041-12~~ 16-405-00	SLEEVE, ASSEMBLY STEERING ADJUST 22-1/2" W/30 DEGREE BEND	1
3-21	~~18-050-00~~	SLEEVE, STEERING ADJUSTMENT 36" W/30 DEGREE BEND	1
3-23	20-146-00	JACK SHAFT 3/4" X 35" WITH LEVER	1
3-24	88-228-61	3/4 SAE WASHER	5
3-26	96-102-00	"U" BOLT 5/16 NC	1
3-27	88-088-62	LOCK WASHER 5/16"	2
3-28	88-089-80	HEX NUT 5/16" NC	2
3-29	88-149-80	HEX NUT 1/2" NC	2
3-30	32-047-00	SLEEVE ONLY - JACK SHAFT	3
3-31	97-100-00	WOODRUFF KEY - 3/16"	3
3-32	80-400-10	BALL BEARING - 3/4"	4
3-33	30-010-00	SPROCKET 32T #40 CHAIN 3/4" BORE	1
3-34	30-246-00	CHAIN #40 31-1/2" LONG	1
3-35	30-400-00	LINK - MASTER #40	1
3-36	30-002-00	SPROCKET 11T #40 CHAIN 3/4" BORE	1

SECTION 10
Page 7

FIGURE NO. 3
FRONT AXLE, FORK & STEERING

FIG. I.D.	T-D PART NO.	DESCRIPTION	QTY.
3-37	20-145-00	SHAFT - STEERING 3/4" X 1-1/4 W/TAPER	1
3-38	19-007-00	STEERING WHEEL	1
3-39	88-199-82	NUT 5/8" NF (HEX JAM)	1
3-41	88-100-17	HEX HEAD CAP SCREW 3/8 X 2-1/4" NC	1
3-42	88-108-61	WASHER - 3/8" NC	1
3-43	88-108-62	BOLT, 5/8 X 1-1/2 NC	1
3-44	88-109-80	HEX NUT 3/8" NC	1
3-45	96-317-00	BOLT, 5/8 X 1-1/2 NC	1
3-46	97-175-20	WASHER.687 ID X1.620 OD .048 THICK	4
3-47	16-406-10	SPACER, WHEEL - 1" OD X .095 WALL X 3/4" LONG	1

SECTION 11
Page 1

MAINTENANCE PROCEDURES
REFER TO FIGURE 5
"POWER TRACTION" REAR AXLE, MOTOR AND BRAKES

Your "Power Traction" direct drive assembly is a highly efficient unit. Great care was taken in its design to promote long life with a minimum of maintenance. It employs an automotive type differential unit which operates within an enclosed housing. The gears, bearings, etc. are lubricated from within by oil which when maintained at its proper level insures complete coverage of all moving parts. This oil level should be checked on a regular basis as outlined in the Maintenance Guide and lubrication diagrams (Section 5) of this manual. If the oil level is allowed to drop below normal limits serious damage to the differential and drive unit will result.

An adjustable motor mount has been provided to extend normal chain life. Refer to Section 11 for proper adjustment procedures. It is important to adhere to the adjustment schedule included. Failure to do so will seriously effect normal chain life.

The electric motor will provide many hours of trouble free service. It is provided with sealed ball bearings which are pre-lubricated for their lifetime.

Periodically, the motor brushes should be inspected and cleaned. The carbon dust should be blown out of motor. When brushes are worn they should be replaced. Approximately 3000 hours operating life may be expected from a new set of brushes. To determine when to replace worn brushes, proceed as follows:

1. For motors equipped with brushes having end pigtails and side hooks, replace brush when hook is within 1/16" from bottom of hook slot.

2. For motors equipped with brushes having side pigtails only, replace brush when pigtail is within 1/16" from bottom of pigtail slot.

NOTE: When one brush is replaced in a motor, it is considered good maintenance practice to replace all brushes.

Inspect commutator for roughness or undue wear as arcing and shortened brush life will result from this condition.

Check wiring terminals for cleanliness and tightness. A loose connection will cause burning of the respective terminal and can induce motor failure.

SECTION 11
Page 2

MAINTENANCE PROCEDURES
REFER TO FIGURE 5
"POWER TRACTION" REAR AXLE, MOTOR AND BRAKES

Refer to Maintenance Guide (Section 4) and Service and Adjustment (Section 11) for further recommendations on motor care.

The mechanical brake assembly located on the differential pinion shaft will require a periodic inspection for lining wear and consequently periodic adjustment. Refer to Service and Adjustment Section of this manual for proper procedures.

A few drops of oil on the clevis pin and pivot pins of the mechanical linkage is recommended on a monthly basis. Great care must be taken that no oil is allowed to contact the brake band or drum as it will seriously impair the braking ability. If the braking surfaces become oily or contaminated for any reason it will be necessary to remove the brake band and clean all parts thoroughly. Refer to the appropriate section of this manual for the correct procedure to follow.

A periodic tightening of all bolts and nuts, especially the spring mounting "U" bolts should be made.

The normal life of the shock absorber unit is approximately 2 years.

ADJUSTMENT OF BRAKE (MINOR) TO COMPENSATE FOR NORMAL LINING WEAR. IMPORTANT NOTE.

Observe position of Brake Lever Arm. It must be 1/16" to 1/4" from Gear Case Cover with brake pedal and hand brake fully released.

If brake lever arm is not in the correct position, due to improperly adjusted cables or brake rods, then it will be necessary to perform a complete major brake adjustment as itemized under next section "Adjustment of Brakes (Complete)"

NOTE: If brake lever arm is in the correct position as described above, it will not be necessary to touch cable or rod adjustments.

1. Adjust brake band anchor bolt and nut, tightening it until brake pedal travels approximately half way to floorboard engaging brake sufficiently to stop vehicle. Vehicles equipped with automatic (deadman) brake requires the treadle to operate the braking action within the last 1/4 of its stroke.

SECTION 11
Page 3

MAINTENANCE PROCEDURES
REFER TO FIGURE 5
"POWER TRACTION" REAR AXLE, MOTOR AND BRAKES

2. Adjust centering screws, centering band around drum to bring band as close to drum as possible without brake dragging. Lock centering screw. If band is too far from brake drum, brakes will grab in the forward direction.

CAUTION: Never bend the brake band anchor bolt. Any bending of the bolt may result in unexpected failure of the bolt and complete loss of Drive Line Braking Action.

ADJUSTMENT OF BRAKE (COMPLETE EXCEPT FOR AUTOMATIC DEADMAN BRAKE REFER TO SECTION 13)

1. Loosen clevis and locknut on foot brake, cable (or rod) and adjust length to position brake lever arm 1/16" to 1/4 " from gear case cover as described above. It may be necessary on vehicles equipped with other control cables such as handbrake cables to disconnect them so they will not interfere with this first important adjustment.

2. Adjust brake band as outlined in steps 1 and 2 and **CAUTION** note above.

3. Adjust hand parking brake lever knob on end of handle, turning counterclockwise until it stops. Place lever in locked position. Then loosen clevis locknut on cable or rod on underside of parking brake lever and adjust cable or rod (by shortening) until brake band engages drum properly. Lock clevis nut.

NOTE: Brake band and brake cable must be adjusted first as outlined above.

4. Try completely releasing hand lever to be certain brake band is completely released . Additional brake holding power can be applied by turning knob on end of handle in clockwise direction.

NOTE: Turning knob in clockwise direction increases travel of brake but decreases leverage of brake lever. Therefore, if it is adjusted too far clockwise the lever will be difficult to operate. You compensate for this condition by shortening hand brake rod as outlined above.

CAUTION: If you shorten rod too far, you will not allow the brake band to completely release. Obviously the ideal condition is midway between the two extremes described above.

SECTION 11
Page 4

MAINTENANCE PROCEDURES
REFER TO FIGURE 5
"POWER TRACTION" REAR AXLE, MOTOR AND BRAKES

5. If vehicle is equipped with brake-accelerator lock, refer to Section 13 for service and adjustment.

6. If vehicle is equipped with Automatic (Deadman) brake, refer to Section 13 for service and adjustment.

REMOVAL OF BRAKE ASSEMBLY AND DRUM

1. Remove cotter pin and clevis pin, disconnecting cable from brake lever arm, (Note location of clevis.) Remove lever arm return spring.

2. Remove 4 bolts holding brake mounting assembly and slide assembly off drum.

3. Band and drum may now be cleaned, inspected, and if necessary parts may be replaced as needed.

4. Brake band lining is bonded to the band for long dependable service. When it wears to approximately 1/16" thickness the band should be replaced.

5. If the brake drum is glazed or scored, it should be removed and turned. It is recommended that a brake drum that has been severely scored, damaged or less than 5.850 diameter, it should be replaced with a new drum.

6. Inspect seal in gear case cover. If worn or damaged, replace with new one. It is recommended that new seal be pre-soaked in light oil for several hours before installation. Use small amount of oil resistant sealer on seal opening in cover when pressing seal into place.

7. Slide brake and spacer on pinion shaft and into seal. Apply Permatex to base of pinion shaft washer nut. Install and tighten to 100 ft. lb. torque. Stake nut in two places .

8. Replace brake assembly in the reverse order to which it was removed.

9. Adjust brake band and cables as outlined on pages 2 and 3.

SECTION 11
Page 5

MAINTENANCE PROCEDURES
REFER TO FIGURE 5
"POWER TRACTION" REAR AXLE, MOTOR AND BRAKES

REMOVAL OF "POWER TRACTION" REAR AXLE & DRIVE ASSEMBLY FROM CHASSIS

1. Disconnect one battery lead to prevent accidental engagement of power while servicing unit.

2. Clearly mark motor leads to insure their proper location when re-assembling.

3. Remove motor leads.

4. Pull clevis pin and disconnect brake cable from brake arm.

5. Remove lower bolt from shock absorber. (Only vehicles equipped with shock absorbers.)

6. Disconnect hydraulic brake line at hose end. (Only vehicles equipped with hydraulic brakes.)

NOTE: Steps 7 and 8 refer to vehicles with spring suspension.

7. Remove "U" bolt clamp and nuts attaching spring to frame.

8. Remove spring eye anchor bolts.

9. Remove 4 bolts attaching power traction assembly to frame (Only on unsprung type vehicles.)

10. Remove axle and drive assembly from chassis.

11. Install axle and drive assembly in the reverse order of removal, taking care that support pads and rubber bushings are in good condition. (Replace if worn or damaged).

12. Check brake adjustments as previously outlined on page 2 of this section.

DISASSEMBLY OF "POWER TRACTION" REAR AXLE

1. Remove unit from chassis. (As previously outlined.)

2. Remove wheels and drain oil from housing.

3. Lock drive shaft brake by pulling brake lever. Remove pinion nut and pull off brake drum.

4. Remove four bolts and spring and lift off brake assembly.

SECTION 11
Page 6

MAINTENANCE PROCEDURES
REFER TO FIGURE 5
"POWER TRACTION" REAR AXLE, MOTOR AND BRAKES

5. Remove remaining nuts and bolts, and remove drive case cover.

6. Remove 3 nuts and washers and remove motor and mount plate. (If motor requires further service, refer to appropriate Section of this manual.)

7. Remove chain and pinion sprocket. Observe location of spacers on shaft. Refer to Figure 5 for their correct location.

8. Remove five bolts holding back plate and remove from carrier housing.

9. On hydraulic brake models, remove brake drums, disconnect hydraulic line, remove brake shoe return springs (orange color) and remove wheel cylinder.

10. Remove four bolts on each end holding axle retainer (and brake backing plate on hydraulic brake models) and pull both axles.

11. Remove nuts around differential carrier housing and remove carrier from axle housing. (Note position of clip for proper reassembly of brake spring.)

12. Mark one differential bearing cap and bearing support to insure proper assembly. Remove adjusting nut locks, bearing caps, and adjusting nuts. Lift differential out of carrier.

13. Remove drive gear from differential case.

14. Drive out differential pinion shaft retainer and separate the differential pinion shaft and remove gears and thrust washers.

15. Remove drive pinion retainer from carrier. Remove O-ring from retainer.

16. Remove pinion locating shim. Measure shim thickness with micrometer.

17. If the drive pinion pilot bearing is to be replaced, drive the pilot end and bearing retainer out at the same time. When installing, drive the bearing in until it bottoms. Install a new retainer with the concave side up.

18. Press the pinion shaft out of front bearing cone and remove spacer.

SECTION 11
Page 7

MAINTENANCE PROCEDURES
REFER TO FIGURE 5
"POWER TRACTION" REAR AXLE, MOTOR AND BRAKES

19. Remove pinion bearing cone.

20. Do not remove pinion bearing cups from retainer unless they are worn or damaged. The flange and pilot are machined by locating on these cups after they are installed in the bores. If new cups are to be installed, make sure they are seated in the retainer by trying to insert a .0015" feeler gauge between cup and bottom of bore.

RE-ASSEMBLY OF POWER TRACTION REAR AXLE

1. **Differential Case:** Place a side gear and thrust washer in the differential case bore.

NOTE: LUBRICATE ALL PARTS LIBERALLY WITH AXLE LUBRICANT DURING ASSEMBLY.

With a soft faced hammer, drive pinion shaft into case only far enough to retain a pinion thrust washer and pinion gear. Place the second pinion and thrust washer in position. Drive the pinion shaft into place. Be careful to line up pinion shaft retainer holes. Place second side gear and thrust washer in position and install differential case cover. Install retainer. A pinion or axle shaft spline can be inserted in side gear spline to check for free rotation of differential gears. Insert two 7/16" x 2" bolts through differential flange and thread them three or four turns into the drive gear as a guide in aligning the drive gear bolt holes. Press or tap the drive gear into position. Install and tighten the drive gear bolts evenly and alternately across the gear to 60-65 lb. ft. torque.

2. If the differential bearings have been removed, use a suitable press to install them.

3. **Pinion and Retainer:** install pinion rear bearing cone on the pinion shaft. Install spacer with shims on the shaft. Place the bearing retainer on the pinion shaft, and install the front bearing cone.

4. Lubricate both bearings with differential oil. Place spacers, sprocket and brake drum on spline with nut and washer and tighten to 100 lb. ft. torque.

NOTE: The bearing should spin free but have no play. If tight or loose, adjust with .005" and .019" shims.

SECTION 11
Page 8

MAINTENANCE PROCEDURES
REFER TO FIGURE 5
"POWER TRACTION" REAR AXLE, MOTOR AND BRAKES

5. **Shim Selection:** Manufacturing tolerances in the pinion bore dimensions and in the best operating position of the gears make an adjustment shim necessary. This shim is placed between the pinion retainer and the carrier, Fig. 5. An increase in the thickness of the shim moves the pinion AWAY from the drive gear. manufacturing objectives are to make axles requiring a .0015" shim and if a new assembly is being built, a .0015" shim should be used for a tentative build-up. Shims are available in .010" to .021" thicknesses in steps of .001" Pinions and drive gears are marked, when matched, with the same number. Following the number on the pinion is a minus (-) or (+) followed by a number. If the pinion is marked "-1" it indicates that a shim .001" thinner than a standard shim for this carrier is required. A minus number means the pinion should be moved closer to the drive gear and a thinner shim is required. A plus number means the pinion should be moved farther from the drive gear and a thicker is required. A pinion marked zero (0) is a standard pinion. To select a shim, measure the original shim with a micrometer. Note the dimensional mark on the original pinion. Compare the mark on the original pinion with the mark on the new inion to determine how the original shim should be modified. For example, if the original shim is .015" and the original pinion requires a .002" thicker shim, and a .017" shim should be used. If the new pinion is marked the same as the old pinion, no shim change is required.

6. After the proper selection of shims, insert "O" ring seal and pinion retainer assembly into differential carrier. Tighten 5 retainer bolts to 50 lb. ft. torque. (Note: The 5 bolts will have to be removed later to install back plate assembly.)

7. Install differential case, bearing cups, adjusting nuts, and bearing caps being sure that each cap is located in the same position from which it was removed (Use marks as guide).

SECTION 11
Page 9

MAINTENANCE PROCEDURES
REFER TO FIGURE 5
"POWER TRACTION" REAR AXLE, MOTOR AND BRAKES

8. Adjust bearing nuts so that differential case will be free to revolve. It is very important that there will be no bearing play or looseness, as this will inevitable lead to gear noise and wear. Gear backlash must be set at the same time to a tolerance of .005" to .009". Note: It will be necessary to release some of the cap bolt tension in order to allow the bearing to move while making the adjustments. If the caps are too loose an error will result when trying to set backlash and bearing clearance. Therefore double check your setting after the cap bolts have been tightened. If necessary make corrections in your settings until the specified tolerances are maintained after the cap bolts have been tightened.
9. Install nut locks.

10. Install differential carrier assembly in the axle housing using new gasket and gasket sealer.

11. \nstall axles, brake assemblies (on models with hydraulic brakes), bearing retainers, and gaskets. Note: Axles are equipped with special sealed bearings. Should there be evidence of seal leakage, it is recommended that the bearing be replaced. It is also recommended that gasket located between bearing and bearing seat in axle housing be replaced at the same time. Refer to Fig. 5.

RE-ASSEMBLY OF POWER TRACTION REAR AXLE

12. Remove pinion nut, spacers, brake drum, and sprocket. Remove 5 bolts from pinion bearing retainer.

13. Install gasket (use gasket sealer) and back plate assembly. Tighten 5 bolts to 50 lb. ft. torque.

14. Install spacers, sprockets and chain in the reverse order to which they were removed. Take care that 3/16" woodruff key is in proper position and all spacers are in original position. Tighten 3/4" motor shaft nut to 75 lb. ft. torque (if sprocket was removed from motor).

15. Install motor and motor mount plate with "O" ring. Do not tighten 3 nuts until final adjustment is made. Be sure motor terminals are located in the same position as when motor was removed.

SECTION 11
Page 10

MAINTENANCE PROCEDURES
REFER TO FIGURE 5
"POWER TRACTION" REAR AXLE, MOTOR AND BRAKES

16. If seal is worn or damaged in gear case cover, replace with new seal. It is recommended that new seal be pre-soaked in light oil for several hours before installation. When pressing new seal into cover use small amount of oil resistant sealer on seal opening in cover.

17. Install cover gasket and cover.

18. Install brake drum and pinion nut per Item 7, Section 11, Page 4.

19. Install brake assembly in the reverse order to which it was removed.

20. Replace wheels and fill chain and differential housing with approximately 2 quarts SAE 30 oil.

21. Replace unit in chassis following steps 11 to 13 outlined in Section titled Removal of "Power Traction" Rear Axle.

22. Adjust motor mount plate (as outlined in Motor Adjustment Section following) to proper chain tension.

ADJUSTMENT OF DRIVE CHAIN TENSION - POWER TRACTION

1. Disconnect one battery lead to prevent accidental engagement of power while servicing vehicle.

2. Tighten three motor mount nuts.

3. Loosen and unscrew each nut exactly one full turn.

NOTE: This procedure is very important because if the nuts are too loose or too tight an error will result in the final adjustment which will seriously reduce the life of the chain.

4. Loosen adjusting set screw lock nut. Using standard socket set screw wrench turn set screw clockwise until tight. (If a torque wrench is available tighten to 80 inch lbs. torque.) without a torque wrench bear in mind that a standard socket set screw wrench is approximately 4" long. An average person will only be able to develop the required torque necessary if he tightens it as far as possible with his hands and does not use any extended handle on the wrench.

SECTION 11
Page 11

MAINTENANCE PROCEDURES
REFER TO FIGURE 5
"POWER TRACTION" REAR AXLE, MOTOR AND BRAKES

5. After developing the required torque, unscrew the adjusting screw exactly 2-1/2 turns. It is also very important to be exact on this adjustment.

6. Tighten locknut. DO NOT allow adjusting screw to move while tightening locknut.

7. Be certain that motor has moved all the way back and adjusting screw is in contact with back plate. If necessary tap motor lightly to assure this condition.

8. Tighten three motor mount nuts securely. Perform this adjustment procedure regularly as listed below to assure long and trouble free life from your "Power Traction" Drive.

Scheduled Adjustment	After	Comments
1st Adjustment	100 Hours	New unit or after installing new chain
2nd Adjustment	Next 150 Hours	Normal running conditions
3rd Adjustment	Next 250 Hours	Normal running conditions
Thereafter	Every 400 Hours	Normal running conditions

REMOVE MOTOR - POWER TRACTION

1. Remove rear axle and drive assembly from chassis as described in steps 1 through 10 in Subsection titled "Removal of Power Traction Rear Axle and Drive Assembly from Chassis."

2. Drain oil from gear case by removing drain plug.

3. Unhook brake spring.

4. Remove pinion nut, washer, and brake drum.

5. Remove all bolts and nuts around gear case cover.

6. Remove gear case cover.

7. Remove three nuts and washers, and remove motor and mounting plate.

8. If replacing motor, remove nut, washer, sprocket, and spacers. Also remove motor mounting plate. NOTE: Observe location of motor terminals in relation to motor mounting plate for proper positioning when re-assembling.

SECTION 11
Page 12

MAINTENANCE PROCEDURES
REFER TO FIGURE 5
"POWER TRACTION" REAR AXLE, MOTOR AND BRAKES

INSTALL MOTOR IN "POWER TRACTION" DRIVE

It is not necessary to remove motor mount plate when performing minor motor repairs. Therefore, follow Step 1 only when replacing motor with new one.

1. Clean motor surface and install mounting plate with four flat head screws. Tighten to 30 lb. ft. torque. Stake head in place with center punch.

NOTE: It is important to locate the motor mount plate in relation to the motor terminal so that the motor terminals will be in an accessible location when drive is completely assembled.

2. Place "O"ring into motor mount plate opening and attach motor and plate to back plate.

3. Re-assemble drive in the reverse order to that of removal.

4. Adjust motor mount to obtain proper chain tension.

5. Refill gear case with SAE 30 oil.

6. **CONNECT MOTOR LEADS AS FOLLOWS:**
   A. Check that each motor terminal stud nut is tightened securely but not over-tightened as this could bend or twist the terminal post and cause an electrical short within the motor.

   B. Install motor leads on correct motor terminal post.

   C. Install a second nut on each terminal post and finger tighten.

   D. To avoid bending, twisting or breaking-off a terminal post, use a thin pattern 9/16" wrench to hold the bottom nut from moving while tightening the top nut. Carefully tighten the top nut so as to make a good connection between the terminal post and motor lead.

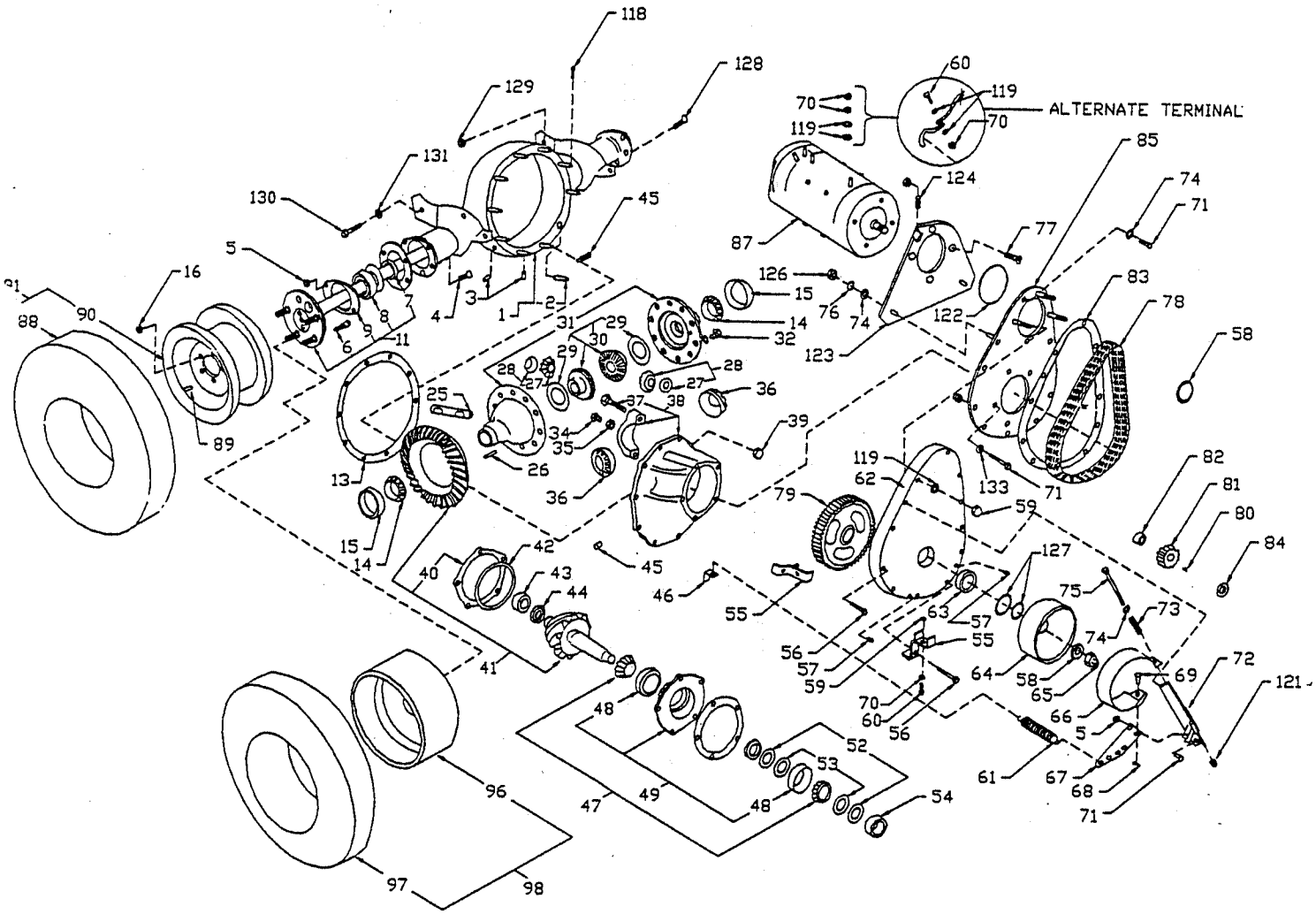
MOTOR REPAIRS

Unless the maintenance man is properly qualified, it is advisable that repair work be done at a qualified service station. When ordering parts, give complete name plate data.

NOTE: Refer to Section 12 for Motor Disassembly.

SECTION 11
Page 13

POWER TRACTION REAR AXLE, MOTOR AND BRAKES
FIGURE NO. 5



SECTION 11
Page 14

POWER TRACTION DRIVE AXLE REFER TO FIGURE 5

FIG. ID.	PART NO.	DESCRIPTION	QTY.
1	41-290-13	HOUSING, DRIVE WITH STUDS FOR 1.350 ID X 3.150 OD DRIVE AXLE BALL BEARING 80-503-00	1
2	96-330-00	BOLT DIFFERENTIAL CARRIER TO HOUSING	10
3	41-997-00	DRAIN AND LEVEL PLUG (I/8" PIPE)	1
4	88-100-11	SCREW, HEX HEAD CAP 3/8 X 1 NC. USE WITH 41-290-00 DRIVE HOUSING	0 OR 8
4	88-120-11	SCREW, HEX HEAD CAP 7/16 X 1 NC. USE WITH 41-290-13 DRIVE HOUSING	0 OR 8
5	88-129-81	NUT, LOCK 7/16 NC. USE WITH 41-290-12 DRIVE HOUSING	0 OR 10
6	96-331-00	BOLT - 1/2" N.F. (SPEC.) REAR HUB	10
7	32-509-00	RING, RETAINER FOR 80-505-00 DRIVE AXLE AXLE BALL BEARING	2
7	32-515-00	RING, RETAINER FOR 80-503-00 DRIVE AXLE BALL BEARING	2
8	80-503-00	BEARING, BALL, DRIVE AXLE 1.530 ID X 3.150 OD FOR 41-290-13 DRIVE HOUSING	2
9	32-514-00	PLATE, RETAINER FOR USE WITH 80-503-80 DRIVE AXLE BALL BEARING	2
11	41-163-21	ASSEMBLY, LEFT AXLE SHAFT 13-1/4 LONG AXLE FLANGE FACE TO SPLINED END, 28 TEETH SPLINE, WITH 80-503-00 BEARING, 32-514-00 RETAINER PLATE, 32-514-00 RETAINER RING, 45-045-00 GASKET, 45-301-00 OIL SEAL AND LUGNUTS. USE WITH 41-290-13 DRIVE HOUSING.	1
11	41-162-21	ASSEMBLY, RIGHT AXLE SHAFT 10-13/16 LONG, AXLE FLANGE FACE TO SPLINED END 28 TEETH ON SPLINE WITH 80-503-00 BEARING, 322-514-00 RETAINER PLATE, 32-515-00 RETAINER RING , 45-045-00 GASKET, 45-301-00 OIL SEAL AND LUG NUTS. USE WITH DRIVE HOUSING 41-290-13	1
NOT SHOWN	45-301-00	SEAL, OIL, USED WITH 41-163-21 AND 41-162-21 AXLES ONLY	1
12	32-512-00	SPACER RETAINER. USED WITH 80-505-00 AXLE BALL BEARING (USED ONLY WITHOUT HYDRAULIC BRAKES)	1
13	45-042-00	GASKET (HOUSING TO DIFFERENTIAL CARRIER)	1
14	80-512-00	TAPERED ROLLER BEARING, LM603049, ID 1.7812. USE WITH 80-128-00 BEARING RACE	2
15	80-128-00	TAPERED BEARING RACE, LB 60311, OD 3.0625. USE WITH BEARING 80-512-00	2
16,24	97-236-00	NUT, 1/2" N.F. (LUG)	14
25	41-700-00	DIFFERENTIAL PINION SHAFT	1
26	41-701-00	PIN	1

SECTION 11
Page 15

POWER TRACTION DRIVE AXLE REFER TO FIGURE 5

FIG.ID.	PART NO.	DESCRIPTION	QTY.
27	41-702-00	THRUSH WASHER - DIFFERENTIAL SHAFT	2
28	41-703-00	DIFFERENTIAL SHAFT PINION KIT (TWO DIFFERENTIAL GEARS AND TWO THRUST WASHERS)	1
29	41-704-00	THRUST WASHER-DIFFERENTIAL SIDE GEAR	2
30	41-705-00	DIFFERENTIAL SIDE GEAR KIT (TWO DIFFERENTIAL SIDE GEAR AND TWO THRUSH WASHERS)	1
31	41-713-00	DIFFERENTIAL GEAR CASE ASSEMBLY (LARGE CARRIER BEARING 1.784" ID	1
32	96-243-00	7/16 X 7/8 NF HEX HEAD BOLT	10
34	88-080-04	HEX HEAD CAP SCREW 5/16" X 3/8" NC	2
35	41-706-00	NUT LOCK, DIFFERENTIAL BEARING ADJUSTMENT WITH 30 DEGREE ANGLE TAB. USE WITH 41-707-00 OR 41-708-00 DIFFERENTIAL BEARING ADJUSTMENT NUTS.	2
36	41-708-00	NUT DIFFERENTIAL, BEARING ADJUSTMENT 3-1/8 OD OBLONG LOCKING HOLES. USE LM603049 BEARING	2
37	88-140-16	1/2 X 2 NC HEX HEAD SCREW	4
38	41-710-00	DIFFERENTIAL CARRIER ASSEMBLY (FOR LARGE CARRIER BEARING 1.784" ID	1
39	88-119-80	NUT, 3/8 NF (HEX)	14
40	41-711-00	SHIM-DRIVE PINION BEARING	1TO 3
41	31-235-00	RING AND PINION GEAR SET 2.75 RATIO	1
41	31-236-00	RING AND PINION GEAR SET 3.10 RATIO	1
41	31-239-00	RING AND PINION GEAR SET 5.43 RATIO	1
41	31-234-00	RING AND PINION GEAR SET 3.00 RATIO	1
42	80-702-00	"O" RING DRIVE PINION BEARING RETAINER	1
43	80-555-00	BALL BEARING, REAR, PINION PILOT	1
44	41-714-00	DRIVING PINION PILOT BEARING RETAINER	1
45	41-996-00	PLUG (LEVEL) 1/2" WITH RECESSED TOP	1 OR 3
46	91-509-00	SPRING CLIP	2
47	80-554-00	TAPERED ROLLER BEARING-PINION SHAFT	2
48	80-125-00	TAPERED BEARING RACE-PINION SHAFT	2
49	41-715-10	PINION BEARING CASE ASSEMBLY AND BEARING RACES	1
50	45-021-00	GASKET GEAR CASE TO PINION BEARING ASSEMBLY	1
51	16-415-00	SPACER PINION SHAFT (.440" THICK)	1
52	16-410-00	SPACER PINION SHAFT (.018" THICK)	2 TO 6
53	16-411-00	SPACER PINION SHAFT (.005" THICK)	2 TO 6
54	16-414-00	SPACER SPROCKET (.500" THICK)	1
55	41-371-10	BRAKE ALIGNMENT BRACKET	2
56	88-080-20	HEX HEAD CAP SCREW 5/16" X 3" NC	9
57	41-989-00	PLUG (FILLER LEVEL AND DRAIN) 1/4" N.P.T.	2
58	88-228-61	WASHER 5/16" NC (HEX)	13
59	88-089-81	LOCK NUT 5/16" X 1" NC	2

SECTION 11
Page 16

POWER TRACTION DRIVE AXLE REFER TO FIGURE 5

FIG. ID.	PART NO.	DESCRIPTION	QTY.
60	88-087-11	HEX HEAD CAP SCREW 5/16" X 1" NC	0 OR 1
61	85-270-00	EXTENSION SPRING 1-1/4" OD X 4-3/8" FREE LENGTH	1
62	43-201-00	GEAR CASE COVER	1
63	45-331-00	OIL SEAL-GEAR CASE TO PINION	1
64	41-532-00	BRAKE DRUM (SPLINED)	1
*65	97-250-00	NUT W/INT'L WASHER PINION 3/4 " - 20 EXTRA FINE THREAD	1
66	41-661-00	FULL BRAKE DRUM, FOR 6" DRUM	1
67	50-656-00	BRAKE LEVER ARM	1
68	88-517-11	COTTER PIN 3/32" x 1"	1
69	96-771-00	CLEVIS PIN 3/8" X 3/4" FACE TO HOLE	1
70	88-089-80	NUT - 5/16" N.C. (HEX)	10
71	88-101-13	HEX HEAD CAP SCREW 3/8" X 1-1/4" NC, GRADE 5	5
72	41-372-00	BRAKE MOUNTING BRACKET	1
73	85-060-00	COMPRESSION SPRING 5/8 OD X 2-1/2" LONG	1
74	88-108-60	WASHER 3/8" FLAT CUT	4
75	88-100-24	HEX HEAD CAP SCREW 3/8" X 4" NC	1
76	88-108-62	LOCK WASHER 3/8"	7
77	88-103-09	FLAT HEAD SOCKET CAP SCREW 3/8" X 3/4" NC	4
78	30-506-00	CHAIN-36 LINKS (FOR 42 TOOTH SPROCKET)	1
78	30-507-00	CHAIN-41 LINKS (FOR 59 TOOTH SPROCKET)	1
78	30-508-00	CHAIN-48 LINKS (FOR 81 TOOTH SPROCKET)	1
78	30-320-11	CHAIN, DBL STRAND, #35 ROLLER, 96 PITCHES 36" LONG, ONE PIECE USED WITH 15-81 RATIO DOUBLE TOOTH SPROCKET	1
78	30-320-12	CHAIN, DBL STRAND, #35 ROLLER, 84 PITCHES 31-1/2" LONG, ONE PIECE, USED WITH 15-60 RATIO DOUBLE TOOTH SPROCKETS	1
79	30-070-10	SPROCKET, 81 TOOTH FOR #35 DBL STRAND ROLLER CHAIN, F2 SPLINED HUB	1
79	30-071-11	SPROCKET, 60 TOOTH FOR #35 DOUBLE STRAND ROLLER CHAIN, F2 SPLINED HUB	1
79			
79	30-091-00	SPROCKET-42 TOOTH WITH SPLINED HUB	1
79	30-092-00	SPROCKET-59 TOOTH WITH SPLINED HUB	1
80	97-100-00	WOODRUFF KEY - 3/16"	1
81	30-070-00	SPROCKET, 15 TOOTH FOR #35 DOUBLE STRAND ROLLER CHAIN, 3/4" BORE, 3/16" KEYWAY	1
81	30-080-00	SPROCKET-15 TOOTH X 3/4" BORE	1
82	17-110-10	SHAFT COLLAR -3/4" WITH KEYWAY	1
83	45-002-00	GASKET-GEAR CASE COVER	1
84	88-239-82	JAM NUT-3/4" NF (HEX)	1
85	44-352-53	GEAR CASE BACK PLATE (ANGLE MOTOR MOUNT) ADJUSTABLE	1

* INSTALL WITH PERMATEX 94-400-01 (APPLY WITH TUBE)

SECTION 11
Page 17

POWER TRACTION DRIVE AXLE REFER TO FIGURE 5

FIG. ID.	PART NO.	DESCRIPTION	QTY.
85	44-352-52	GEAR CASE BACK PLATE (VERTICAL MOTOR MOUNT) ADJUSTABLE	1
86,87		SEE SECTION 12	
88	10-075-00	TIRE, 4.80 X 8 FOUR PLY SUPER RIB TUBELESS	2
89	13-989-00	VALVE STEM FOR TUBELESS TIRE	2
91	13-738-00	TIRE, TUBE & WHEEL, 4.80 X 8, SIX PLY STEEL GUARD TIRE (FIVE 1/2" HOLES ON 4-1/2" BOLT CIRCLE)	2
96	12-054-00	WHEEL FOR 16-1/4" X 11-1/4" SOLID CUSHION TIRE (FIVE 1/2" HOLES ON 4-1/2" BOLT CIRCLE)	2
96	12-050-00	WHEEL FOR 16 X 4 X 12-1/8" OR 17 X 4-1/2" X 12-1/8" SOLID CUSHION TIRE. (FIVE 1/2" HOLES ON 4-1/2" BOLT CIRCLE)	2
	10-261-00	TIRE, SOLID XTRA CUSHION, ALL SERVICE 16-1/4 X 4 X 11-1/4"	
97	10-261-00	TIRE, SOLID XTRA CUSHION, ALL SERVICE 16-1/4 X 4 X 11-1/4"	
97	10-250-00	TIRE, SOLID CUSHION, SMOOTH 16 X 4 X 12-1/8"	2
98	13-984-10	TIRE AND CAST IRON WHEEL 16-1/4 X 4 X 11-1/4" SOLID EXTRA CUSHION , ALL SERVICE TIRE (FIVE 1/2" HOLES ON 4-1/2" BOLT CIRCLE)	2
98	13-952-10	TIRE CAST IRON WHEEL 16 X 4 X 12-1/8 SOLID CUSHION TIRE (FIVE 1/2" HOLES ON 4-1/2" HOLES ON 4-1/2" BOLT CIRCLE)	2
106	45-044-00	GASKET - REAR AXLE BEARING	2
118	88-527-11	COTTER PIN 1/8" X 1" (AXLE VENT)	
119	88-088-61	WASHER 5/16" SAE	11
121	88-109-81	3/8 NC LOCKNUT	1
122	80-703-00	"O" RING MOTOR MOUNT SEAL	1
123	70-454-00	MOTOR MOUNT PLATE	1
124	88-067-11	SOCKET SET SCREW 1/4" NC X 1"	1
125	88-069-80	NUT, 1/4" NC (HEX)	1
126	88-109-80	NUT 3/8" NC (HEX)	3
127	16-400-00	SPACER 1-1/4" ID X .125" THICK	0-1 OR 2
128	88-140-14	HEX HEAD CAP SCREW 1/2" X 1-1/2" NC	3 OR 4
129	88-149-81	1/2 NC LOCKNUT	3 OR 4
130	88-180-11	HEX HEAD CAP SCREW 5/8 X 1-1/2 NC	1
131	88-188-62	LOCK WASHER, 5/8"	1
137	88-108-63	LOCK WASHER, 3/8" INTERNAL TOOTH	5

SECTION 12
Page 1

MOTOR MAINTENANCE, SERVICE AND ADJUSTMENT

Detailed service procedures covering maintenance of bearing brushes and commutator are covered in this section. **DO NOT PERFORM THIS PROCEDURE WHILE BATTERIES ARE BEING CHARGED.**

Maintenance of electric motors should be referred to personnel with experience and equipment. Should it be necessary for you to order replacement parts for your motor, **IT IS NECESSARY TO INCLUDE COMPLETE NAMEPLATE DATA WITH ORDER.**

MOTOR MAINTENANCE - BRUSH INSPECTION AND REPLACEMENT

1. Remove cover, exposing brush assemblies. Lift brush from holder for inspection.

2. If brushes are worn, remove, install new brushes. Use fine sandpaper to "seat in" new brushes to commutator. To determine when to replace worn brushes, proceed as follows:

   a. For motors equipped with brushes having end pigtails and side hooks, replace brush when hook is within 1/16" from bottom of hook slot.
   b. For motors equipped with brushes having side pigtails only, replace brush when hook is within 1/16" from bottom of pigtail slot.

NOTE: When one brush is replaced in a motor, it is considered good maintenance practice to replace all brushes.

3. Check operation of each brush to assure that brush slides freely and does not bind in holder.

4. Replace cover.

MOTOR DISASSEMBLY AND REASSEMBLY

1. Remove motor from vehicle as described in Section 11.

2. Determine if witness marks on end bell and stator housing are present. If not, mark end bell and housing to assure proper relation of brushes and commutator when reassembling.

3. Remove cover, exposing brush assemblies. Lift brushes from brush holder.

4. Remove bolts holding end bells and remove end bell and rotor. (Pull fromshaft extension end). Take care not to damage any coils or armature wires when handling motor parts.

SECTION 12
Page 2

MOTOR MAINTENANCE, SERVICE AND ADJUSTMENT

5. Press or pull old bearings off by using bearing press or bearing puller. Do not damage shaft while removing bearings.

6. Install new bearings onto shaft by gentle pressure or tapping with proper tool on inner race only. Bearing will be damaged if pressed or driven by outer race or seals.

7. If the commutator is worn or "burned" it should be turned, the mica undercut and the commutator polished.

8. Oil bearing housing lightly to aid in reassembly.

9. Reassemble motor taking care that all parts are kept clean.

10. Install brushes and "seat in" with fine sandpaper.

11. Check operation of each brush to assure that brush slides freely in holder.

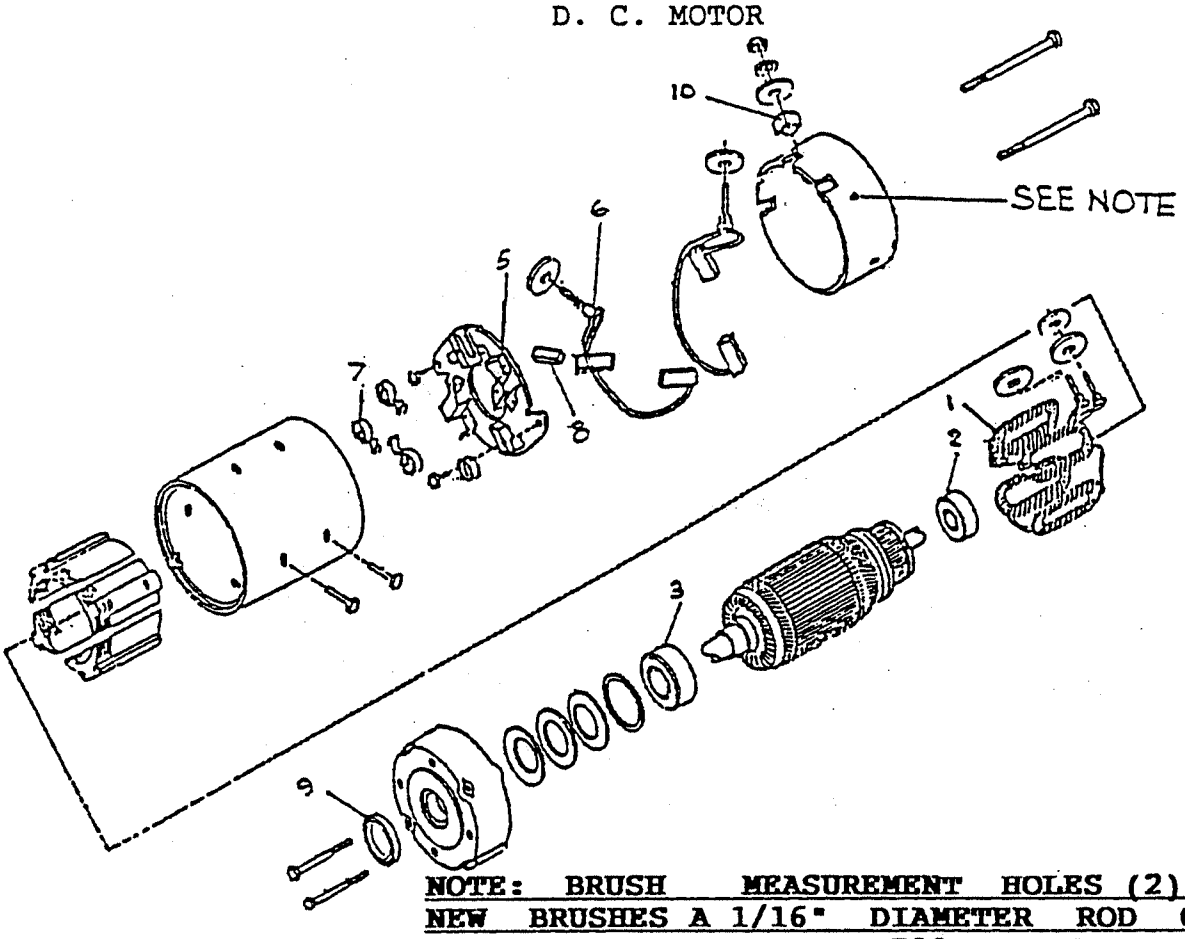
12. Replace cover

13. Reassemble to vehicle as described in preceding subsection.

NOTE: If motor terminal studs were removed for inspection, refer to Section 11 for correct procedure to avoid damaging studs.

SECTION 12
Page 3

D. C. MOTOR



NOTE: BRUSH MEASUREMENT HOLES (2) WITH NEW BRUSHES A 1/16" DIAMETER ROD CAN BE INSERTED APPROXIMATELY .780" INTO THE BRUSH MEASUREMENT HOLES. BRUSHES SHOULD BE REPLACED WHEN ROD CAN BE INSERTED 1.560" INTO HOLE. THIS LEAVES APPROXIMATELY 1/8" WEAR REMAINING.

Replacement parts for G. E. Motor 5BC48JB754 (4.5 / 6.0 H.P. Motor) Taylor-Dunn part number 70-049-00

FIG. I.D.	T-D PART NO.	DESCRIPTION	QTY.
1.	70-205-00	FIELD COIL SET	1
2.	80-200-00	BALL BEARING, COMMUTATOR END	1
3.	80-504-00	BALL BEARING, PULLEY END	1
5.	70-172-00	BRUSH HOLDER ASSEMBLY WITHOUT BRUSHES	1
6.	70-104-00	BRUSH ASSEMBLY	2
7.	85-412-00	SPRING, BRUSH EXTENSION	4
8.	70-250-00	GASKET, TERMINAL	4
9.	45-506-00	OIL SEAL	1
10.	70-210-62	INSULATOR KIT, MOTOR TERMS	1

SECTION 12
Page 4

D. C. MOTOR

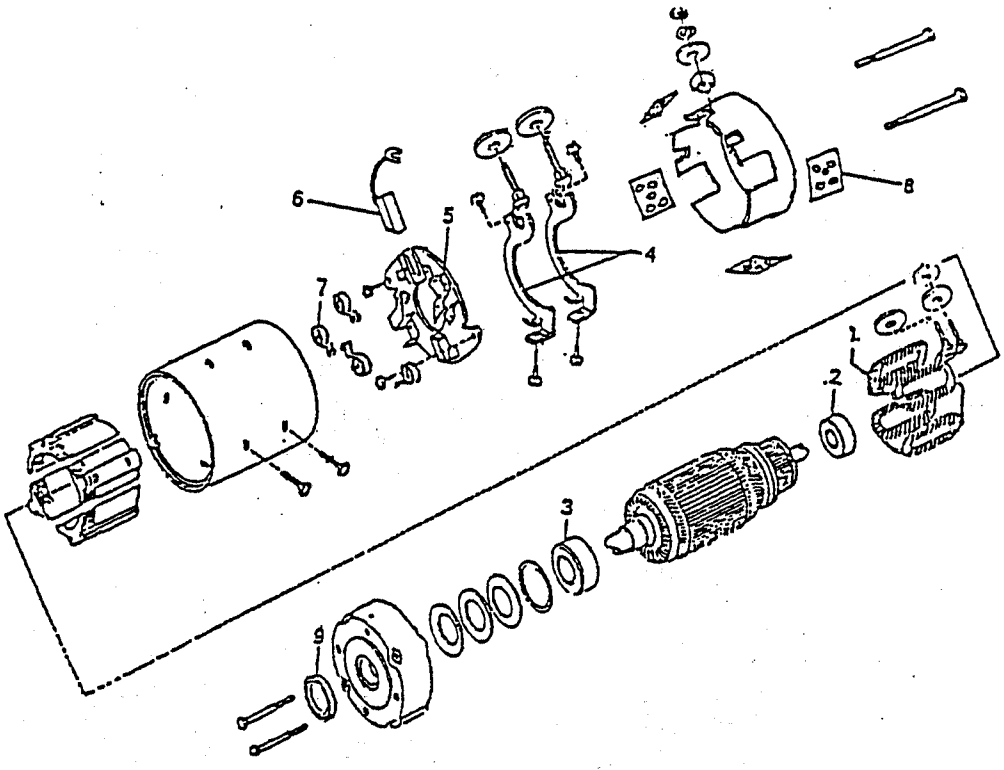


FIG. I.D.	T-D PART NO.	DESCRIPTION	QTY.
70-054-00		D.C. MOTOR 6.7 / 10.0 HP G.E 5BC49JB399	1
1.	70-203-10	FIELD COIL SET	1
2.	80-200-00	BALL BEARING, COMMUTATOR END	1
3.	80-504-00	BALL BEARING, PULLEY END	1
4.	70-195-10	ARMATURE TERMINAL TO BRUSH	2
5.	70-188-00	BRUSH HOLDER ASSEMBLY	1
6.	70-105-00	MOTOR BRUSH	4
7.	85-412-00	BRUSH EXTENSION SPRING	4
8.	30-802-00	BRUSH EXTENSION COVER	4
9.	45-508-00	OIL SEAL	1
10.	70-210-62	MOTOR TERMINALS INSULATOR KIT	1

SECTION 13
Page 1

MAINTENANCE PROCEDURES
REFER TO FIGURE 7
MECHANICAL CONTROL LINKAGE

The mechanical control linkage operates the various controls and mechanism located throughout your vehicle.

The foot treadle is a combination brake and accelerator control. It pivots near its center and operates the program switch or PWR-TRON through a lever and link located on the front portion of the treadle. The treadle and pivot shaft are an integral unit. The brake control lever is fixed to the pivot shaft and through its linkage operates the brake lever arm and brake band.

The treadle assembly being an integral unit, operates the release of braking action while motor power is being applied and disconnects motor power when braking action is applied.

The automatic (deadman) brake lever system couples to the treadle brake linkage. A heavy spring and spring tension control lever activates the deadman brake when the foot is lifted from the treadle.

The safety interlock and brake pressure release pedal is for left foot operation. It is designed to lock the spring pressure control lever in the released position when foot pressure is applied to the pedal. Depressing the pedal also engages the safety interlock switch. Releasing the pedal applies automatic brake spring pressure and disconnects the power to the motor.

Various mechanical linkage components are located under the operator's platform with the exception of the accelerator linkage which is located within the control console.

All wear points should be lubricated monthly, using pressure gun grease, at the four points equipped with zerk fittings, and all purpose engine oil at other points. Refer to Maintenance Guide Section 4 and Lubrication Diagram Section 5.

For service and adjustments refer to the following sections:
Section 11 For brake band service and adjustments.
Section 13 For treadle and automatic brake linkage service and adjustment.

SECTION 13
Page 2

MAINTENANCE PROCEDURES
REFER TO FIGURE 7
MECHANICAL CONTROL LINKAGE

ADJUSTMENT OF AUTOMATIC (DEADMAN) BRAKE LINKAGE

1. With power disconnected depress treadle fully and place wooden block or wedge at rear of treadle to lock into position.

NOTE: Front tip of treadle (toe end) should measure 1/2" to 1" below surface of operator's platform.

2. Observe position of program switch "J" hook. Correct position is when "J" hook and high speed contact bar are in exact alignment. If "J" hook is not correctly aligned loosen two bolts attaching insulator board to accelerator link. Adjust "J" hook position by sliding assembly within slotted holes provided in accelerator link. If slot is not sufficient to provide alignment, then place assembly in approximate center of slots tighten bolts and re-adjust blocking on treadle to move "J" hook alignment.

3. Observe position of brake lever bell crank, located under operator's platform. The spring should be just touching the angle frame member at the point where it is hooked to bell crank. If not in correct position loosen clevis lock nut, (treadle to bell crank linkage) remove clevis and adjust length of link to bring bell crank into proper position.

4. Replace clevis and tighten lock nut.

5. Remove clevis pin and clevis from brake lever arm and adjust brake rod length so that brake lever arm is a maximum of 1/16" from gear case cover. It is preferable to have the brake level just making contact with the gear case cover as this provides an additional stop in the control linkage.

6. Remove block and wedge releasing treadle to normal off position.

7. Adjust brake band as outlined in Section 11 so that the brake is applied during last quarter of treadle travel. Be certain that Program Switch is in the off position prior to application of brake. Normal condition will provide approximately 1" of "J" hook travel beyond the off position, prior to brake engagement and will increase as the lining wears.

8. To compensate for normal lining wear, adjust only the brake band as outlined above and Section 11.

SECTION 13
Page 3

MAINTENANCE PROCEDURES
REFER TO FIGURE 7
MECHANICAL CONTROL LINKAGE

REMOVAL OF BRAKE LEVER BELL CRANK OR SPRING PRESSURE CONTROL LEVER

1. Disconnect power by removing battery plug.

2. Unhook spring.

3. To remove bell crank it is necessary to remove clevis pin, clevis and spherical rod end on brake rod and brake linkage attached to bell crank.

4. Remove 5/8" pivot screw from the lever which is to be removed and lift lever out of vehicle.

REINSTALL BRAKE LEVER BELL CRANK OR SPRING PRESSURE CONTROL LEVER

1. The levers should be installed in the reverse order to which they were removed.

NOTE: The Pivot screw is threaded through the tapped hole in the lever. The clearance between the lever and the pivot block is provided by threading the pivot screw approximately 1/8" to 3/16" beyond the lever before allowing the screw to engage the threads in the pivot block. Extending the screw more or less from the lever before entering the pivot block will provide more or less clearance as needed.

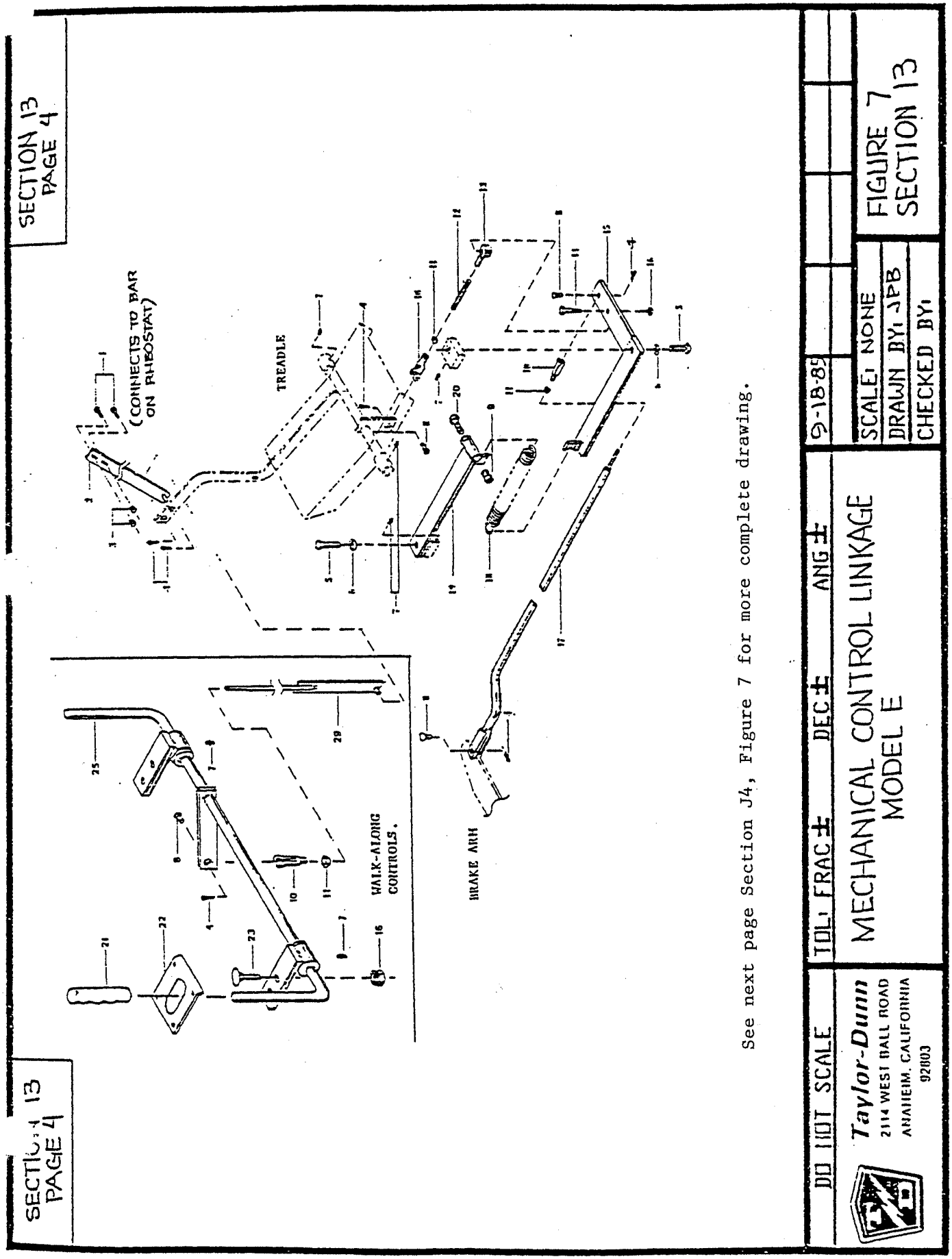
2. It is important that both levers must swing freely without binding after the pivot screw has been locked into position. Lock pivot screw by tightening the head of the screw against the lock washer and lever.

3. If the levers have been damaged or bent it may be necessary to remove and straighten or possibly replace them. Should the levers bind against the chassis or the spring it will interfere with the automatic brake action.

ADJUSTMENT OF TREADLE RETURN SPRING PRESSURE (VEHICLES WITHOUT SPRING RELEASE)

1. Located under the operator's platform, is the brake spring control lever. It is equipped with 2-1/2" adjusting bolts and lock nuts. These bolts hold the lever in position to provide suitable operating spring pressure.

SECTION 13
Page 4



See next page Section J4, Figure 7 for more complete drawing.

SECTION 13
Page 5

MECHANICAL CONTROL LINKAGE
FIGURE NUMBER 7

FIG. I.D.	T-D PART NO.	DESCRIPTION	QTY.
7-1	88-060-09	HEX HEAD CAP SCREW 1/4" X 3/4" NC	2
7-2	50-628-00	ACCELERATOR LINK 1/8" X 1" X 12-3/4"	1
7-3	88-069-86	NUT 1/4" NC FLEXLOCK	1
7-4	88-519-09	COTTER PIN 3/32" X 3/4"	2
7-5	88-180-15	HEX HEAD CAP SCREW (PIVOT SCREW) 5/8" X 1-3/4" NC	2
7-6	88-188-62	LOCK WASHER 5/8"	2
7-7	87-071-00	GREASE FITTING 3/16" DRIVE	4 OR 5
7-8	96-772-00	PIN CLEVIS 3/8" X 1"	3
7-9	98-601-00	RUBBER BUMPER	0 OR 2
7-10	96-762-00	CLEVIS 3/8" CAST	2
7-11	88-119-80	NUT 3/8 N.F. HEX	2
7-12	50-028-00	ROD 3/8" NF X 1-1/2"	1
7-13	86-520-00	ROD END, 3/8" SPHERICAL BEARING	1
7-14	88-100-14	HEX HEAD CAP SCREW 3/8" X 1-1/2" NC	1
7-15	50-647-00	BRAKE LEVER BELL CRANK	1
7-16	88-109-81	LOCKNUT 3/8" NC HEX	1 OR 5
7-17	50-027-00	BRAKE ROD 3/8" PIPE WITH 3/8" PIPE N.F. END 28" LONG	1
7-18	85-280-00	SPRING 1-3/8" OD X 7-3/4" LONG (EXTENSION)	1
7-19	50-648-00	BRAKE LEVER - SPRING PRESSURE CONTROL	0 OR 1
7-19	50-646-00	BRAKE SPRING CONTROL LEVER	0 OR 1
7-20	88-140-14	HEX HEAD CAP SCREW 1/2 X 1-1/2 N.C.	1
7-21	98-300-00	HAND GRIP	2
7-22	50-645-00	COVER PLATE	2
7-23	88-102-11	CARRIAGE BOLT 3/8 X 1 N.C.	4
7-25	50-644-00	HANDLE ASSEMBLY	1
7-29	50-629-00	ACCELERATOR LINK (WALK-ALONG CONTROL)	1

SECTION 13
Page 6

MAINTENANCE PROCEDURES
REFER TO FIGURE 7
MECHANICAL CONTROL LINKAGE

2. Lengthening the bolt nearest the center frame member and shortening the opposite bolt moves the lever towards the left side of the vehicle. This INCREASES the brake spring pressure. Adjusting the lever in the opposite direction towards the center of the vehicles DECREASES the brake spring pressure.

3. It is recommended that the lever be adjusted to provide sufficient return pressure so vehicle program switch will return to neutral when treadle is released. If spring pressure is too great, it will be more difficult to operate treadle and brakes will be applied severely when treadle is released. If spring pressure is too light program switch may not return to neutral and vehicle will continue to run with power on when treadle is released.

ADJUSTMENT OF WALK-ALONG CONTROL LINKAGE

NOTE: Adjustments of walk-along controls should be made after all other control linkage adjustments are completed.

1. Adjust clevis on accelerator link so that control handle swings freely throughout full operating range of treadle and is in a comfortable position to operate.

SECTION 14
Page 1

MODEL E SPEED CONTROLLER

The all-new speed controller is developed and available only from Taylor-Dunn and is warranted for two full years. Modifications to the control unit, drive or power system will void the warranty.

INTRODUCTION

Your electronic control is a solid state voltage regulator designed specifically for use on electric vehicles. The essential function is to regulate the power fed from battery to motor so as to provide full control of the vehicle speed under all operating conditions.

The speed controller unit is connected in between the motor and the battery. Power feed to the motor is regulated by switching the motor on and off at high speed. By adjusting the ON time with respect to the OFF time the average voltage applied to the motor can be verified. This switching is done using power transistors.

FEATURES

Current Limit - Cold current limit is 275A and 400A.

Thermal Roll-Back - Continuous overloading will reduce the current limit progressively above 150 degrees F (65 degrees C).

Acceleration Limit - Built in acceleration ramp to prevent jack-rabbit starts (can be factory set for various applications, or may be adjustable).

Automatic Plug Braking - Built in plugging control to give smooth reversals and prevent operator injury or equipment damage with inadvertent direction changes.

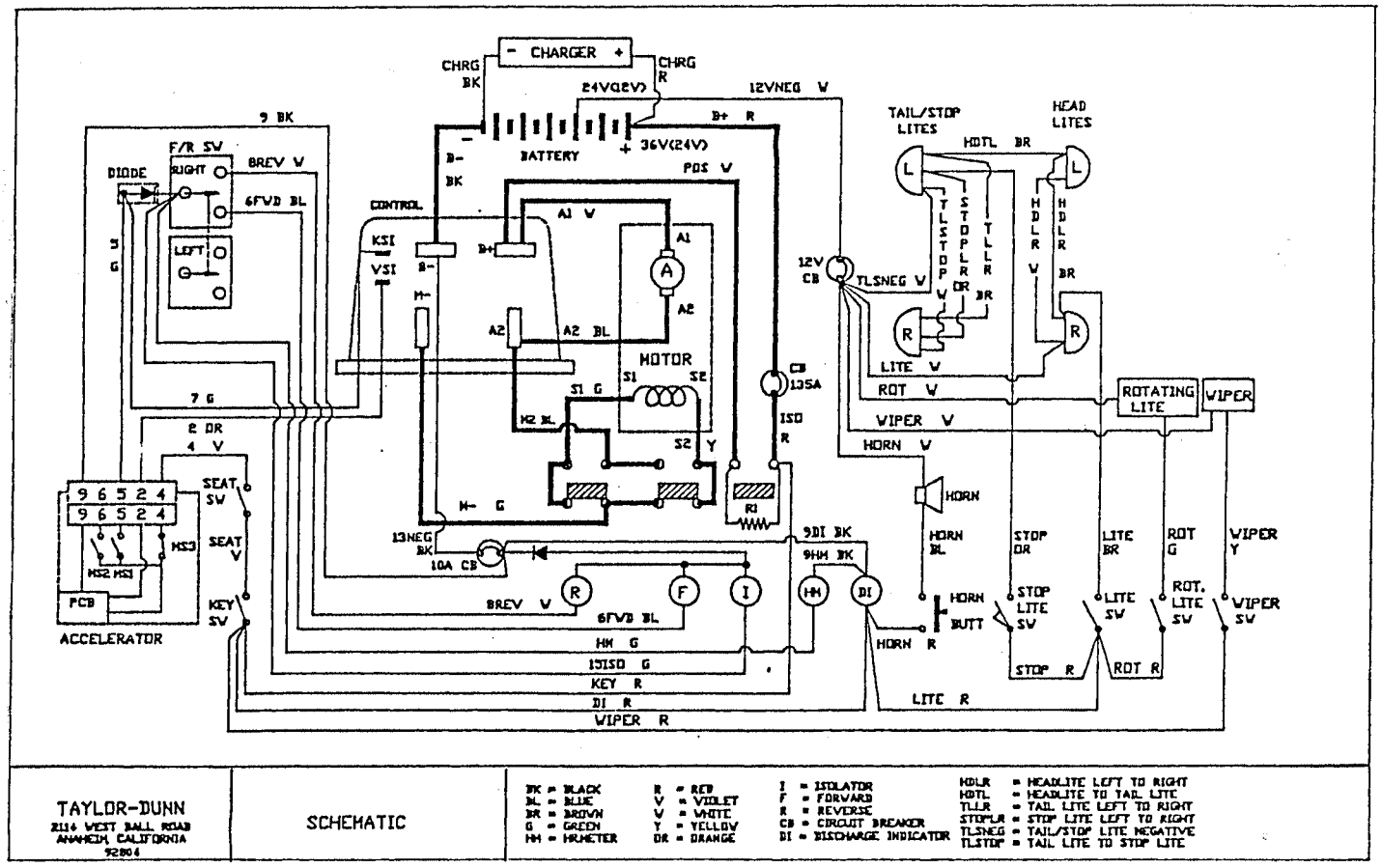
GENERAL

The controller unit is readily accessible under the deckboard, providing two functions: power control for speed and acceleration plus rate control for smooth operation. The unit is a transisortorized supply that regulates the voltage from the battery. An accelerator module provides a signal, proportional to the desired power output of the controller. This gives the operator full control of the vehicle power and speed.

NOTE: This is a solid state module, factory adjusted, requiring no service or maintenance. Do not remove cover or try to service components as this will void your warranty.

If accelerator is not operating properly, see trouble shooting information in this section.

SECTION 14
Page 2



TAYLOR-DUNN 2114 WEST BALL ROAD ANAHEIM, CALIFORNIA 92804	SCHEMATIC	BK = BLACK, BL = BLUE, BR = BROWN, G = GREEN, HM = HRMETER, R = RED, V = VIOLET, W = WHITE, Y = YELLOW, OR = ORANGE, I = ISOLATOR, F = FORWARD, R = REVERSE, CB = CIRCUIT BREAKER, DI = DISCHARGE INDICATOR, HDLR = HEADLITE LEFT TO RIGHT, HDTL = HEADLITE TO TAIL LITE, TLLR = TAIL LITE LEFT TO RIGHT, STOPLR = STOP LITE LEFT TO RIGHT, TLSNEG = TAIL/STOP LITE NEGATIVE, TLSTOP = TAIL LITE TO STOP LITE

Figure 1

CIRCUITRY AND OPERATION

There are two circuits included in the operation of the controller, the control circuit and the power circuit.

The control circuit (light gauge wire) includes: key switch, seat switch, MS-1; activated by the accelerator module, the solid state controller, forward-reverse switch and solenoid panel.

The power circuit (heavy gauge wire) includes the batteries, forward reverse switch and motor.

SECTION 14
Page 3

CONTROL CIRCUIT

Forward Operation 1) Turn key to "ON" position and move forward-reverse to forward position. 2) As the accelerator is depressed, a cam, MS-1 closes providing a current path to the forward solenoid coil and closing forward contact on the forward-reverse switch. 3) The sensor on the PCB board will increase the signal voltage moving the vehicle forward.

Reverse Operation 1) Turn key to "ON" position and move forward-reverse switch to reverse position. 2) As the accelerator is depressed, a cam, MS-1 closes providing a current path to the reverse solenoid coil and closing reverse contact on the forward-reverse switch. 3) The sensor on the PCB board will increase the voltage, moving the vehicle in reverse.

POWER CIRCUIT

Forward Operation When the control circuit is energized and the isolator and forward solenoid contacts are closed current flow is then channeled through the controller and then to the power wiring. Motor speed is controlled by voltage output from the controller.

Reverse Operation The same circuit is used as forward operation except the reverse solenoids contact (not forward) is closed to reverse current flow through the motor.

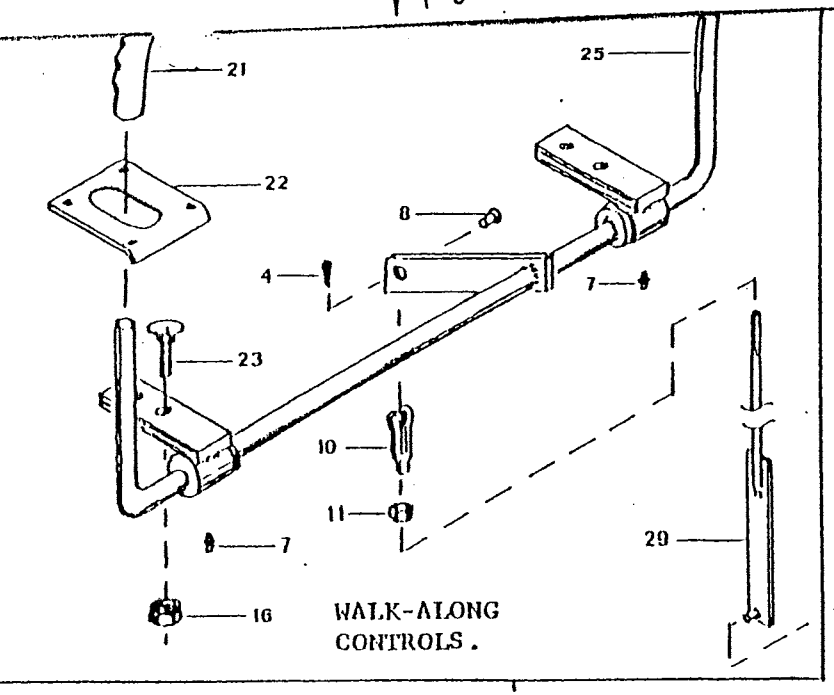
OPERATION

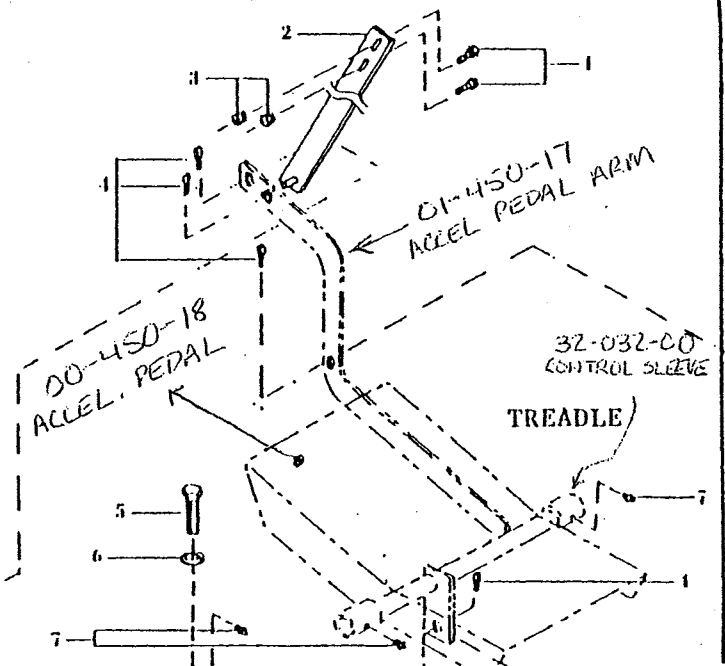
To put you vehicle into operation, turn key to "ON". Select direction you wish to travel by moving forward/reverse switch to desired position. Slowly depress right hand foot treadle (accelerator) until vehicle is moving at desired speed.

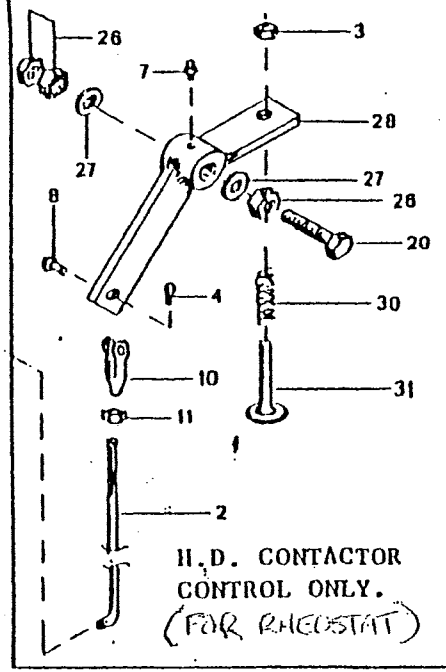
The left hand treadle controls the electric safety interlock. The motor is always disconnected until the treadle is depressed. See "Safety Interlock" Section 3, Page 1.

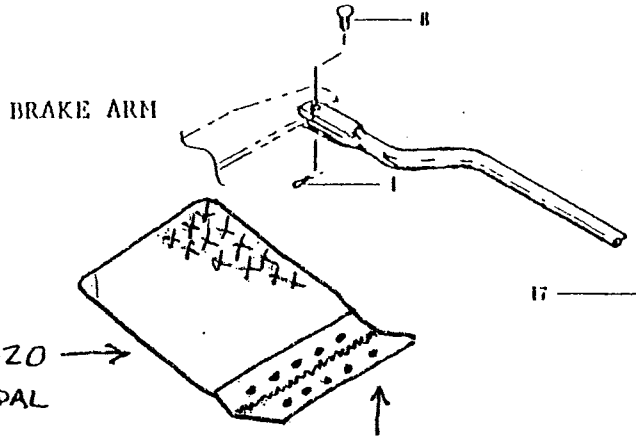
You will notice your vehicle has a smooth transition from start to high speed operation. This is a built-in characteristic of the speed control, avoiding "jackrabbit" starts.

model E 451









SECTION J4
PAGE 4

NO.	DESCRIPTION	LENGTH	QUAN.	REVISED DATE	REVISION

OL. FRAC.± DEC.±
CALE NONE
RAWN BY REA

FIGURE 7
SECTION J4

MECHANICAL CONTROL LINKAGE
MODEL "E" STD & H.D.

TAYLOR DUNN MFG. CO.
2114 West Ball Rd.
Anaheim, Calif.

SECTION 14
Page 4

"Plug braking" is an additional feature. It is a safety feature that makes it unnecessary to come to a complete stop before reversing the vehicle. When reversed, the vehicle will automatically slow to a stop and reverse itself to full acceleration . This maneuver does no damage to the controller. However, stopping the vehicle should be done with the service brake. Also, it is recommended when starting the vehicle to be sure to always turn ignition key on first then select direction of travel with the forward-reverse switch, before depressing the accelerator pedal.

SPEED CONTROLLER PREVENTIVE MAINTENANCE

WARNING: Before working on the controller units or any part of the vehicle system, disconnect both the main positive and negative battery leads. Place the forward-reverse lever in neutral, turn off and remove key. Always set parking brake.

Be sure ignition key is on before depressing accelerator pedal. DO NOT depress pedal then turn on key. This is unsafe operation.

CAUTION: Do not steam clean or spray with water

Make sure all wire connections are secure.

There are three modules as part of this system, solenoid panel, accelerator module and controller module. These are easily removable for replacement.

Only qualified service personnel should perform any replacement, adjustments or servicing of the controller module, solenoid panel or the accelerator module. This will avoid the possibility of voiding your warranty.

When returning vehicle to pre-service configuration make certain batteries are properly connected to avoid damage.

SECTION 14
Page 5

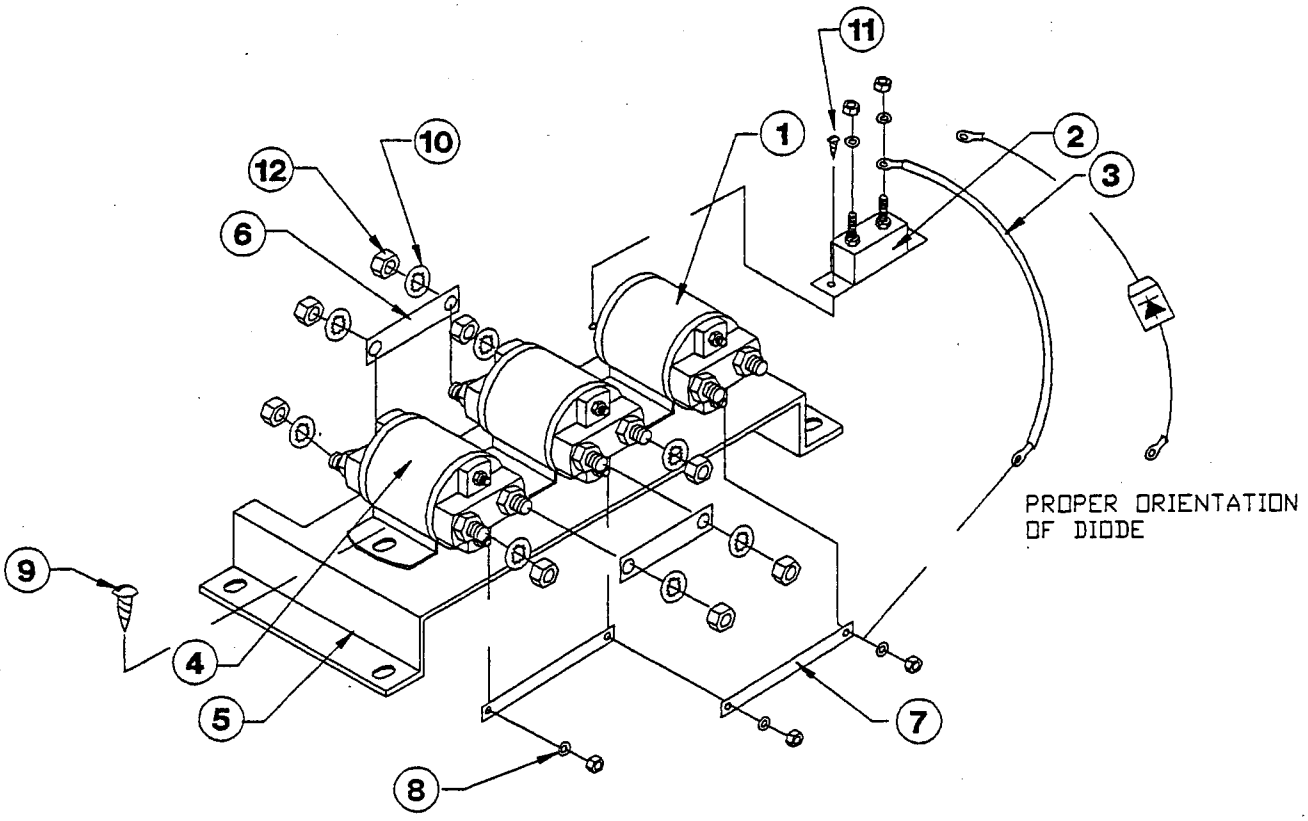
1. REPAIR OR REPLACEMENT OF MODULES
Only the solenoid panel is serviceable on a component level.

a. Wiring - The positions of all wires and lugs should be noted and marked prior to removal so that there is no confusion on replacement.

b. Connections - Check all connections for tightness on completion.

c. Final Checks - Prior to the first switch on, check battery polarity. Use test light to ensure safety.

SECTION 14
Page 6



ASSEMBLY, SOLENOID PANEL, 24VOLT
PART NUMBER 72-560-80

ITEM	PART NO.	DESCRIPTION	QTY.
1	72-501-24	SOLENOID, SPST 24V, 200A	1
2	79-840-00	CIRCUIT BREAKER, 10A, AUTO	1
3	75-224-10	JUMPER, W/DIODE	1
4	72-501-25	SOLENOID, 24V, SPDT, 200 A	2
5	72-560-55	PANEL MTG, BRACKET, SOLENOID	1
6	61-838-41	BUS BAR, 5/8 X 1-1/2 HC	2
7	61-838-42	BUS BAR, 3/8 X2-5/8 HC	2
8	88-048-62	LOCK	5
9	88-838-06	#14 X 1/2 PAN HEAD SCREW	4
10	88-088-63	5/16 LOCK WASHER, INT	8
11	88-818-06	#8 X 1/2 PAN HEAD SCREW	2
12	88-099-91	5/16 NF THIN PATTERN NUT	8

SECTION 14
Page 7

CHECK FOR CONTROLLER OUTPUT

1. Connect the voltmeter (+) lead to the controller B+ terminal; connect the voltmeter (-) lead to the M- terminal.

2. Turn on the key switch put the directional switch in neutral and watch the voltmeter as you depress the pedal. Depending on the nature of the fault and what kind of voltmeter you have, it may or may not read zero with the pedal up, but it should be at full battery voltage with the pedal all the way down. If it does not, the controller is bad and must be replaced.

3. The next step requires that you measure the current in the M- lead. If you have a means of measuring this high DC current, such as a shunt/meter setup or a clamp-on DC ammeter, use it. If not, we recommend that you buy an ammeter of the type which is simply held against the wire under test. Though the accuracy of these meters is not great, they are adequate for this test.

4. Turn the keyswitch on, put the directional switch in forward or reverse, and watch the ammeter while depressing the pedal.

5. If you see no current flowing in the M- lead, the problem is an open circuit in the motor or the wiring between it and the controller. Check directional solenoids to see that they are operating and that their contacts are closing. If these are okay, check the motor armature and field coils for opens.

6. If you do see a high current flowing in the M- lead, but the motor does not turn, the problem is either a short in the motor circuit, or that the controller's internal plug diode is shorted. Test this plug diode as follows:

   Remove power by opening the battery circuit and take the cable off of the controller A2 terminal. Use the ohmmeter to check the resistance between the controller A2 and B+ terminals. You are testing for the presence of a diode inside the controller, so swap the two meter leads and look for a low resistance one way and a much higher one the other way. If your meter has a diode test function, use that. If you find the diode to be shorted, the controller is bad. Replace the controller.

SECTION 14
Page 8

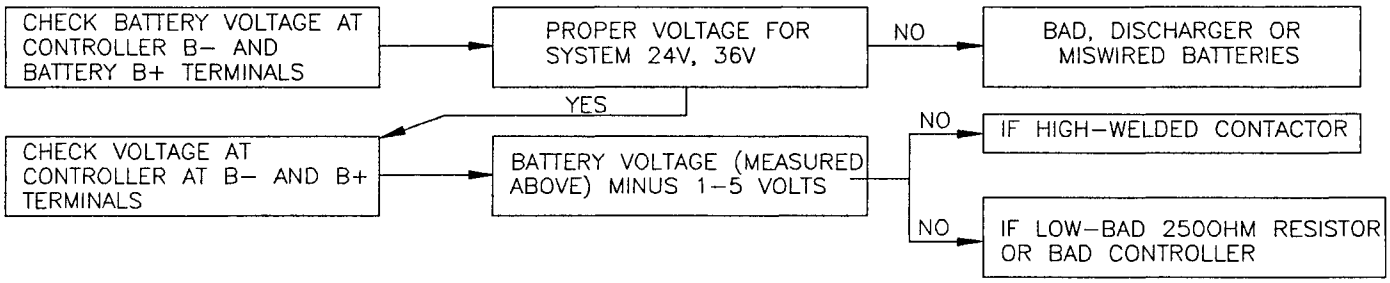
7. Put the A2 cable back on the controller and hook the battery back up.

8. If the plug diode is okay, there is a short in the motor circuit. An ordinary ohmmeter will not work to find the short, because the resistances of the motor windings are so low. Run the controller as in steps 4 and 5, and measure the motor winding voltage drops at the motor terminals. This should lead you to the short.

SECTION 14
Page 9

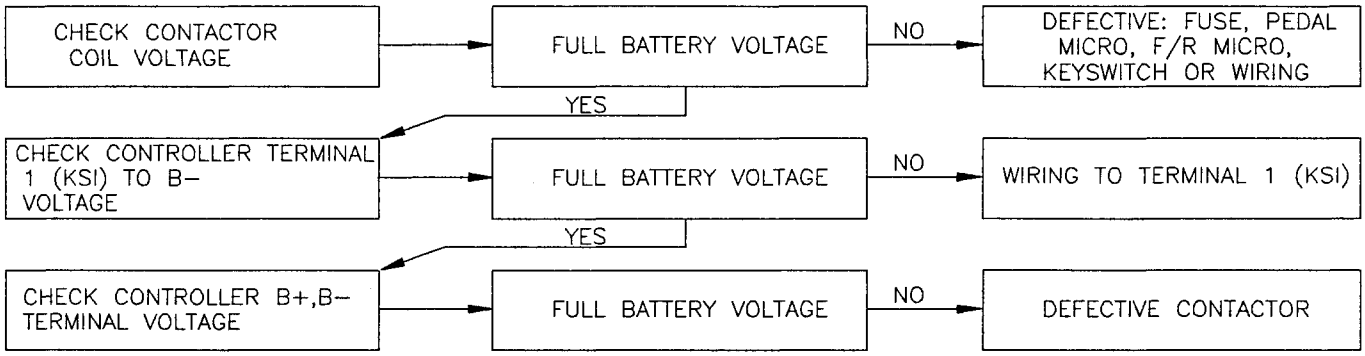
TROUBLE SHOOTING CHART

SET-UP: Key Switch Off



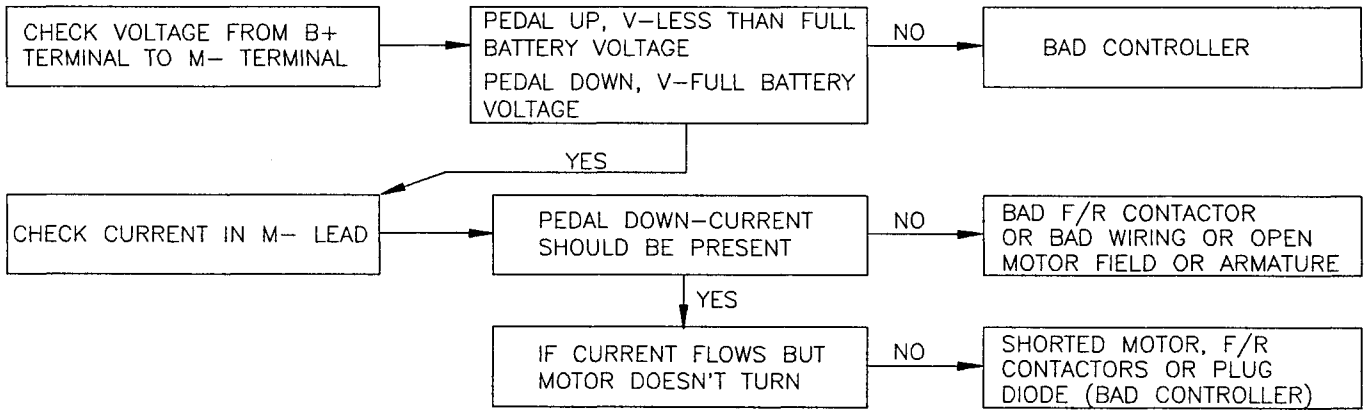
TESTING CONTROL WIRING

SET-UP: Key Switch On, F/R in Forward, Depress Pedal Until Microswitch Clicks



TESTING CONTROLLER OUTPUT

SET-UP: Key Switch On, F/R in Neutral
-If Main Contactor is De-Energized in Neutral it Must be Wired to Turn on for this Test



SECTION 14
Page 10

BENCH TESTING

EQUIPMENT

To test controller on the bench will require the simple setup shown in Figure 19. You will need the following:

1. A power supply having a voltage equal to the rating of the controllers you wish to test. This can be a string of batteries or a regulated line operated power supply. Since only low power tests will be described. A 10 amp fuse should be wired in series with batteries to protect both operator and controller against accidental shorts. A battery charger alone should not be used as a power supply, since without a battery load its output voltage may exceed the rating of the controller.

2. A control input source. Use , solid state accelerator (62-033-00).

3. A contactor with 250 ohm, 5 watt resistor across its contacts and a toggle switch to turn it on and off, as shown.

4. A test load, test light 62-027-00, set to the same voltage as your controller, 24V or 36V.

5. A general purpose volt ohmmeter or digital voltmeter.

Bench Test Procedure

1. To begin, pick up the controller and shake it. If anything rattles around inside, the unit must be considered defective.

2. Hook up the controller as shown, and connect the voltmeter leads to the controller B+ and B- terminals.

3. Turn on the power supply (not the contactor) and watch the voltmeter. Its reading should build up slowly over several seconds to the full battery voltage. If this voltage does not come up, the controller is bad.

4. The lamp should not come on at this point.; if it does, the controller is bad.

5. Now turn on the switch operating the contactor and the key switch input to the controller.

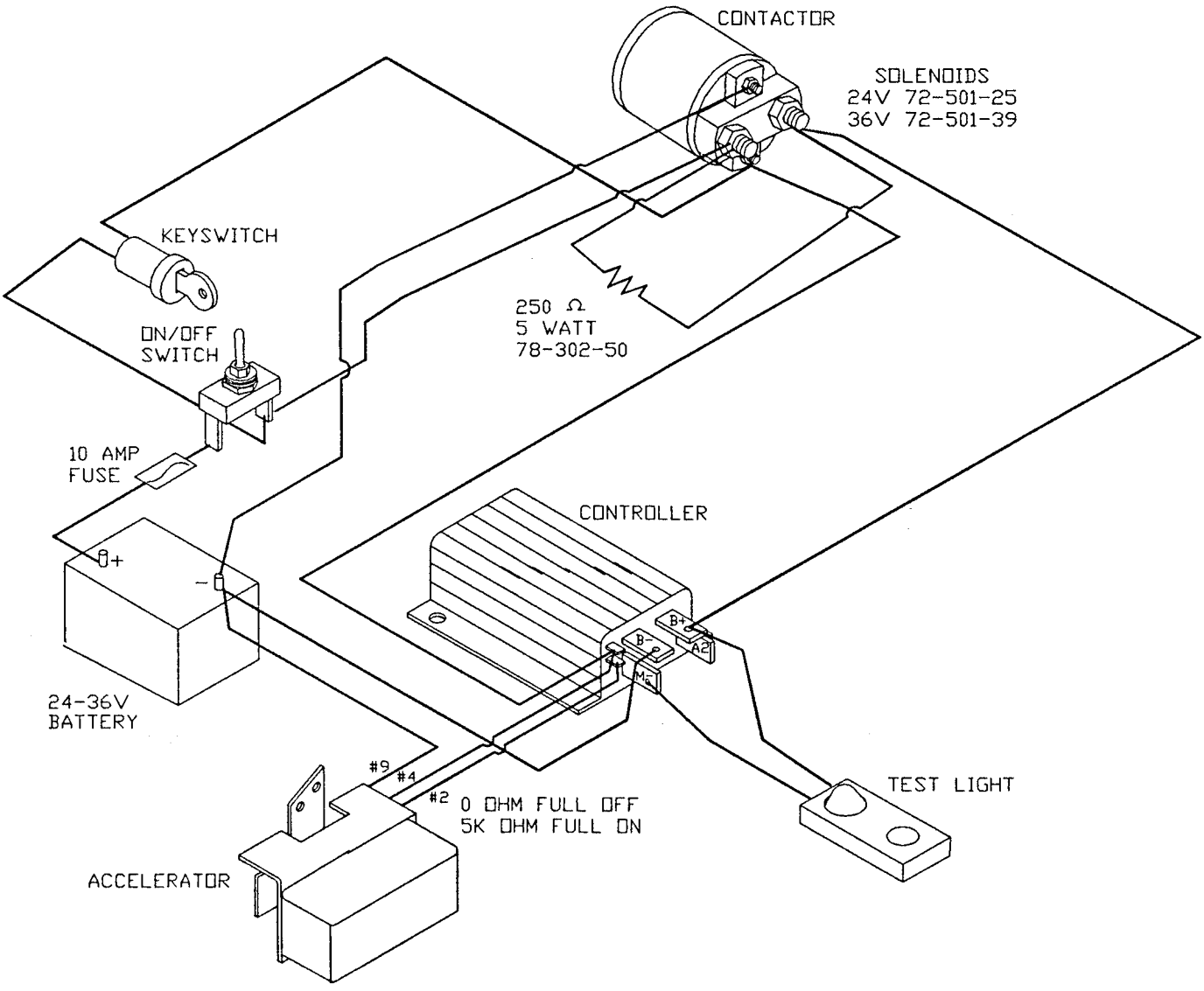
6. Move the accelerator arm and watch the lamp brightness. The lamp should go smoothly from full off to full on.

SECTION 14
Page 11

BENCH TESTING

7. Test the controller's high pedal disable function:
   a. Turn toggle switch off
   b. Depress accelerator until test light comes on full.
   c. Turn switch back on. Verify test light does not come on until the accelerator arm is depressed most of the way down, then turn back up.

BENCHTOP CHECKOUT SETUP



SECTION 14
Page 12

TROUBLE SHOOTING

Before proceeding with any trouble shooting, read the manual; understand the basic principles of operation and be familiar with component testing and replacement procedures. The pulsing of the equipment is too fast to measure with conventional equipment and the following fault procedure is based on the use of simple tools.

TOOLS AND EQUIPMENT REQUIRED

(a) Test light, part number 62-027-00
(b) Clip leads
(c) Multimeter
(d) Accelerator module test box,part number 62-027-30

PHYSICAL INSPECTION

Check controller for physical damage, loose or broken wiring, evidence of component overheating, etc. Pay particular attention to adjustment of accelerator switch and potentiometer operation.

NOTE: PRIOR TO TOUCHING ANY ELECTRICAL COMPONENTS, DISCONNECT BATTERY AND CONNECT TEST LIGHT IN SERIES WITH MOTOR ARMATURE.

Reconnect battery as needed for carrying out any specific tests.

1. Using an accelerator module test box, 62-027-30, plug in the accelerator module pigtail. Set V.O.M. to volt range to make the readings.
   All readings must agree with the table.

PIN POSITIONS	WIRES	V.O.M. READINGS (VOLTS PEDAL UP	PEDAL DOWN
2	ORANGE #2	6.2	11.0V
4	RED #4	B+	B+
5	RED #5	OV	B+
9	BLACK #9	OV	OV

* Supply B+ at Pin #4, and B- at Pin #9

2. Check that the pedal stops before the lever on the accelerator module runs out of travel (in pedal positions up and down).

3. Plug the test pig tail. Plug in the vehicle wire harness.

SECTION 14
Page 13

TROUBLE SHOOTING

CAUTION: DOUBLE CHECK BATTERY POLARITY. Severe damage will result if the battery polarity is reversed.

It is always good practice to use the test light (part number 62-027-00) in series with the motor, prior to initial turn on. This will indicate any abnormalities in the control.

NOTE: VEHICLE DRIVE WHEELS MUST BE JACKED UP OFF THE FLOOR FOR THE FOLLOWING TEST.

CAUTION: THIS IS A FACTORY CHECKOUT PROCEDURE AND SHOULD ONLY BE MADE BY A QUALIFIED MECHANIC.

After the system has been installed, a preliminary power check is required. A vehicle should be ready for basic operation at this time.

Lift green lead at S1 (refer to wiring schematic) and place test light in series with S1 as shown. Place forward/reverse switch in forward. Initiate accelerator slowly, light should come up to maximum brilliance at full acceleration. Repeat same step for reverse. If problems are encountered, see "Trouble Shooting" in this section. Also check acceleration rate by quickly depressing accelerator full. Light should come to full brilliance in about 3 seconds. (**CAUTION: DO NOT PERFORM PLUGGING WITH LIGHT ATTACHED.**)

SECTION 14
Page 14

TROUBLE SHOOTING

	SYMPTOM	POSSIBLE CAUSE
1.	Vehicle will not reach	Check that the accelerator is set full speed up correctly and the voltage swing at logic pin 2 is correct (6.2 volts to 11 volts)

NO TEST VOLTAGES. FIRST PLACE TEST LIGHT IN SERIES WITH THE MOTOR

1.	Solenoids do not operate. No voltage at solenoid coils.	Check power and control fuses. Replace if defective.
		Check for power at both sides of key switch.
		Check for power at both sides of direction switch.
		Check for power at both sides of brake switch.
		Check for flat or reversed battery.
	If there is voltage at requested solenoid coil.	Check that there is no short between S2 (FIELD) and NEG, e.g. shorted transistor.
		Check that battery voltage is reaching terminals 4 (Forward), 5 (Reverse) as relevant.

SECTION 14
Page 15

TROUBLE SHOOTING

	SYMPTOM	POSSIBLE CAUSE
2.	Solenoids close. No power and no transistor when speed is wound up.	Check circuit breaker. Battery voltage should appear at both ends of fuse. Check battery volts. Check accelerator circuit and operation of speed pot - to do this, place test light in series with the armature and wind the speed up and down with accelerator pedal. The voltage at pin 2 should move from 6.2 volts to 11 volts. If it stays at 6.1 volts the fault is in the accelerator may be bad or it has lost negative lead to battery. Replace accelerator. Check motor circuit. If the voltage at S2 (FIELD) terminal is lower than B+ then examine the motor circuit for worn brushes, sticking brushes, loose cable connections, etc. Also low voltage may indicate loss across contactor (solenoid) tips. Check resistance.
3.	Solenoids close, little or no power. High frequency whistle.	Check motor circuit for short circuits. Check for loose connections. Check for interchanged armature and field connections
4.	Solenoids close. Vehicle accelerates to full speed buts lacks power.	Check battery voltage under load.

FULL MOTOR TORQUE AVAILABLE - GENERAL FAULTS

SECTION 14
Page 16

TROUBLE SHOOTING

TO TEST VOLTAGES, FIRST PLACE TEST LIGHT IN SERIES WITH ARMATURE

	SYMPTOM	POSSIBLE CAUSE
1.	Solenoid closes and full speed.	Check accelerator circuit and voltage at pin 2. Should swing from 6.2 to 11 volts with depression of accelerator.
2.	Unequal braking in either direction, or unequal power in each direction.	Misadjusted motor brushes. Rotate brush gear to give equal braking in each direction.

SECTION 15
Page 1

OPTIONAL ACCESSORIES

T-D PART NO.	DESCRIPTION	QTY.
71-070-00	SWITCH, TOGGLE	1
72-006-00	HEADLIGHT - SEALED BEAM 4" - 24 VOLT	1
72-007-00	HEADLIGHT - SEALED BEAM 4" - 36 VOLT	1
72-032-00	LIGHT - TAIL - 24 VOLT OR 36 VOLT	1
78-303-00	RESISTOR FOR 36 VOLT TAILLIGHT	1
74-000-00	HOURMETER	1
75-202-00	WIRE #0 (PER FOOT)	
75-204-00	WIRE #4 (PER FOOT)	
75-208-00	WIRE #16 (PER FOOT)	
75-302-00	CONNECTOR #0 WIRE	
75-304-00	CONNECTOR #4 WIRE	
75-308-00	CONNECTOR #8 WIRE	
75-318-00	CONNECTOR #16 WIRE	
75-402-53	TERMINAL LUG #0 WIRE 5/16" HOLE	
75-404-53	TERMINAL LUG #4 WIRE 1/4" HOLE	
75-404-54	TERMINAL LUG #4 WIRE 5/16" HOLE	
75-408-52	TERMINAL LUG #8 WIRE 3/16" HOLE	
75-408-53	TERMINAL LUG #8 WIRE 1/4" HOLE	
75-418-51	TERMINAL LUG #16 WIRE #6 HOLE	
75-418-52	TERMINAL LUG #16 WIRE 3/16" HOLE	
75-418-53	TERMINAL LUG #16 WIRE 1/4" HOLE	
72-074-00	BULB, SEALED BEAM, HEADLAMP, 36 VOLT FOR 36 VOLT HEADLIGHT W/O VOLTAGE DROPPING RESISTOR	
72-073-00	BULB, SEALED BEAM, HEADLAMP, 28 VOLT FOR 24 VOLT HEADLIGHT AND 36 VOLT HEADLIGHT WITH VOLTAGE DROPPING RESISTOR	
73-001-00	HORN 24 VOLT	1
73-002-00	HORN 36 VOLT	1
74-009-00	CHARGE INDICATOR (36 VOLT)	1
74-009-10	CHARGE INDICATOR (24 VOLT)	1

62-016-25 ASSY, CONTROL PANEL E457

SECTION 16
Page 1

BATTERIES AND CHARGERS

MAINTENANCE PROCEDURES BATTERIES

WARNING: Lead acid batteries continuously emit highly explosive gasses. Flame or sparks must be kept away from the batteries at all times.

This **emission is greatly increased during the charging process.** Any area in which charging batteries are confined must be well ventilated, and flame or sparks must be kept out of the charging area and away from ventilator openings. DO NOT disturb battery connections while batteries are being charged.

The lead acid battery (or batteries) will furnish all power required by your vehicle. Two types are generally employed. The electric vehicle type battery pack, commonly used, can be expected to have a life of approximately 2 years, or 350 to 400 cycles. One cycle is the discharging and charging of the battery within proper limits. The heavy duty industrial type of battery has a life of approximately 7-1/2 years, or 1800 cycles, with appropriate use and care.

It cannot be over emphasized how important good maintenance procedures and judicious care of your batteries will affect their useful life. It is therefore recommended that a comprehensive maintenance program be established and adhered to throughout the life of your vehicle. A 5 point program is outlined below to assist you in understanding and establishing good battery care.

1. CORRECT CHARGING

Poor charging practices are responsible for more short battery life than any one other item. The charging equipment must be properly maintained and adjusted to give a charge which the battery will accept with maximum efficiency. Two things are involved in correct charging. These are the charging rate in amperes and the termination of the charge at the correct time. no amount of overcharging will increase the battery capacity or raise the specific gravity above its full charged condition.

Overcharging will reduce battery life. undercharging will cause poor vehicle performance, and shorten the life of all electrical components, including the batteries. Refer to Service and Adjustment section for proper methods to determine charge condition.

SECTION 16
Page 2

MAINTENANCE PROCEDURES BATTERIES

2. DISCHARGING - CAPACITY
Batteries are commonly rated in ampere hours at the six hour discharge rate to a final voltage of 1.75 per cell. They will deliver additional capacity in an emergency, but should not be required to do so regularly. The best way to avoid discharging is to prepare a rigid schedule for charging batteries which will insure against their being discharged beyond the limits of their capability.

3. WATERING
Water must be replaced from time to time. The frequency and quantity depends upon the watering space above the plates and the amount of gassing which the battery does on charge. Only approved or distilled water should be added to the battery. Water should be added after hydrometer or voltmeter readings have been taken. The liquid level within the battery raises as the gassing occurs. Thus filling after charging minimizes over-filling. However the water level should cover the plates prior to charging.

4. CLEANING
Batteries pick up various kinds of dirt and dust, depending on their surroundings and the type of service they are subject to. This is usually dry dirt, which can readily be blown off with low pressure air or brushed off. However, if cells are overfilled and electrolyte collects on the covers, the top of the battery becomes wet and stays wet, since the acid in the electrolyte does not evaporate. This must surface in combination when certain kinds of dirt becomes electrically conductive and permits stray currents to flow externally over the top of the battery. These currents cause corrosion of cell posts, nuts, connectors and steel trays, which eventually become troublesome and expensive to repair.

When wet dirt accumulates on top of the battery, remove it by washing the battery with strong solution of baking soda and hot water (1 lb. of soda to 1/2 gallon of water). A convenient brush to use is one having flexible bristles like an old paint brush. Continue the application of the soda solution until all fizzing stops, which indicates that the acid has been neutralized. Then rinse thoroughly with clear water.

Wet covers can be an indication of overfilling, leaky seals at posts and covers or of excessive gassing during charge. When observed the cause should be determined and the abusive conditions corrected.

SECTION 16
Page 3

MAINTENANCE PROCEDURES BATTERIES

5. RECORDS

A battery record system is recommended for all vehicles. It is considered essential for large operations, and where minimum battery operating cost is desired. A properly supervised record system can be made to detect and call attention to such operating irregularities as:

a. Overcharging
b. Undercharging
c. Overdischarging
d. Excessive Water Consumption
e. Cleanliness
f. Worn Out Batteries
g. Excessive Current Consumption on Trucks

It is not advisable to allow a battery to stand for a long period of time in a low state of charge. Doing so subjects the battery to excessive plate erosion and in cold climate conditions the electrolyte will freeze at a much higher temperature. For example, a fully charged battery will not freeze at temperatures near 60 degrees below zero. Yet a battery in a very low state of charge may freeze at temperatures around 10 to 15 degrees above zero.

A battery not in use maintains small amounts of chemical action which slowly tends to dissipate the charged condition. It is wise to re-charge a battery not in use every 1 to 2 months. If possible store the battery in a cool place, as the self discharge rate is increased with warmer temperatures.

SECTION 16
Page 4

BATTERIES AND CHARGERS

MAINTENANCE PROCEDURES BATTERIES

BATTERY MAINTENANCE RECORD VEHICLE NO.

Battery No.	Cell No.	Date			Date			Date		
		Water OK or Low	Gravity Before Charge	Gravity After Charge	Water OK or Low	Gravity Before Charge	Gravity After Charge	Water OK or Low	Gravity Before Charge	Gravity After Charge
	1									
1	2									
	3									
	1									
2	2									
	3									
	1									
3	2									
	3									
	1									
4	2									
	3									
	1									
5	2									
	3									
	1									
6	2									
	3									

SECTION 16
Page 5

BATTERIES AND CHARGERS

MAINTENANCE PROCEDURES BATTERIES

1. **CAUTION: Batteries emit explosive gases. During normal operation the concentration of these gases is rarely sufficient to be considered dangerous unless flame or sparks occur in the battery compartment close to the vent holes in the battery caps. It is important that this not be allowed to occur at anytime. Any area in which charging batteries are confined must be well ventilated, and flame, sparks or lighted cigarettes must be kept out of the charging area and away from ventilator openings associated with the charging area. Battery connections must not be disturbed while batteries are being charged.**

2. Do not fill an uncharged battery. Bring water level up to just cover the plates, and complete filling after battery is fully charged. Use distilled water. Fill only to level indicated on battery.

3. Batteries which require unusually frequent watering may indicate overcharging. Review charging practices and/or adjustment of transformer taps in charger.

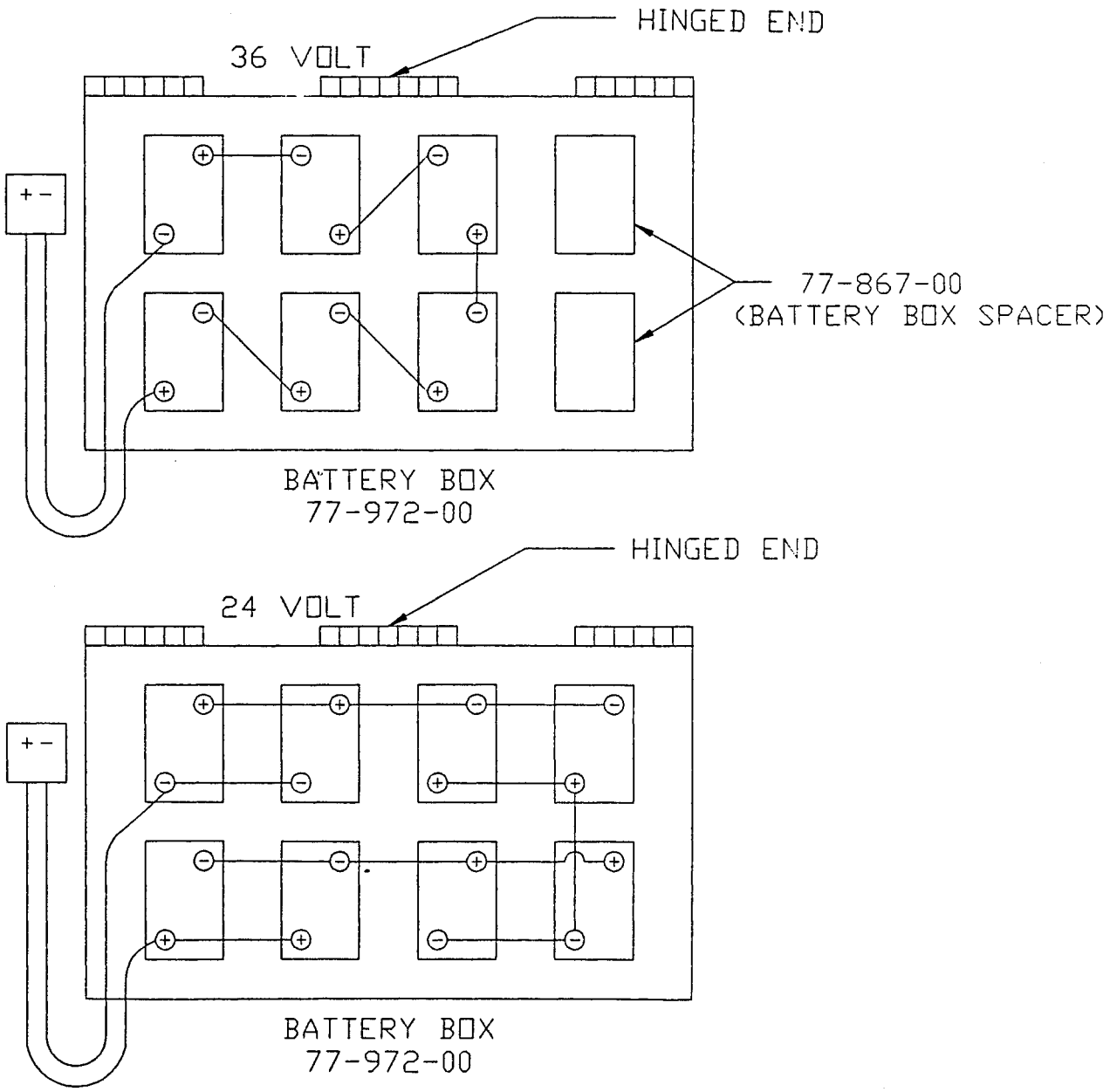
4. Gravity should be kept between 1175 (30% charged) and 1260 (100% charged), and gravity readings of all cells should be within 10 point range. When they are not, an equalizing charge should be applied. Refer to information under "Charging Time Chart" in Charger Handbook.

5. Periodically check for loose terminal posts or loose connections to terminal posts, **but not while batteries are being charged.**

6. Keep tops of batteries clean, and free of moisture, grease, and acid films. Any of these can cause current leakage.

7. Keep weekly (or more often) record as shown in sample chart, for a new vehicle or when charging results seem unsatisfactory, until satisfactory charging continues for a four week period, then keep record on a monthly basis.

SECTION 16
Page 6



SECTION 16
Page 7

CHARGER AND BATTERIES

SERVICE AND ADJUSTMENTS

PARTS LIST, BATTERIES (SEE FIGURE 1)

T-D PART NO.	DESCRIPTION
75-231-00	JUMPER, BAT, 10-1/4 LG
75-234-00	JUMPER, BAT 18-1/4 LG
75-244-00	POWER CORD, SB 175 RECEPT
77-048-00	6V 250 AH TROJAN BATTERY
77-050-00	6V 350 AH TROJAN BATTERY
77-060-00	24V 340" AH INDUSTRIAL
77-061-00	36V 375" AH INDUSTRIAL
77-063-00	36V 425" AH INDUSTRIAL
77-971-00	LIFT OUT BATTERY BOX
77-972-00	LIFT OUT BATTERY BOX (8 BATTERIES)
88-080-11	5/16 X 1 NC HEX HD CAP SCREW
88-089-80	5/16 NC HEX HD NUT
96-607-00	CLAMP, CABLE TIE-5, 5 INCH
98-615-00	GROMMET, RUBBER, 3/4 IN ID

BATTERIES

To determine whether or not a battery is properly charged, a measuring device known as a hydrometer should be used. A hydrometer consists of a glass tube or body with a rubber bulb at one end and a small spout at the other. Inside the tube is a graduated float.

The float will reach a point of equilibrium relative to the specific gravity of the fluid in which it floats.

The electrolyte within your battery becomes heavier as it is charged, therefore a higher specific gravity reading indicates a higher charge condition of your battery.

The specific gravity reading will range from 1100 for fully discharged condition to 1260 for fully charged condition on the electric vehicle type of battery.

On the heavy duty industrial type of battery, the specific gravity reading will be approximately 1275 to 1285 for fully charged condition.

NOTE: Because of the difference in the electrolyte the specific gravity will range slightly higher on the industrial type of battery. No amount of overcharging will raise the specific gravity above 1290 on the electric vehicle type of battery. Actually overcharging will only injure the plates and shorten battery life.

SECTION 16
Page 8

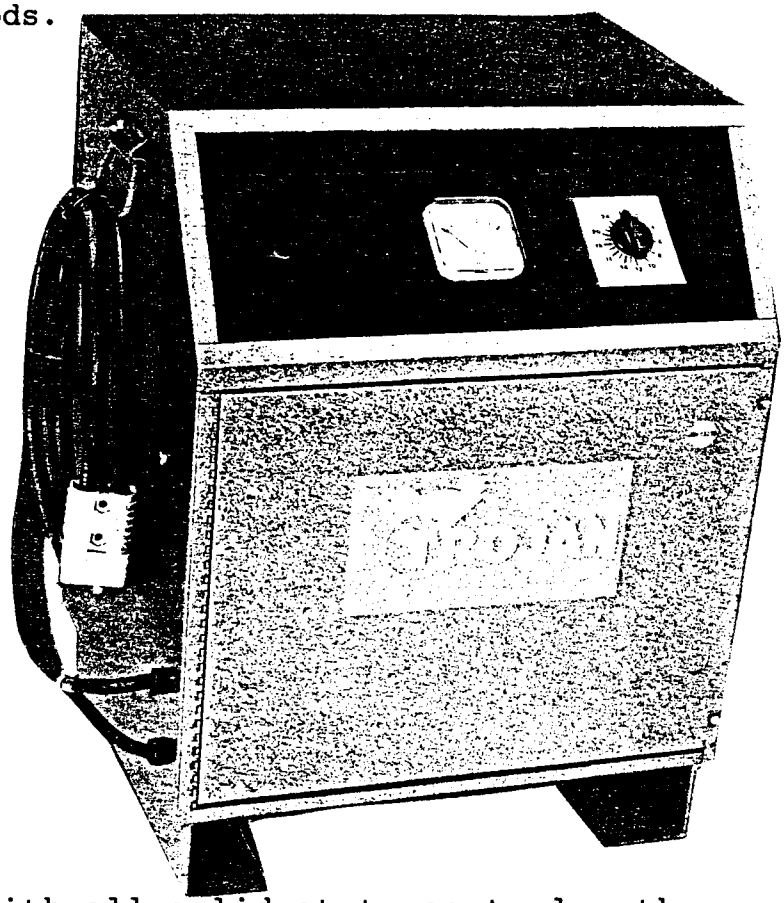
BATTERIES AND CHARGER

SERVICE AND ADJUSTMENTS

When testing battery charge condition with hydrometer, always return electrolyte solution to the same cell from which it was removed. DO NOT MIX electrolyte from one cell to another.

Refer to charger section for additional information on battery testing and charging methods.

CHARGERS



Equipped with all solid state controls, these units automatically monitor the charge rate, protecting your batteries from undercharge or overcharge, thus allowing your batteries to achieve their maximum life while always operating at peak efficiency.

All units are constructed of the finest materials and carry a written guarantee.

SECTION 16
Page 9

CHARGER AND BATTERIES

SERVICE AND ADJUSTMENTS

CHARGERS

Trojan industrial type batteries are offered as an optional item for 12, 24 and 36 volt D.C. operation, the features are as follows:

Full Magnetic Control automatically allows for full taper charge from high rate to trickle.

Exact amount of Required Current is automatically replaced and completely equalized, thus bringing every cell up to peak voltage at the end of each charge cycle.

Charging Rate is held below the gassing point to insure longer battery life and much less watering.

Automatic Cell Equalization maintains every plate in exact electrical and chemical balance. This means no over or undercharging.

Electric Timer serves as back-up to automatic solid state control system.

Circuit Protection-overload-short circuit-reverse battery connection-surge suppression on rectifiers.

Battery Compensation-Charging rate is easily readjusted to accommodate aging batteries or batteries with faulty cells.

INSTALLATION

The charger is designed for convection cooling, depending on a free circulation of air.

Locate the charger as near as possible to the main power source.

IMPORTANT PROCEDURES PRIOR TO INITIAL OPERATION

Disconnect charger from power line. Open front door, remove safety cover. Check connection to voltage tap; it should match power line. On dual voltage models AC contactor should match power line. Check that 240 line is not 208, if so connect to 208 voltage tap.

Your charger is fully automatic, requiring no other attention than turning the switch to 8-12 hours; 8 hours is normal. Use 12 hours for hard working applications. Set to 24 hours on weekends.

WARNING! DO NOT DISCONNECT BATTERY WITH SWITCH IN "ON" POSITION!

SECTION 16
Page 10

CHARGER AND BATTERIES

SERVICE AND ADJUSTMENTS

With the battery voltage controlling the rate of charge your charger will automatically replace current to bring your battery unit or units to full charge condition plus equalization of all cells during a normal charging cycle.

The following instructions should be adhered to in placing your charger in service:

1. Check name plate for AC (Alternating current) voltage rating. Your charger is designed for 114.240, 480 or 520 volts AC or dual combinations thereof. Proper line voltage adjustment assures maximum operating efficiency.

2. Your DC (Direct current) voltage output should now be as follows: (charger turned on, battery **not** connected)

6 cell chargers (12 volts)	15 volts
12 cell chargers (24 volts)	30 volts
15 cell chargers (30 volts)	37.5 volts
16 cell chargers (32 volts)	40 volts
18 cell chargers (36 volts)	45 volts

3 phase Chargers have proper voltage stamped on the control board

Above readings are approximate, do not exceed the suggested DC output-a lower reading than the suggested one is advisable if you cannot reach maximum.

DC voltage readings are determined on 2.5 volts per cell of battery to be charged.

Above readings are compiled by connecting the positive and negative leads of a DC volt meter to the corresponding terminals on the charger receptacle or same terminals on front panel.

Turn on charger switch. (Note that battery is not attached at this time.)

Read voltage on volt meter. If reading is not correct, adjust output on Adjustment tap (upper part of control panel) left for lower, right for higher output.

SECTION 16
Page 11

BATTERIES AND CHARGERS
CHARGER OPERATION

Turn off switch, connect charger to battery and turn switch on. Observe charging current on ammeter. On a discharged battery (1.150 or less specific gravity) meter should show close to maximum charging rate.

If a battery is fully charged (1.260 specific gravity) charging rate should have tapered to approximately 2 amps per 100 AH of capacity (finished rate) or less, recheck line voltage adjustment.

If correct, move adjustment lead on control panel towards the high setting one tap. Let the charger go through another overnight cycle. Repeat process of moving tap until battery shows full charge 1.260 when charging current is a approximately 2 amps per 100 AH of capacity (finished rate) or less after completed cycle.

On the other hand, if after an overnight cycle ammeter is showing a reading of 3 amps per 100 AH of capacity (finished rate) or more, check your battery for faulty cells.

WARNING!!!!!!!!!

AT NO TIME SHOULD AMMETER READ HIGHER THAN DC AMPERE RATING OF CHARGER

DO NOT DISCONNECT BATTERY WITH SWITCH IN ON POSITION.

SECTION 16
Page 12

BATTERIES AND CHARGERS
CHARGERS continued

TROUBLE SHOOTING

IN CASE CHARGER DOES NOT OPERATE CORRECTLY

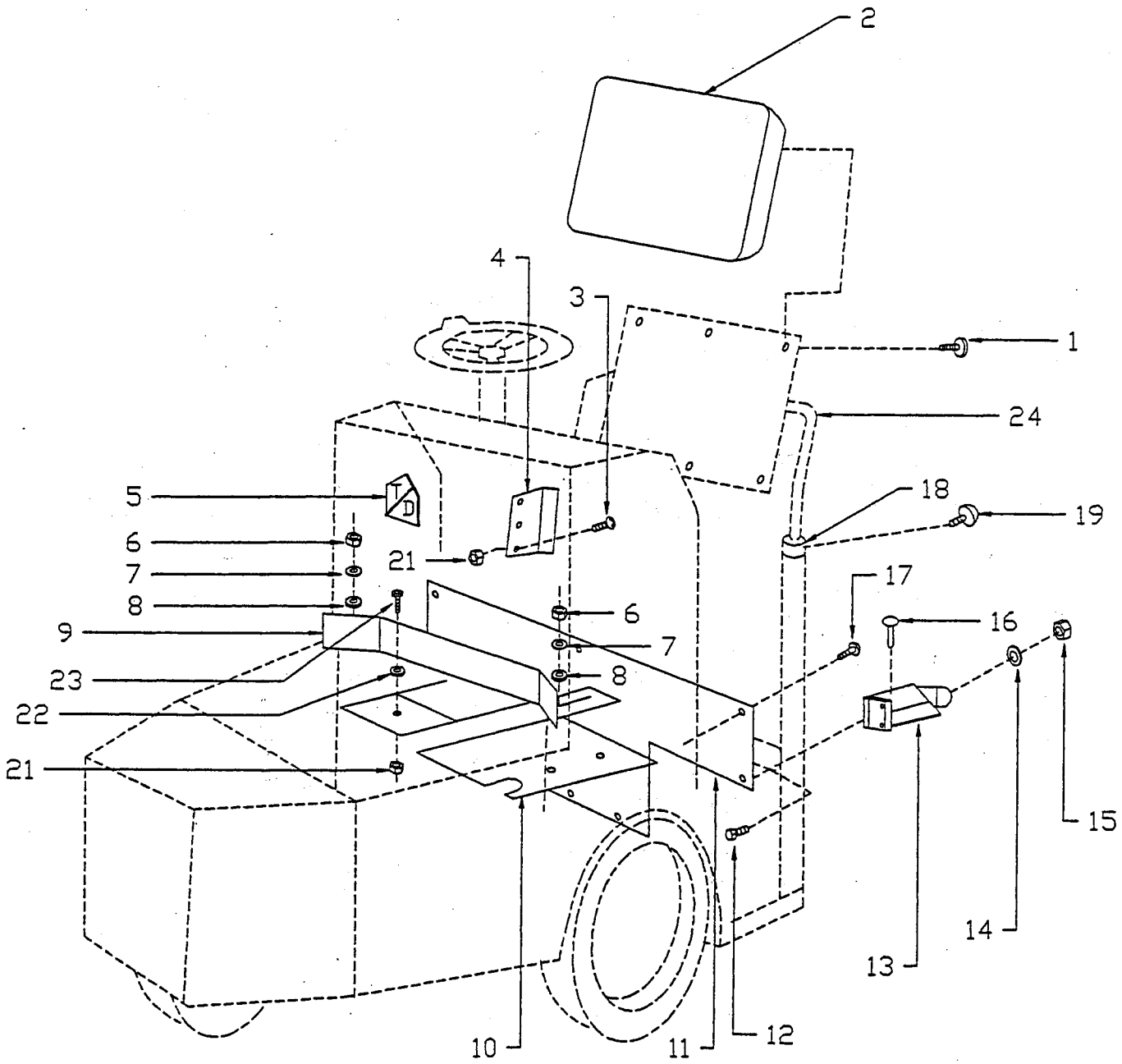
1. Check fuses on terminal panel inside charger.
2. Check fuse or breaker in AC supply.
3. Check battery connections on battery and connectors to charger.
4. If DC fuse blows, check for too high charging rate at start of charge, dead or **shorted cell in battery** (2 volt or less per cell during charge) or short in charging line, or shorted Diode.
5. If AC fuse blows, check for defective rectifier in charger. (This condition will occur when battery is not attached). Defective Rectifier will blow AC with battery not attached and will blow DC fuse immediately when battery is attached with power off.
6. Weak or damaged rectifier can be detected through sudden amperage drop to half of usual output or less.
7. Defective power transformer cannot increase or partially decrease output. It will either decrease output to zero or blow AC fuses.
8. Defective control transformers will increase charging rate substantially. No taper charge will occur.
9. Low output on initial installation usually is caused by connecting a charger set on 240 V to a 208 V AC line.

CHARGER PARTS LIST

PART NO.	DESCRIPTION
79-255-10	CHARGER, 24 VOLT, 60 AMP, SINGLE PHASE
79-275-10	CHARGER, 24 VOLT, 70 AMP, SINGLE PHASE
79-290-10	CHARGER, 24 VOLT, 100 AMP, SINGLE PHASE
79-355-10	CHARGER, 36 VOLT, 60 AMP, SINGLE PHASE
79-375-10	CHARGER, 36 VOLT, 70 AMP, SINGLE PHASE
79-390-10	CHARGER, 36 VOLT, 100 AMP, SINGLE PHASE

SECTION 17
Page 1

BODY AND TRIM PARTS



SECTION 17
Page 2

BODY AND TRIM PARTS

FIG. I.D.	PART NO.	DESCRIPTION	QTY.
1	88-837-09	PAN HEAD SHEET METAL SCREW #14 X 3/4"	6
2	90-144-00	CUSHION - BACK REST 13" X 16-34"	1
3	88-065-11	TRUSS HEAD MACHINE SCREW 1/4" X 1" NC	2
4	71-615-00	BRACKET - PROGRAM SWITCH MOUNTING	1
5	94-201-00	EMBLEM (TAYLOR-DUNN)	1
6	88-109-80	NUT - 3/8" NC (HEX)	2
7	88-108-62	LOCK WASHER 3/8"	2
8	88-108-60	WASHER 3/8" FLAT	2
9	77-863-00	BATTERY CLAMP - ADJUSTABLE	1
10	71-614-00	DIRT PROTECTIVE PANELS (SET OF 3)	1 SET
11	71-617-00	REAR PANEL - MOTOR COMPARTMENT	1
12	88-140-14	HEX HEAD CAP SCREW 1/2" X 1-1/2" NC	4
13	97-809-00	HITCH - HOOK,PIN & EYE TYPE	1
13	97-804-00	HITCH - PINTLE TYPE	1
13	97-808-00	HITCH - AUTOMATIC COUPLING	1
14	88-148-62	LOCK WASHER - 1/2"	4
15	88-149-80	NUT - 1/2 " NC (HEX)	4
16	97-809-51	HITCH PIN - HOOK, PIN & EYE TYPE	1
17	88-025-06	TRUSS HEAD MACHINE SCREW 8-32 X 1/2"	10
18	17-113-00	COLLAR - 1-1/16"	2
19	95-901-00	KNOB - KNURLED PLASTIC HANDLE - 5/16 NC	2
20	94-301-00	DECAL (TAYLOR-DUNN)	2
21	88-069-87	NUT - 1/4" NC KEPS	2
22	88-068-62	LOCK WASHER 1/4"	4
23	88-060-06	HEX HEAD CAP SCREW 1/4" X 1/2" NC	4
24	90-159-00	BACKREST WITH CUSHION MOUNTING PLATE	1
25	71-618-00	CONSOLE COVER FOR VEHICLES WITH BATTERY RECEPTACLE MOUNTED ON RT. SIDE OF CONSOLE	1
25	71-618-10	CONSOLE COVER FOR VEHICLES WITH BATTERY RECEPTACLE MOUNTED TO CONSOLE UPPER PANEL	1

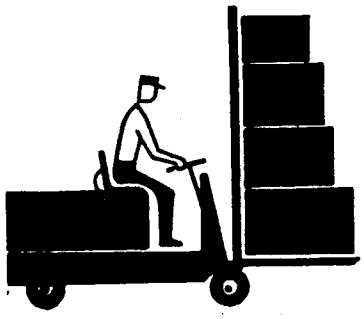
GEK-40724C

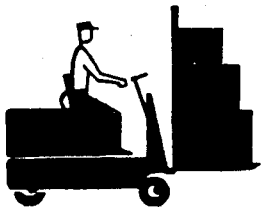
OPERATING & MAINTENANCE

INSTRUCTIONS

MODELS EV-1A, EV-1B, EV-1C, EV-1D
VOLTS 24-48, 48-84

EV-1* SCR CONTROL FOR ELECTRIC VEHICLES





CONTENTS

*Trademark of General Electric Company

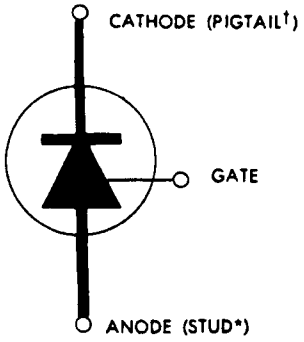
The information contained herein is intended to assist truck users and dealers in the servicing of SCR control furnished by the General Electric Company. It does not purport to cover all details or variations in equipment nor to provide for every possible contingency to be met in connection with installation, operation or maintenance.

Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purpose, the matter should be referred to the truck manufacturer through his normal service channels, not directly to General Electric Company.

GENERAL ELECTRIC

WHAT IS AN SCR?

Since the heart of the control is a silicon controlled rectifier (SCR), a general understanding of the characteristics of the device will be helpful. The SCR is a semi-conductor rectifier used as a latching switch; i.e., it may assume either a conducting or nonconducting state (On or Off).



The SCR can be turned On by a momentary application of control current to the gate. To turn it Off, it is necessary in addition to removing the turn-on signal from the gate, either to remove all power from the SCR or to apply momentary reverse voltage between cathode and anode.

† Typical of SCR as used in GE control for electric vehicles.

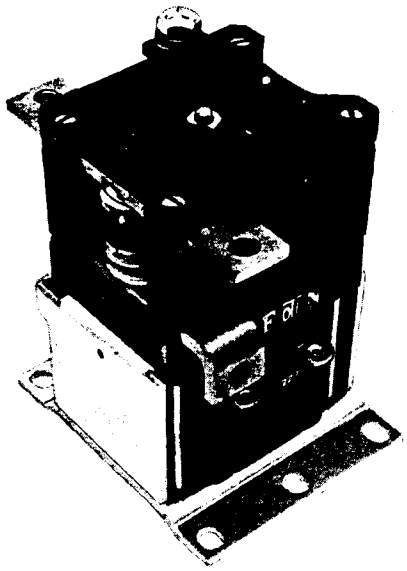


Fig. 2. Typical contactor

PHOTOS OF CONTROL

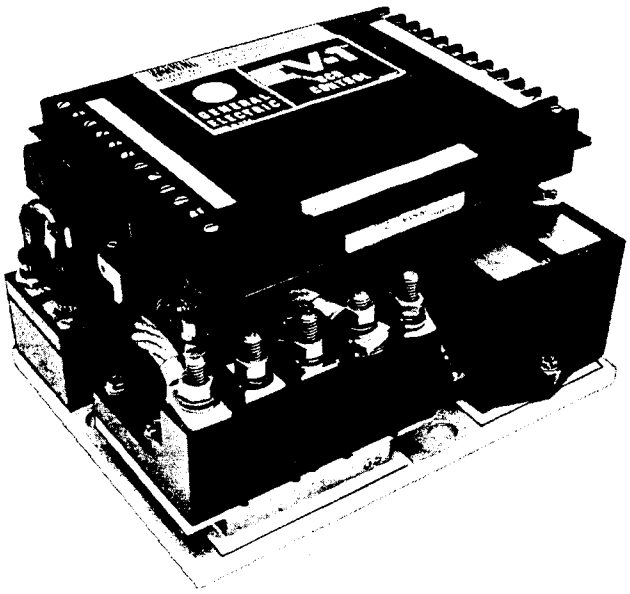


Fig. 1. Typical SCR static panel

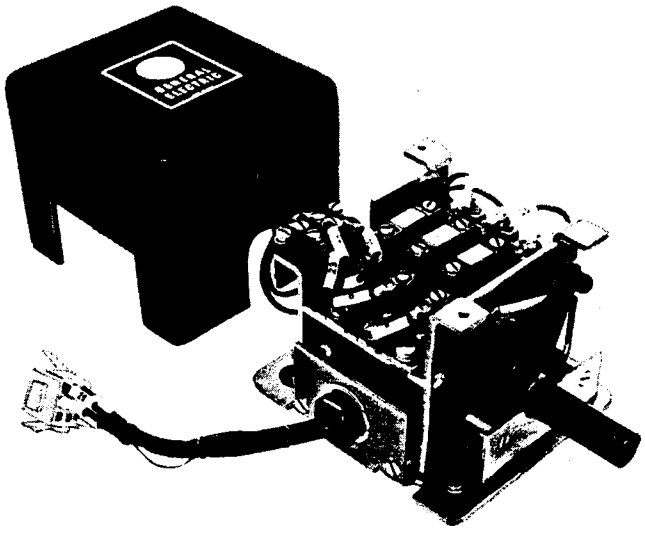


Fig. 3. Typical accelerator switch with cover removed

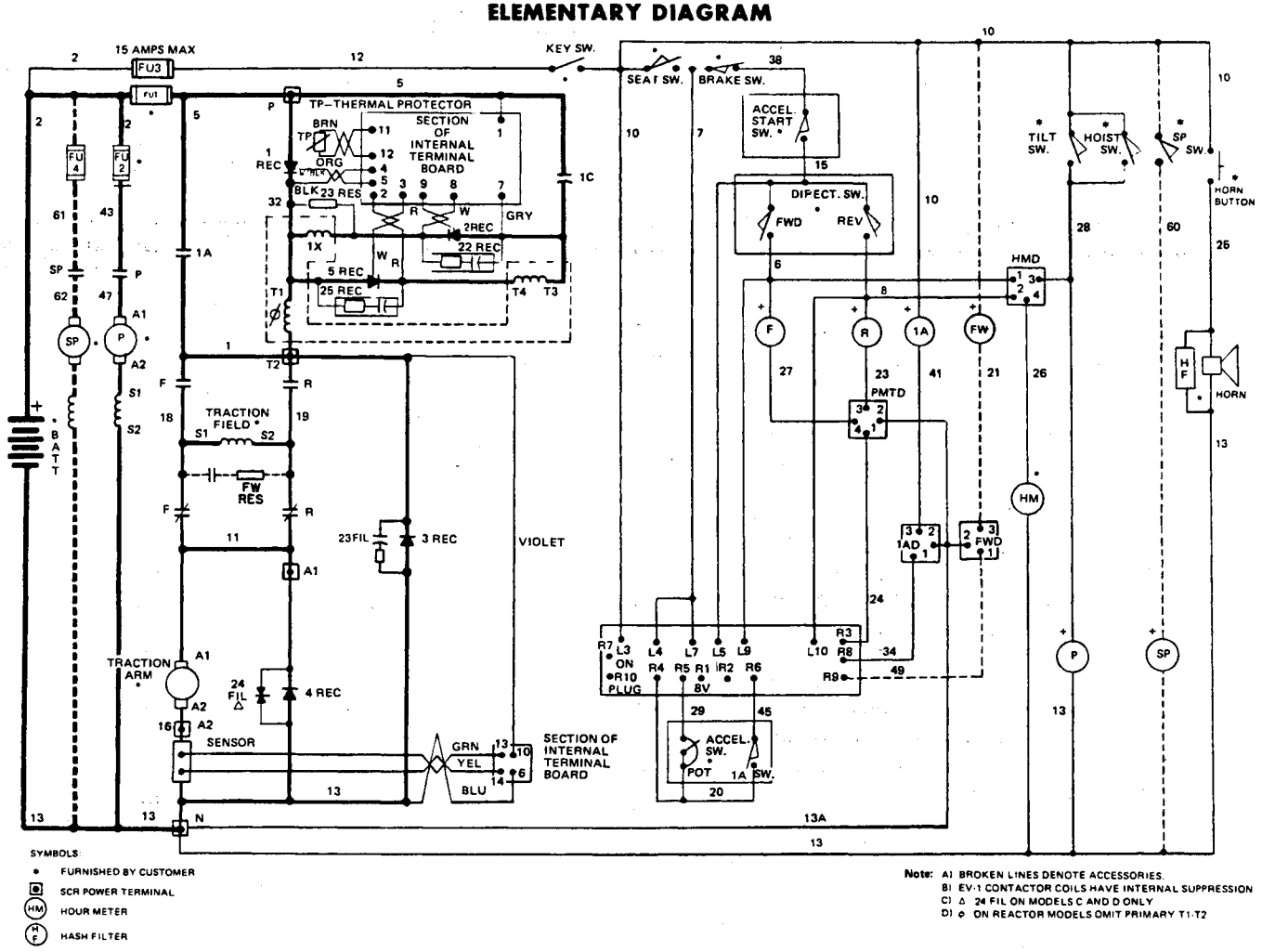


Fig. 4. Elementary diagram, General Electric EV-1 control for typical sit-down truck. Refer to the manufacturer's instruction book for diagram for your specific truck.

CIRCUIT OPERATION (SEE FIG. 4)

The control circuit is energized by closing the Key switch, Seat switch, and moving the Forward or Reverse lever to either position and then depressing the accelerator, thus closing the Start switch. This applies power to the control card and, if the static return to OFF and pulse monitor trip requirements are satisfied, turns on the PMT driver, which will close the selected directional contactor, completing the circuit to the traction motor.

The control card supplies a gate pulse to 2 REC, turning it on to a conducting state, allowing current to flow from the battery through 1C, 2 REC, 1X, motor field, motor armature, current sensor, and back to the battery. After 1C charges, 2 REC shuts OFF due to lack of current. The control card checks that 1C is charged and unlocks the gates to 1 REC and 5 REC.

The control card then supplies a gate pulse to 1 REC, turning it ON to a conducting state, allowing current to flow from the battery through 1 REC, motor field, motor armature, sensor, and back to the battery. 5 REC turns ON and allows current to flow T4-T3, 1C, 1 REC, 5 REC back to T4-T3. This current charges 1C positive (card terminal 7 is now positive). This charge is now stored on the capacitor until it is time to turn OFF 1 REC. This charging cycle occurs in less than 1 millisecond (0.001 seconds) and 5 REC shuts OFF.

Current continues to flow in 1 REC until the control card turns ON 2 REC. When 2 REC conducts, capacitor 1C discharges around the circuit composed of 1C, 2 REC, 1X and 1 REC. This discharge current opposes the battery current through 1 REC until the resultant current is zero.

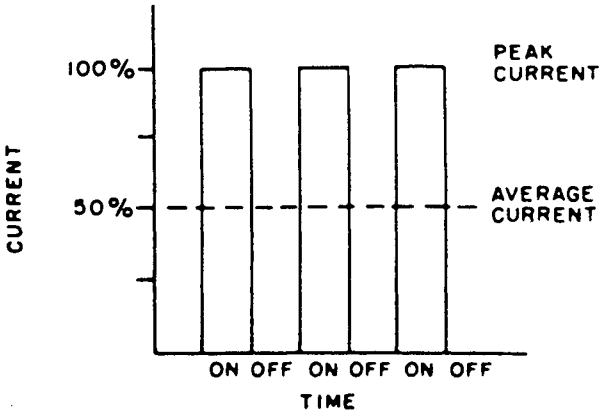


Fig. 5. Battery current

With reverse voltage across 1 REC, 1 REC is turned OFF. Current continues to flow in 1C, 2 REC, motor and the battery loop until the capacitor (card terminal 7) is fully charged negative. This charge exceeds battery voltage by an amount which is a function of motor current, and 2 REC turns OFF. Figure 5 illustrates the pulsing of current from the battery.

During the OFF time, the energy stored in the motor, by virtue of its inductance, will cause current to circulate through the motor around the loop formed by 3 REC, thus providing what is called "flyback current". Figure 6 shows the nature of the motor current, which is composed of both battery current and the inductive flyback current. It should be noted that the average motor current measured will be greater than the average battery current. The SCR control, in effect, converts battery current at battery volts into a higher motor current and a lower motor volts.

The time for the next On and Off cycle to start is determined by the time that the control card takes to oscillate. The oscillation times are controlled by the potentiometer in the accelerator. Slow speed is obtained by having maximum ohms in the potentiometer. As the resistance in the potentiometer decreases, the speed of the motor increases. With level operation, the SCR circuit is capable of delivering approximately 85 to 90 percent speed. For full-speed operation, the 1A contactor is closed to apply full battery voltage across the motor.

CONTROL FEATURES

- OSCILLATOR — The oscillator section of the card has two adjustable features, creep speed and controlled acceleration, and one fixed feature, top speed.

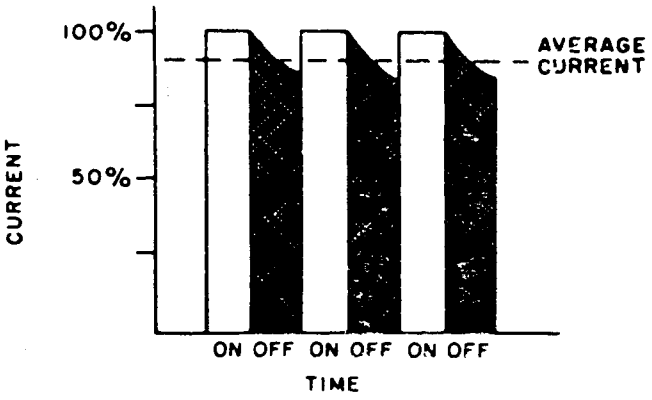


Fig. 6. Motor current

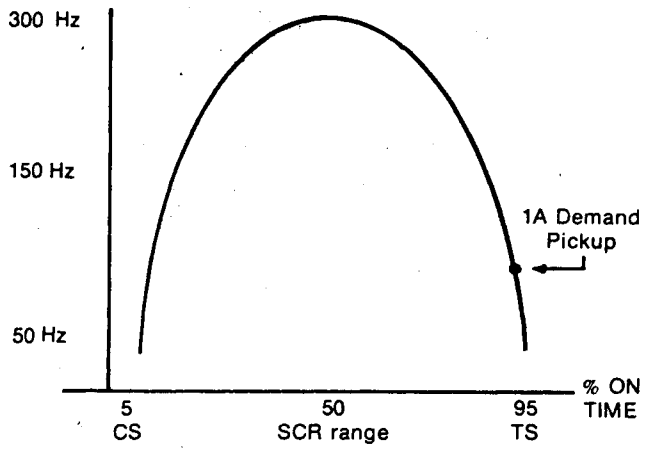


Fig. 7. Oscillator frequency curve

With the accelerator potentiometer at maximum ohms, the creep speed can be adjusted with a trimpot on the card. Top speed is fixed by card design, and is obtained with the accelerator potentiometer at minimum ohms.

The rate at which the oscillator may increase its % ON time is limited by "Controlled Acceleration". The minimum time required to go from creep speed to the 1A pickup point may be varied by an indexed trimpot (C/A) on the card, adjustable from approximately 0.5 seconds to 1.0 seconds.

The % ON time has a range of approximately 5 to 95 percent. The center operating condition of the oscillator is at 50 percent ON time with a nominal 1.7 milliseconds ON time and 1.7 millisecond OFF time. This corresponds to a maximum operating frequency of about 300 hertz. At creep the ON time will decrease to approximately 0.8 milliseconds while OFF time will become in the order of 20 milliseconds. At full SCR operation, this condition will be reversed (short OFF time, long ON time). This variation of ON and OFF time of the oscillator produces the optimum frequencies through the SCR range. See Fig. 7.

- CURRENT LIMIT — This circuit monitors motor current by utilizing a sensor in series with the armature. The information detected across the sensor is fed back to the card so current may be limited to a maximum safe value. If heavy load currents are detected, this circuit overrides the oscillator and limits the average current. An indexed trimpot for the current limit (C/L) adjustment is provided to maintain the peak voltage on the capacitor within its rating when

used on high source inductance and/or low motor resistance applications. Because of the flyback current through 3 REC, the motor current usually runs 2 to 3 times the battery current. The (C/L) trimpot adjustment will produce little or no variation of battery current when used with high resistance motors.

- PLUGGING — Slowdown is accomplished when reversing by providing a small amount of retarding torque for deceleration. If the vehicle is moving and the directional lever is moved from forward to reverse, the motor field is reversed, the motor armature is driven by the inertia of the vehicle and acts as generator. This generated current passes through 4 REC and the current sensor. When the plug signal is initiated, the oscillator circuit regulates at a plug current limit level as set by the Plug trimpot on the control card. This controls the pulse rate of 1 REC to regulate the generated motor current and bring the truck to a smooth stop and reversal.

- RAMP START — This feature provides SCR torque to restart a vehicle on an incline. The memory for this function is the directional logic in the card. When stopping on an incline, the Directional switch must be left in its original or OFF position to allow the control to assume full power when restarting in the same direction. The "C/L" trimpot affects this torque.

- FULL-POWER TRANSITION — This built-in feature provides smooth transition from SCR to 1A bypass. This is accomplished by the SCR continuing to pulse until the 1A contactor power tips close.

- 1A CONTROL — The 1A contactor has 6 modes of control:

  1. DEMAND PICKUP (fixed feature of the card) — If the oscillator has attained a % ON time equivalent to a motor voltage of 80 to 85 percent of the available battery volts, the 1A contactor will automatically pick up. The 1A switch in the accelerator is not necessary for this function. On "H3" cards, this feature may be eliminated by adding a jumper from R9 to R4.

  2. TIMED PICKUP — This feature works with the 1A switch in the accelerator. The time-delay pickup of 1A is provided by a circuit in the card. This feature allows 1A to be picked up after a time delay without reaching the demand point, and is normally used to apply full power at near stall conditions. This time delay is adjustable by means of a 1A time trimpot on the card.

  3. 1A THERMAL HOLDOFF — This feature prevents the 1A contactor from closing as a function of time when the truck is in severe thermal cutback to avoid torque jumps. When a truck starts to go into thermal cutback, the 1A time will rapidly increase to infinity as the control goes deeper into thermal cutback. On "E" and later cards, this feature may be eliminated by adding a jumper from R2 to R4.

  4. 1A CURRENT HOLDOFF — This feature is obtained by not wiring in the 1A switch in the accelerator. 1A will not pick up until the vehicle can accelerate to a point where the demand pickup will close the 1A contactor.

  5. 1A PLUGGING HOLDOFF — This built-in feature is designed to prevent 1A closure anytime during plugging.

  6. 1A DROPOUT (1A DO) — This adjustable feature can be set to open the 1A contactor if the traction motor is subjected to excessive currents. The dropout is adjustable with the (1A DO) trimpot. The directional or Accelerator switch must be returned to NEUTRAL to unlock the dropout circuit. Using this feature will reduce the 1A contactor tip life, thus it should be used only where needed to protect the motor.

- PULSE MONITOR TRIP — This function contains three features: The look ahead, the look again, and the automatic look again reset.

If 1 REC is shorted or 1A is welded, PMT will look ahead and prevent F or R from closing if either condition exists.

If 1 REC fails to commutate, or if 1A power tips remain closed when they should be open, the control will open F or R contactor. PMT will then look again by testing for a fault and, if none, reclose F or R. If the fault still exists, the F or R will reopen and remain open.

If 1A closes before a second commutation failure, the look again counter will automatically reset. This eliminates the inconvenience of resetting the PMT with the key switch if the tripping is due to random noise.

When the PMT circuit prevents F or R from closing, the PMT circuit can be reset only by opening the Key switch.

- STATIC RETURN TO OFF — This built-in feature of the control requires the operator to return the directional lever to NEUTRAL anytime he leaves the vehicle and returns. If the Seat switch or Key switch is opened, the control will shut off and cannot be restarted until the Directional switch is returned to NEUTRAL. A time delay (0.5 seconds) is built into the Seat switch input to allow momentary opening of the Seat switch. This same delay requires the Directional switch not be closed until both the Key switch and the Seat switch have been closed for 0.5 seconds.

- TIP BOUNCE TIMER — After F or R are closed or 1A opens, the oscillator card checks that the capacitor has been charged by 2 REC, the battery volts appear across 1 REC, and an interval of time has elapsed before 1 REC and 5 REC can be gated.

- COIL DRIVE MODULES — These modules are typically located on the contactor portion of the control. They are the power devices that operate F, R, 1A and FW contactor coils. These modules pick up or drop out these coils on command from the control card. All modules are equipped with reverse battery protection so that if the battery is connected incorrectly, none of the contactors controlled can be closed electrically.

- THERMAL PROTECTOR (TP) — This temperature-sensitive device is mounted in the 1 REC heat sink. If the 1 REC temperature exceeds design limits, the thermal protector will lower the maximum current limit and not allow 1 REC to exceed its temperature limits. Even at a reduced current limit, the vehicle will normally be able to reach sufficient speed for full 1A operation, thereby allowing the panel to cool. As the panel cools, the thermal protector will automatically return the control to full power.

- FIELD WEAKENING (optional) — If the vehicle is supplied with a field weakening circuit, the FW PU and FW DO trimpot adjustments will be on the SCR control card. Field weakening is a method of attaining higher running speed for the vehicle in level operation. The normal settings for this feature are: pickup of FW contactor from 125 to 150 percent of normal full-load running current (1A), and dropout of FW contactor from 275 to 300 percent current. The dropout puts the motor back to the 1A range to climb ramps and inclines.

- FW WITH 1A CURRENT HOLDOFF — The 1A switch in the accelerator has to close to allow the FW circuit to operate. To allow the two functions to operate, the 1A switch has to be rewired per Fig. 8.

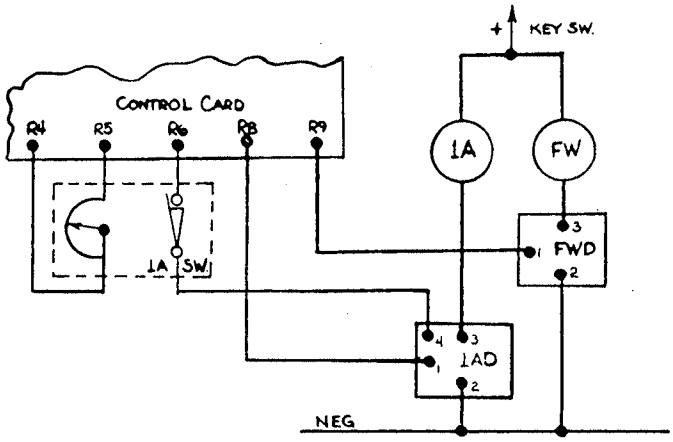


Fig. 8. FW with current 1A holdoff

- LOW VOLTAGE — Batteries under load, particularly if undersized or more than 80 percent discharged, will produce low voltages at the SCR control terminals. The EV-1* control is designed for use down to 50 percent of the nominal battery volts. Low battery volts may cause the control to not operate correctly but the PMT should open the F or R contactor in the event of a commutation failure.

- ACCESSORIES — Other functions and equipment available with SCR control for electric vehicles and their instruction references are:

IC3645	System Analyzer	GEK-40725
IC3645	Pump Time Delay	GEK-73400
IC4482	Contactors	GEH-4469
IC4484	Auxiliary Plugging Control	GEK-64881
IC4484	Battery Discharge Indicator	GEK-73401
IC4484	Dual Motor Control	GEK-64882
IC4485	Accelerator Switch	GEH-4470

- OSCILLATOR CARD CHANGES

Card IC3645	Volts	FW	Features (Described on page 8) 1	2	3	4	5	6	7
OSC1A3	24-48	Yes	X	X	X		X	X	
A4	48-84	Yes		X	X	X	X	X	
B3	24-48	No	X	X	X		X	X	
B4	48-84	No		X	X	X	X	X	
C3	24-48	Yes					X*	X	
D3	24-48	No					X*	X	
E3	24-48	Yes							
E4	48-84	Yes							
F4	48-84	No							
H3	24-48	No							X

*Only on cards up to Rev. B-2 (see card nameplate)

- OSCILLATOR CARD CHANGE FEATURES

1. Optional reduced current limit.
   Adding a connector from R1 to R2 will reduce motor current (by about 50 amperes when used with the EV-1B control.)

2. Low thermal cutback.
   Reduction in current limit is adequate only when the panel is mounted on a good heat sink. 1A thermal holdoff occurs at a low temperature. The low temperature thermal protector (group 1) must be used with this card.

3. No PMT look again reset.
   The PMT look again counter will not reset when 1A closes.

4. Motor current output signal location.
   IM Output is located at R2 instead of L6.

5. 1 REC synch circuit.
   1 REC synchronizing circuit shuts off 1 REC gate pulse causing failure to gate 1 REC with certain motors.

6. Non-optional 1A thermal holdoff.
   The provisions for disabling 1A thermal holdoff by adding a connector from R2 to R4 is not available.

7. Optional no 1A on demand and soft ramp start. Adding a connector from R9 to R4 softens the initial torque on ramp start on some applications, and also prevents 1A from picking up on demand.

GENERAL MAINTENANCE INSTRUCTIONS

The SCR control, like all electrical apparatus, does have some thermal losses. The semiconductor junctions have finite temperature limits above which these devices may be damaged. For these reasons, normal maintenance should guard against any action which will expose the components to excessive heat, such as steam cleaning; or which will reduce the heat dissipating ability of the control, such as restricting air flow.

The following DO'S and DON'TS should be observed:

- Any controls that will be used in ambients of 100 F (40 C) or over should be brought to the attention of the truck manufacturer.

- All external components having inductive coils must be filtered. Refer to vehicle manufacturer for specifications.

- The control should not be steam cleaned. In dusty areas, use low-pressure air to blow off the control. In oily or greasy areas, a mild solution of detergent or denatured alcohol can be used to wash off the control and then blow completely dry with low-pressure air. The control can also be cleaned with Freon TF† degreaser.

- For the SCR panel to be most effective, it must be mounted against the frame of the truck. The truck frame, acting as an additional heat sink, will give improved truck performance by keeping the SCR control package cooler. The use of a heat-transfer grease (Dow Corning 340) is recommended.

- Terminal boards and other exposed SCR control parts should be kept free of dirt and paint that might change the effective resistance between points.

  CAUTION: The truck should not be plugged when the truck is jacked up and the drive wheels are in a free wheeling position. The higher motor speeds can create excessive voltages that can be harmful to the control.

- Do not hipot (or megger) the control. Unless the terminals of each semiconductor and card are connected together, the control may be damaged. Refer to control manufacturer before hipotting.

- Use a lead-acid battery with the voltage and ampere hour rating specified for the vehicle. Follow normal battery maintenance procedures, recharging before 80 percent discharged and with periodic equalizing charges.

†Registered trademark of the E.I. duPont de Nemours & Company

TROUBLE-SHOOTING INSTRUCTIONS

The pulsing of the main SCR is too fast for conventional instruments to measure. When the control is functioning properly, a low hum can be heard.

Malfunctions of the SCR will generally fall into one of two categories. They are either no power (Table 1) or full power (Table 2), when operating in the SCR control range.

These simple and easy-to-follow tables outline the various symptoms and the corrective action to be taken.

The same device designations have been maintained on different controls but the wire numbers may vary. Refer to the elementary and wiring diagrams for your specific control. The wire numbers shown on the elementary diagram will have identical numbers on the corresponding wiring diagrams for a specific truck, but these numbers may be different from the numbers referenced in this publication.

WARNING: Before trouble-shooting, jack up wheels, disconnect the battery and discharge capacitor 1C. Reconnect the battery as needed for the specific check.

If capacitor 1C terminals are not accessible, discharge capacitor by connecting from SCR POS terminal to 2 REC anode. Check resistance on RX1000 scale from frame to SCR power and control terminals. A resistance of less than 20,000 ohms can cause misleading symptoms. Resistance less than 1000 ohms should be corrected first.

Before proceeding, visually check for loose wiring, maladjusted linkage to accelerator switch, signs of overheating of components, etc.

Tools and test equipment required are: (a) 6-volt lamp, 6-volt battery, two A14 diodes (1 Amp 400V), clip leads, volt-ohm meter (20,000 ohms per volt) and general hand tools, or (b) EV-1 System Analyzer, volt-ohm meter (20,000 ohms per volt) and general hand tools. If the system analyzer is used, refer to the analyzer instruction book.

Note: To test an EV-1 Model D, 1 REC, use a 12-volt battery and test lamp.

FUNCTION OF EV-1 CARD TERMINALS FOR IC3645OSC1E3 AND E4 CARDS

TERMINAL	DESCRIPTION (Voltage measurements with respect to negative, SCR power terminal.)	CONDITION	VOLTS NOMINAL	VOLTS THRESHOLD† E3	VOLTS THRESHOLD† E4
L1	Not presently used				
L2	Not presently used				
L3	Card power supply input must be low to satisfy PMT reset.	Key open Key closed	0 BV	4.1	4.1
L4	SRO Input. When used ignores open switch between L4 and L5.	Key or seat open Key and seat closed	0 BV		
L5	Accelerator Start and Brake switch input. Must be high after L3 and L7 are at battery volts for over 0.5 seconds and while L9 and L10 are low to complete SRO logic.	Key, seat, brake, or start open.	0		
		Key, seat, brake, and start closed.	BV		
		Key, seat, and direction closed.	0.07 BV (E3) 0.17 BV (E4)	4.1	18
		Key and seat closed, start and direction open.	0.9 BV (E3) 0.5 BV (E4)	4.1	18

†Threshold is the voltage ± approx. 5% below which the logic is the same as for zero volts.

TERMINAL	DESCRIPTION	CONDITION	VOLTS		
			NOMINAL	THRESHOLD †	
				E3	E4
L6	Motor current sensor output	No current	1.8		
		500 Amps average motor current model "B"	3.3		
L7	Seat switch input	Key open	0	8.2	19
		Key and seat closed.	BV		
L8	Not presently used				
L9	Direction switch input from positive side of "F" coil.	Key open	0		
		Key, seat, start, brake and direction "F" closed.	BV	8.2	19
L10	Direction switch input from positive side of "R" coil.	Key open	0		
		Key, seat, start, brake and direction "R" closed.	BV	8.2	19
R1	Card power supply	Key off	0		
		Key on	8.2		
R2	1A thermal holdoff control jumper to R4 to disable 1A thermal holdoff.	Key on, cold T/P	0		
		Key on, thermal cutback	0.66 or more		
R3	Output to PMT Driver	Key off	0 Volts		
		Key, seat, start, brake and direction selected. See Note 1.	5-10 milliamps		
R4	Common return to card for accelerator pot and 1A switch	Key off, use VOM and read from TBR4 to "Neg."	Less than 1 ohm		
R5	Accelerator pot input	Key on and accelerator at "creep".	3-4		
		Key on and accelerator at top speed.	0-.2		
R6	1A switch input	Key on, 1A switch open	8		
		Key on, 1A switch closed	0	2.0	2.0
R7	% ON time output. See Note 2.	Creep speed	2.2		
		Top speed	6.2		
R8	1A driver output	1A contactor open	0 Volts		
		Top SCR Speed. See Note 1.	5-10 milliamps		
R9	FW driver output	FW contactor open	0 Volts		
		1A closed high speed. See Note 1.	5-10 milliamps		
R10	Plugging output logic	Not plugging mode.	0 Volts		
		Plugging mode.	8 Volts		

NOTE 1: Connect milliammeter from terminal to R4. If contactor picks up during this test replace driver. If zero milliamps open lead and recheck to eliminate possible driver short from terminal 1 to 2.

NOTE 2: If B card is used, remove wire to R7 when checking voltage.

†Threshold is the voltage ± approx. 5% below which the logic is the same as for zero volts.

ALL TESTING SHOULD BE DONE WITH TRUCK JACKED UP.

TABLE 1
FAILURES WHICH CAUSE REDUCED OR NO MOTOR TORQUE WITH SCR CONTROL

Trouble-shooting is based on using the voltmeter to determine if the proper voltages are available to permit the control to operate properly. Refer to table pages 9 and 10 for theshold voltages. Check for leakage in switches if voltage is close to the threshold.

SYMPTOM	PROBABLE CAUSE
1A. Contactors do not pickup. No control voltage from positive to negative.	• Check power and control fuses. • Check battery for low specific gravity and connections for looseness or broken fittings.
1B. Contactors do not pickup. Control volts present from positive to negative with proper polarity.	• Plug in battery with Key switch OFF. Volts on L3 should be less than 4 volts. • Close Key switch. Check volts at T2 (pin 10). Should be about 50% of battery volts. Above 70% locks out 1 REC. (Control card contains a 10 K bridge from pin 5 to L3 and pin 6). If near battery volts, check for shorted 1A tips or a shorted 1 REC. If near zero volts, check for shorted 3 REC. (4G). • Close Brake, Start switches (all switches needed to close F or R contactor except the Direction switch). Volts on L3, L5, L7 should be battery volts. Volts on L9 and L10 should be near zero. Wait for one second, then close FORWARD Direction switch. Volts at L10 should remain near zero. Volts at L9 and L9 side of F coil should be battery volts. If not, check wiring and switches. • Connect milliammeter (10 ma scale) from R3 to R4. Should read 5-10 milliamps. If not, open Key switch, open lead from R3 to PMT driver, reclose all switches except Direction switch, wait over one second and close FORWARD Direction switch. If reading is not 5-10 milliamps, replace control card. If reading is good, the coil or wiring to the PMT driver is open or the PMT driver is defective. Check driver. (4E)
1C. Contactors close. NO power and NO SCR hum with accelerator in SCR range.	• Check volts at SCR positive. Should be battery volts. If not, check power fuse. • Check volts at T2. Should be zero. If not, check volts at S1, S2, A1, and A2 to locate open circuit.

SYMPTOM	PROBABLE CAUSE
1C. Contactors close. NO power and NO SCR hum with accelerator in SCR range. (Cont'd.)	• Check volts at R5. Should be 3-4 at creep reducing to 0.2 or less at top speed. If R5 remains about 4 volts, check accelerator. If R5 is zero, check volts at R1. Should be 8-8.5 volts. If R1 is above 10 or near zero and L3 is battery volts, replace control card and check PMT driver for short. (4E) • Check volts at R7. Should be 2-2.5 when Key switch closed. When F or R contactor is closed and accelerator depressed, should increase to about 6.2 volts. If remains near 2 volts, check volts at 1C (grey wire or 2 REC anode). If more than 0.125 BV, check if 2 REC will gate on. (4G) If less than 0.125 BV, check if 1 REC will gate on. (4G) Check current sensor green lead to card input pin 13. • Check 23 FIL for shorted resistor. • Replace control card. (4A)
1D. Contactors close. Little or no power. Normal SCR hum.	• Check 3 REC for open circuit. (4H) • Check 4 REC for short. (4H) • Check for open thermal protector. (4J)
1E. Contactors close. Little or no power. Abnormal SCR hum.	• Check 2 REC for short. (4G) • Check 5 REC for short. (4G) • Check 22 REC and 25 REC. (4M) **Note:** A 25 REC which checks good with an ohmmeter can cause a mis-operation of 5 REC under load, and can cause 1A to close on demand at lower than normal motor volts.
1F. Contactors close. Little power. No SCR hum.	• Check 1C for low resistance (4B).
1G. One contactor closes with normal operation but opposite contactor will not close.	• Close Key, Brake, Start switches (all switches needed to close F or R contactor except the direction switch.) Volts on L9 and L10 should be near zero. Wait for one second, then close Direction switch in the direction that contactor will not close. Volts at other direction input (L9 or L10) should remain near zero. Volts at non-closing direction (L9 or L10) and top of coil should be battery volts. If not, check wiring and switches. • Close switches as above. Check volts at negative side of coil or corresponding terminal of PMT driver. Zero volts indicates open coil, battery volts indicates open driver. (4E) • Replace control card. (4A)
1H. PMT trips after operating in 1A and acceleration is returned to SCR range.	• Check for cause of long 1A dropout time, i.e., defective 1A driver, low resistance in 1A filter, shorted turns in 1A coil, or low voltage coil.

TABLE 2

FAILURES WHICH CAUSE FULL MOTOR TORQUE WITH SCR CONTROL

SYMPTOM	PROBABLE CAUSE
2A. Contactors close. Full SCR speed immediately with audible hum. NO PMT trip.	• Key switch on. Check volts at R5. Should be 3-4 volts at creep position. If near zero, check Accelerator potentiometer. (4D) • Replace control card. (4A)
2B. Contactors close once or twice and then remain open. PMT trips.	• Check 5 REC for open circuit or open gate. (4G) • Check 1C for open and connections. (4B) • Check 1C for dead short. (4B) • Check 5 REC for short. • Check 2 REC for short. • Check 1X choke and transformer T3-T4. (4N) • Replace control card. (4A)
2C. Contactors close. Stall currents, under SCR operation, higher than normal and uncontrollable with C/L trimpot. Contactors may open once or twice and then remain open.	• Check current sensor yellow lead from negative end of sensor to card input pin 14. • Replace control card. (4A)

TABLE 3
MISOPERATION OF OTHER FEATURES

SYMPTOM	PROBABLE CAUSE
3A. 1A or FW contactors close with Key switch.	• Check drivers for short from terminals 2 to 3 by disconnecting wires to terminal 1 on the driver. (4E) • Check resistance from R4 to SCR negative. If not zero, the control card has been damaged, probably by a high-current input to R4 burning open a run on the card. Check for possible shorts and improper leads being connected to this terminal. Normally only the accelerator pot, 1A switch from R6, and B card use R4 as a negative. • Replace control card. (4A)
3B. F or R will close without returning Direction switch to OFF.	• Check location of L5. Any open switch between L5 and Direction switch will satisfy SRO. • Open lead from R3 to driver. Close switches normally used to close F or R. If F or R close, replace driver. • Reconnect lead from R3. Close Key switch only. Volts at L3 should be BV, volts at L5, L7, L9, L10 should be near zero. Close Seat, Brake and Direction switches. Volts at L7 should be BV. Volts at L5 should be about 0.07 BV (0.17 BV on E4 card). If near 4.1 volts, (18 on E4 card) check Start switch leakage. Close Start switch. If contactor picks up, replace control card. (4A)
3C. PMT does not open F or R contactor.	• Operate traction drive. Jumper R3 to R4. If contactor does not drop out, replace PMTD driver. • Operate traction motor in low speed SCR range. Be sure wheels are turning freely. Push 1A tips closed manually. F or R should open. If not, replace control card. (4A)
3D. 1A will not close at run (percent pickup).	• Connect a milliammeter from R8 to R4. Should read 5-10 milliamps when 1A should be closed. If near zero, see later steps for improper inputs or control card. Check volts at terminal 3 of 1A driver. Should be battery volts decreasing to about 2 volts when 1A should be closed. If near zero, check coil and wiring to terminal 3. If remains battery volts, check wiring from R8 to terminal 1 and terminal 2 to negative, then replace 1AD driver.

SYMPTOM	PROBABLE CAUSE
3D. 1A will not close at run (percent pickup). (Cont'd.)	• If milliamps from R8 to R4 are near zero when 1A should be closed, open lead from R8 to 1A driver and recheck. If now good, there is a wiring short to negative in the lead from R8 or defective driver. (4E) • Check volts at R7. Should be greater than 6 at top speed. If less than 5.7 volts, 1A will not close on demand. Check volts at R5, should reduce to less than 0.2 volts at top speed. If over 0.2 volts, check accelerator. If less than 0.2 volts, check that creep trimpot is not turned too far CCW. • Check continuity of violet wire from T2 to pin 10. • Replace control card. (4A)
3E. 1A will not close at SCR stall (time pickup). (Check truck diagram to see if 1A switch closes card circuit R4 to R6.)	• Check 1A switch circuit. Key switch on. Volts at R6 should drop to less than 2 volts when 1A switch is closed. • Check volts at orange lead to TP. If volts are above 1.6 (0.06 on OSC1A and OSC1B cards), control is in thermal cutback. Allow to cool, and recheck 1A function. • Turn 1A trimpot fully CCW and recheck. • Check continuity of violet wire from T2 to pin 10. • Replace control card. (4A)
3F. 1A will not open until start switch is opened.	• Check volts at R6. Should be near 8 volts when 1A switch is open. If not, check wiring and 1A switch.
3G. FW contactor will not close after 1A pickup.	• Check volts at R6. After 1A contactor closes, this point must be less than 2 volts. If not, check 1A switch and wiring. • Open lead to R9 and connect milliammeter from R9 to R4. When control signals FW to pick up, should read 5-10 milliamps. If remains at zero, turn FW PU trimpot fully CW and recheck. If remains zero, replace control card. (4A) If reads 5-10 ma, reset FW PU trimpot. (6)

SYMPTOM	PROBABLE CAUSE
3G. FW contactor will not close after 1A pickup. (Cont'd.)	• Reconnect lead to R9 and check volts at R9 when FW should pick up. If near 8 volts, check lead from R9 to terminal 1 of FW driver and R2 to negative for open, then replace driver. If about 2 volts, check volts at terminal 3 of FW driver. Should be battery volts dropping to 2 volts or less when FW should pick up. If volts are near zero, check wiring from positive to FW coil, FW coil, and wiring to terminal 3 of FW driver. If volts remain greater than four volts, replace driver.
3H. FW contactor will not drop out with increasing load.	• Check dropout setting on card. (6) • Replace control card. (4A)
3J. Stiff plug. Severe reversal.	• Check plug adjustment setting on card. (6) • Check 4 REC for open circuit. (4H) • Replace control card. (4A)
3K. Very soft reversal.	• Check plug adjustment setting on card. (6) • Replace control card. (4A)
3L. Blown power fuse. Very hot power cables.	• Check 3 REC for short. (4H) (Possible damage also to 1 REC and transformer module.)
3M. Hourmeter feeder faults:	
(1) Pump contactor closes when either F or R direction is selected.	• Diode shorted 3 to 4. (4H) Replace hourmeter block.
(2) One direction okay; opposite direction picks up *both* F and R.	• Diode shorted 1 to 4 *or* 2 to 4. (4H) Replace hourmeter block.
(3) Either direction selected picks up *both* F and R.	• Diode shorted 1 to 4 *and* 2 to 4. (4H) Replace hourmeter block.

TABLE 4
CHECKING COMPONENTS

4A. Main SCR Control Card

All trouble-shooting is written to check all outside devices and eliminate them as the source of symptoms. The conclusion being then that the card is faulty.

1. Instructions for Removal of Card
   a. Remove the four (4) screws shown in Fig. 9.
   b. Jack out the right- and left-hand terminal board, using a screwdriver in the slots, (leaving the wires intact) as shown in Fig. 10.
   c. Pry open the latches carefully with a screwdriver as shown in Fig. 11.
   d. Jack out the bottom plug with a screwdriver as shown in Fig. 12.

The card can be removed by hinging 10 degrees and pulling out, or, if panel components (not related to card hinge mountings) are to be replaced, disregard all instructions above except "C" and the card will hinge up to 90 degrees.

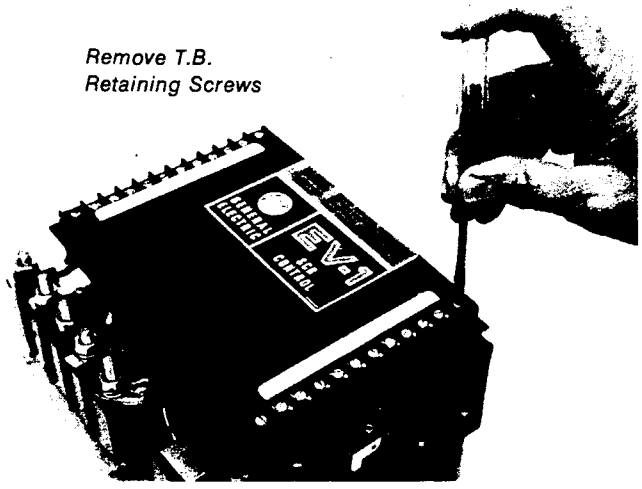


Fig. 9.

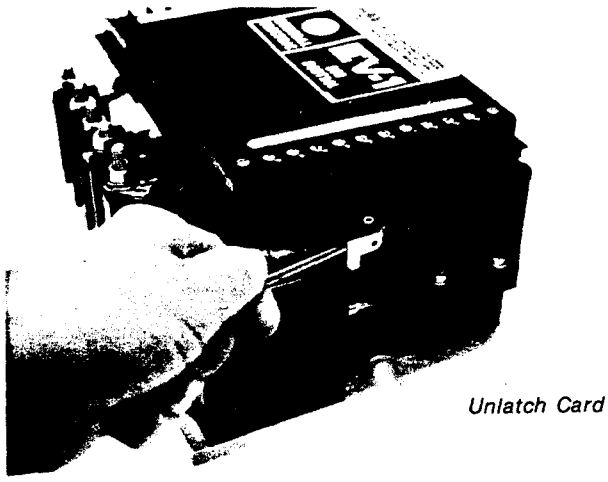


Fig. 11.

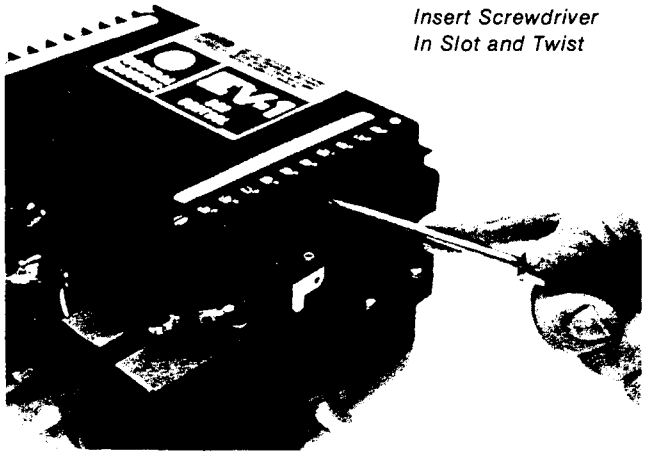


Fig. 10.

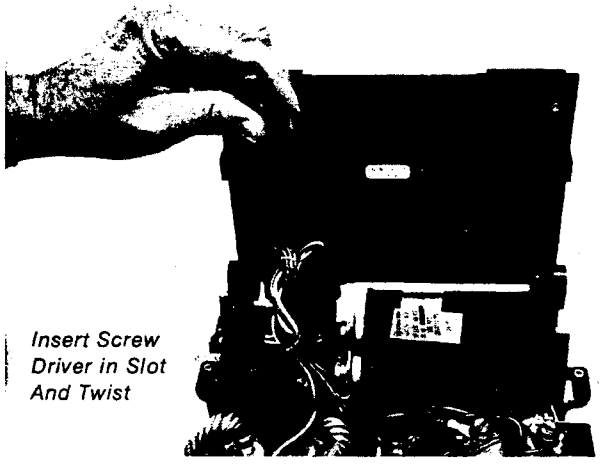


Fig. 12.

4B. Capacitor 1C

Disconnect battery and discharge capacitor. Measure ohms through the capacitor using the R x 10,000 scale. Meter should read zero and then swing slowly to above 100,000 ohms. Replace capacitor if above reading is not obtained.

4C. Contactors F, R, 1A, and P

75-ampere contactors (see GEH-3099)
150-ampere contactors (see GEH-4469)
300-ampere contactors (see GEH-4469)

NOTE 1. Control is arranged so that F and R do not break current. Check to see that 1A drops out ahead of F or R.

NOTE 2. Most contactor coils are polarity sensitive. The left-hand terminal must be connected to positive.

4D. Potentiometer in Accelerator

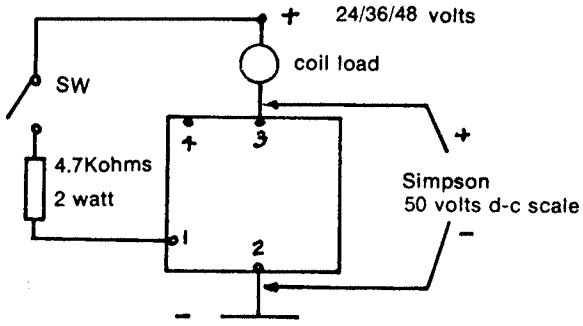
To check operation of the potentiometer, disconnect battery and disconnect wires at card terminal R4 and R5. Connect a VOM to wire removed with scale set to R x 100. With accelerator in creep speed position, the ohms reading should be 4800 to 6000 ohms. With accelerator in top speed position, reading should be 200 ohms or less. With wire disconnected as above, check for resistance of 1 megohm or higher from pot wires to truck frame.

4E. Driver Module

(IC3645CPM1RDA2 and IC3645CPMIRDB2)

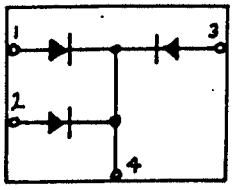
(a) Connect circuit as shown.
(b) Voltmeter should read battery volts with switch open.
(c) Close switch and meter reading should be 3 volts or less.
(d) Move load to terminal 4 and repeat steps (b) and (c).

NOTE: For 72 volt, use 8.2 Kohms 2-watt resistor.



4F. Hourmeter Module

Check individual diode circuits with trouble light or Simpson. (4H)



4G. SCRs (1 REC, 2 REC, 5 REC)

These are silicon control rectifiers. Before checking, disconnect battery and discharge capacitor 1C. Disconnect one power connection on the rectifier. Disconnect gate leads of SCRs at the card plug.

To check an SCR, it is necessary to have a 6-volt battery, a 6-volt lamp and 2 A-14 diodes.

NOTE: Models C and D require 12-volt battery and 12-volt lamp

Connect the positive lead to the anode (1), connect negative lead to the cathode (3) as shown in Figure 13.

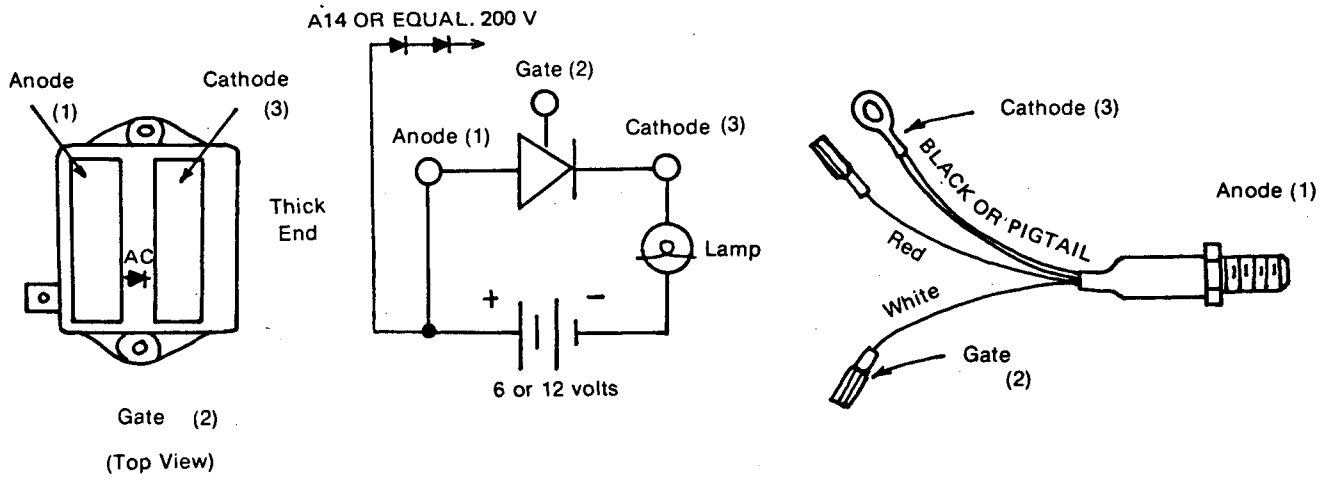


Fig. 13.

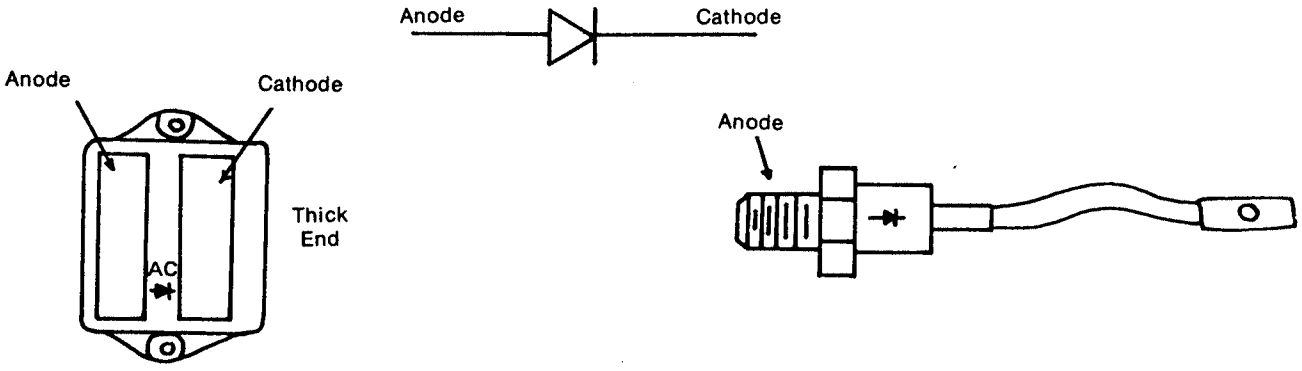
(a) The lamp should not light. If the lamp does light, the SCR is shorted and must be replaced.
(b) If check (a) was satisfactory, test the SCR for its ability to be turned on by the gate. Connect positive through two diodes to gate (point 2). If gate is operative, the lamp will come on and should remain on when the gate is removed. Some SCR's will operate correctly even if the lamp does not remain on, particularly with a weak battery.
(c) If lamp cannot be lit under step (b) the SCR is open and must be replaced.
(d) If the SCR is a stud-type device, check continuity between the red and black cathode leads.

NOTE: If you do not have a test light to check the SCRs as described above, they may be checked for shorts or opens by use of the VOM.
(1) Measure resistance from anode to cathode (R x 100 scale). If SCR is shorted (zero ohms), it must be replaced.
(2) Measure resistance from gate lead (white lead) to cathode and then from cathode to gate lead (R x 1 scale). If resistance reads either zero ohms (shorted) or infinity ohms (open), replace the SCR.
When reassembling SCRs, refer to TABLE 5.

4H. Rectifiers (3 REC, 4 REC, Diode Blocks)

When checking diodes, disconnect battery and discharge capacitor 1C to prevent burning out the ohmmeter. When replacing rectifiers, refer to TABLE 5. For 3 and 4 REC, disconnect one lead or

flexible connection. 3 and 4 REC are diodes with about 7 to 12 ohms in the conducting direction. (+ ——▶|—— −) measured on the R x 1 scale, and 10,000 ohms or higher, in the non-conducting direction (− ——▶|—— +) measured on the R x 10,000 scale.



4J. Thermal Protector (TP)

Remove both connections from TP and with a VOM read between 100 and 200 ohms terminal to terminal, if heat sink is at room temperature. Set VOM to highest ohm scale and check pins to heat sink, reading should be infinity.

4K. Filter Block (HF), 23 FIL, etc.

To check, disconnect all wires from filter block. With VOM on R x 10,000 scale, touch the lead to the filter terminals to charge the filter. After a few seconds, reverse the meter leads and touch the filter terminals. The VOM needle will deflect and return to infinity. If this capacitor action is not observed, replace the filter block.

4L. Filter Block — 23 RES, etc.

Should these filters fail, it will be evidenced visually by severe cracking.

4M. Filter Block — 22 REC, 25 REC.

The capacitor filter test, as in 4K, is valid for 22 REC and 25 REC only to detect an open or shorted filter. If control has symptoms as in 1E, interchange 22 REC and 25 REC and try again. If problem is corrected the old 25 REC is marginal. If problem is not corrected, replace both filters with known good filters.

4N. IX Choke — Transformer Secondary T3-T4

Refer to panel wiring diagrams, page 24 thru 27, to locate windings. With VOM on RX-1 scale, check choke winding or transformer secondary, reading should be zero ohms.

TABLE 5
REPLACEMENT OF EV-1 COMPONENTS

When replacing stud semiconductors such as 2, 3, 4, or 5 REC, it is not necessary to torque these devices to a specific value. However, the device should be screwed into the heat sink and tightened to a snug fit. SCR gates, not screw connected, terminate inside card plug. Remove card connector for access to stab terminals.

The use of a heat-transfer grease (such as GE Versilube G-350-M or equivalent) is recommended.

5A. When replacing module semiconductors such as 1 REC (Models A and B), 1 REC and 3 REC (Model C), and 1 REC, 2 REC and 3 REC (Model D):

(1) Remove all module connections.
(2) Remove module by backing out the two screws at the device sides.
(3) If a 1 REC, remove the thermal protector.
(4) Clean the insulator surface with a clean rag and isopropyl alcohol.
(5) Inspect insulator surface for tears or cracks. If defective, replace. Wipe a light layer of machine oil on base and smooth insulator into position.
(6) Coat insulator with a light coat of heat-transfer grease similar to GE-350.
(7) Install thermal protector in new module. Tighten until snug.
(8) Set new module on insulation and start screws back into the base. Be sure to use original screws and washers. Run screws in to "finger tight."
Check to see the bottom of the heat sink is flat against the insulator.
Alternately tighten the two screws by 1/4 turn until firm.
(9) Replace all connections removed in Step 1.

5B. Capacitor (EV-1A and B)

(1) Remove card completely.
(2) Remove card box right support.
(3) Remove nuts from capacitor connections and slide capacitor to the right.
(4) Reverse procedure to install new capacitor.

5C. 22 REC and 25 REC, 23 FIL (Models C and D)

When replacing these devices, use original hardware in the same holes, as the inserts are used for electrical connections to the transformer.

5D. Transformer/Choke

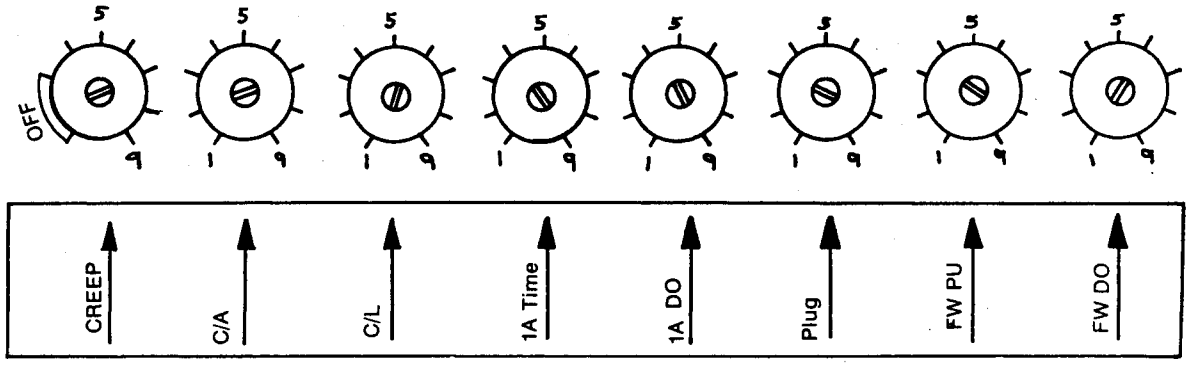
(1) Remove card box and card supports.
(2) Remove capacitor (Models A and B).
(3) Disconnect all transformer leads.
(4) Remove 2 REC, 5 REC, and snubbers as needed.
(5) Remove 4 mounting bolts and lift transformer free.
(6) Reverse procedure to reassemble.

TABLE 6
TUNEUP FOR NEW OR MISTUNED CARD 1

Panels are factory adjusted for a particular motor and truck and should not need adjustment. The card is supplied with single turn potentiometer with internal stops and the box is marked with "dial" setting.

The truck manufacturer should supply the "combination" setting for the particular model truck. The following is for explanation only and should not be used for setting your control:

Creep 7, C/A 7, C/L 5-1/2, 1A Time 4, 1A DO 9, Plug 8, FW PU 3-1/2, FW DO 6

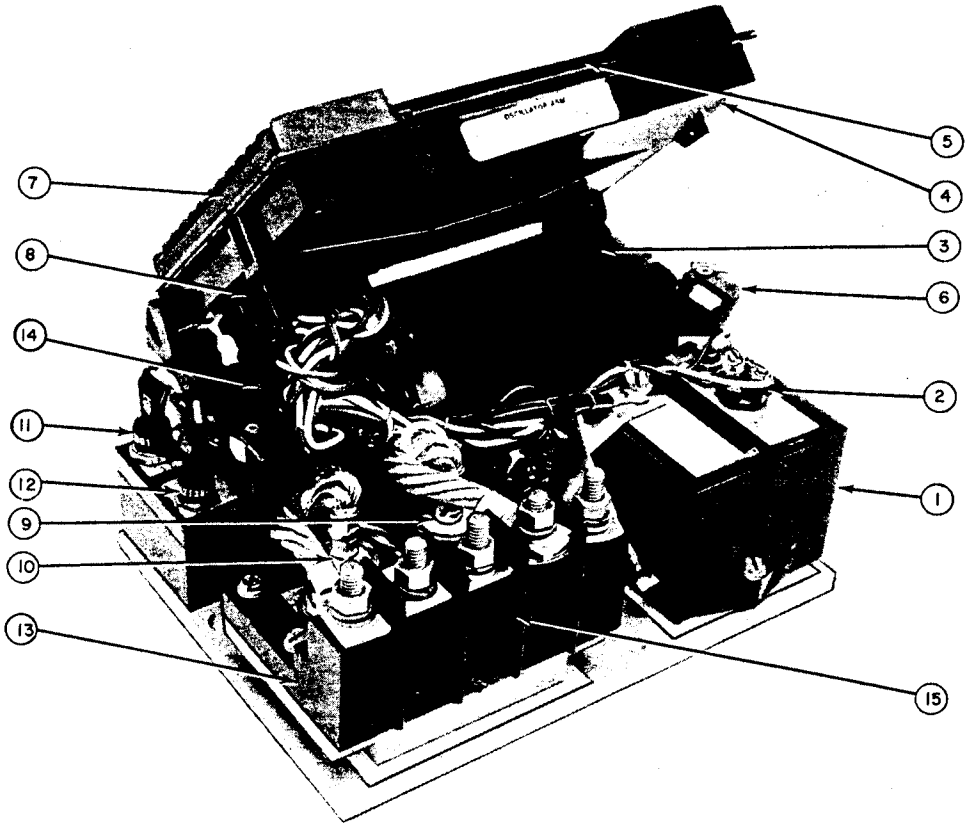


With a new card, turn all pots fully CCW to "1". Then set each pot to the setting for the particular truck.

Turning pots CW increases the particular function (i.e., CW adjustment increases creep speed, acceleration rate [C/A Pot], C/L, 1A Time, 1A DO, stiffness of plug, FW PU, FW DO).

TYPICAL PHYSICAL ARRANGEMENT AND IDENTIFICATION OF COMPONENTS

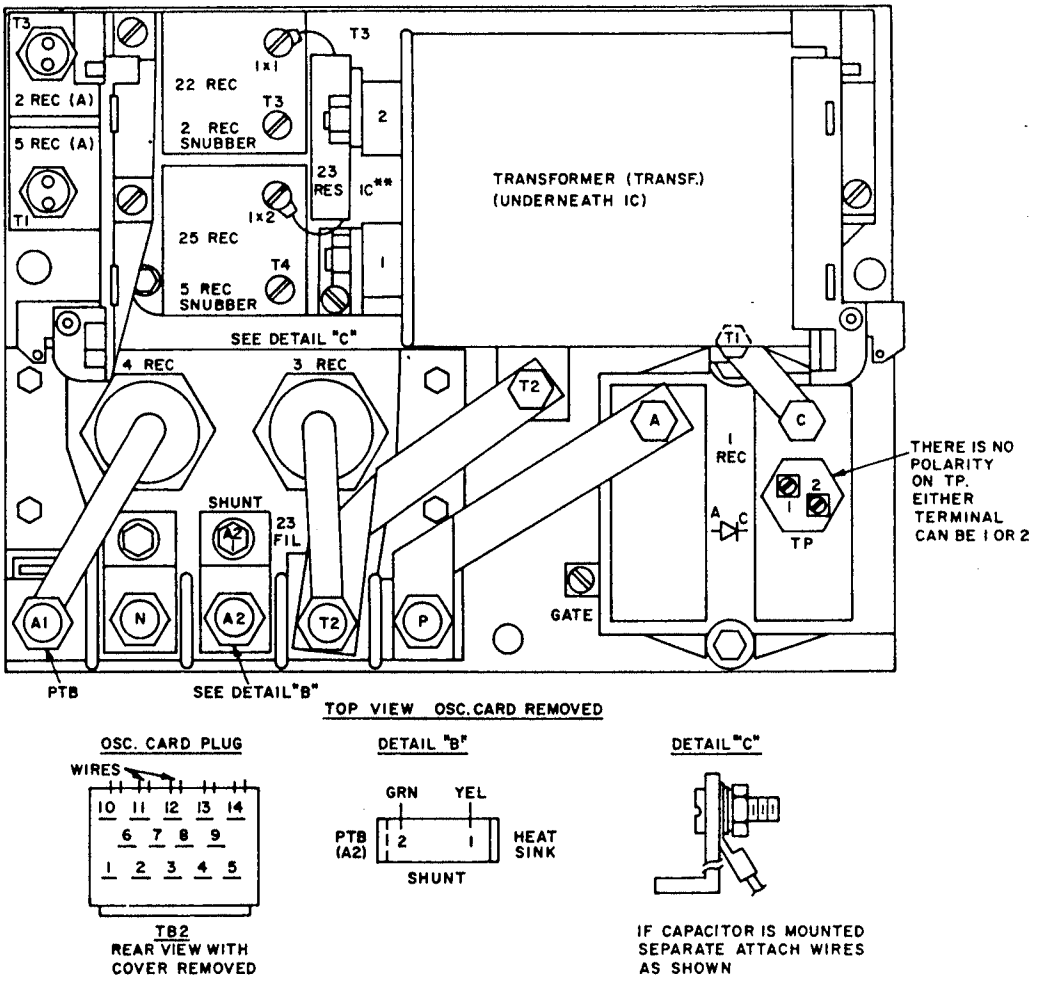
(Refer to wiring diagram furnished with truck for precise arrangement of components.)



(1) Main SCR (1 REC)
(2) Thermal Protector
(3) Commutating Capacitor
(4) Oscillator Card
(5) Card Adjustments
(6) Quick Card Release
(7) Card Connection Block
(8) Card Connector
(9) Flyback Diode (3 REC)
(10) Plugging Diode (4 REC)
(11) Turn-off SCR (2 REC)
(12) Charging SCR (5 REC)
(13) Power Connections
(14) Filters for 2 and 5 REC
(15) Motor Current Sensor
(Located behind middle power connector)

Transformer and choke (1X) located in encapsulated block under capacitor. 3 REC filter (23 FIL) located under pigtail of the diode.

Fig. 14. Typical EV-1 SCR panel (Model A or B)



	WIRE TABLE					
	WIRE NO. OR SIZE	WIRE COLOR	FROM DEVICE	FROM TERM	TO DEVICE	TO TERM
	BUS		TRANSF	T1	1 REC	C
	BUS		PTB	P	1 REC	A
	BUS		PTB	T2	T	T2
	#10	BLK	1 REC	A	1C **	1
	2 REC LEAD	BLK	2 REC	C	22 REC	1X1
	5 REC LEAD	BLK	5 REC	C	25 REC	T4
TWIST	SHUNT LEAD	YEL	SHUNT	2	TB2	14
TWIST	SHUNT LEAD	GRN	SHUNT	1	TB2	13
	#22	BLU	PTB	A2:1	TB2	6
TWIST	#22	BRN	TP	1	TB2	11
TWIST	#22	ORN	TP	2	TB2	12
TWIST	2 REC LEAD	RED	2 REC	C	TB2	9
TWIST	2 REC LEAD	WHT	2 REC	GATE	TB2	8
	#22	GRY	1C**	2	TB2	7
	#22	VIO	1	T2	TB2	10
	#22	BLK	1 REC	C	TB2	5
TWIST	#22	WHT/BLK	1 REC	GATE	TB2	4
TWIST	5 REC LEAD	RED	5 REC	C	TB2	3
TWIST	5 REC LEAD	WHT	5 REC	G	TB2	2
	#22	WHT/RED	1C**	1	TB2	1

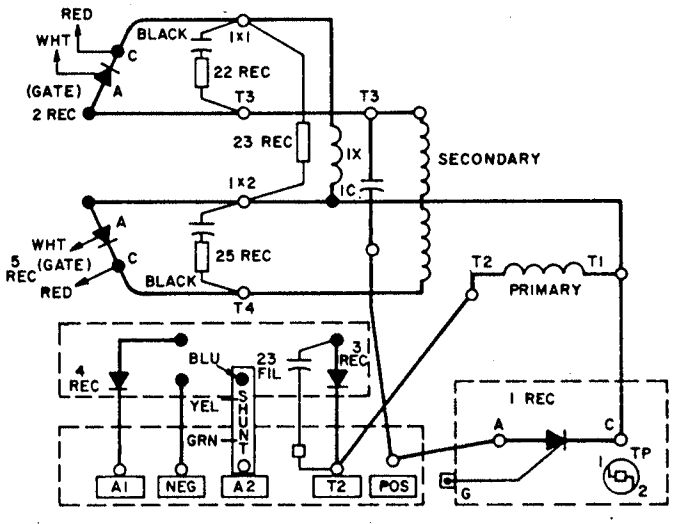
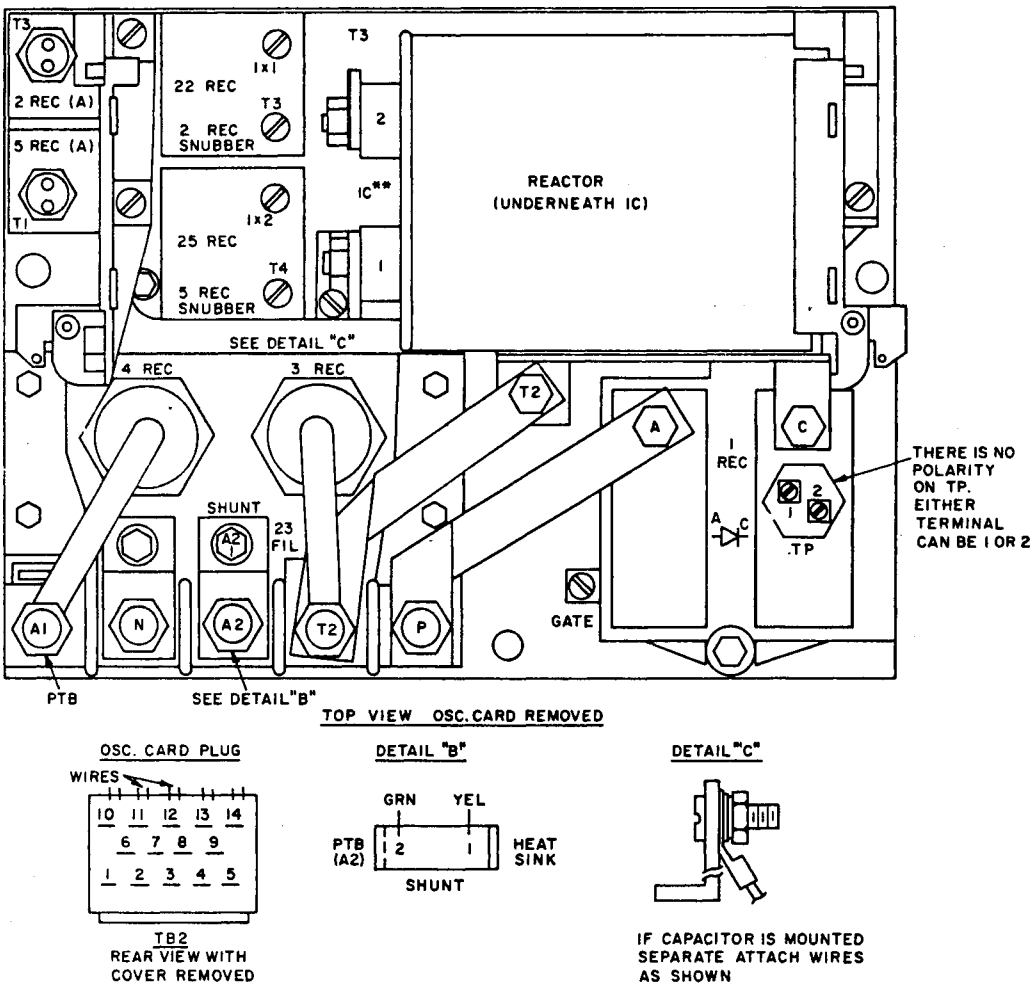


Fig. 15. Model A and B wiring diagram (transformer)



**REFER TO DETAIL "C" FOR TERMINATION OF WIRES WHEN CAPACITOR IC IS MOUNTED SEPARATE TO SCR.

	WIRE TABLE					
	WIRE NO. OR SIZE	WIRE COLOR	FROM DEVICE	FROM TERM	TO DEVICE	TO TERM
	BUS		REACTOR	T1	1 REC	C
	BUS		PTB	P	1 REC	A
	BUS		PTB	T2	T	T2
	#10	BLK	1 REC	A	1C**	1
	2 REC LEAD	BLK	2 REC	C	22 REC	1X1
	5 REC LEAD	BLK	5 REC	C	25 REC	T4
	SHUNT LEAD	YEL	SHUNT	2	TB2	14
TWIST	SHUNT LEAD	GRN	SHUNT	1	TB2	13
	#22	BLU	PTB	A2-1	TB2	6
	#22	BRN	TP	1	TB2	11
TWIST	#22	ORN	TP	2	TB2	12
	2 REC LEAD	RED	2 REC	C	TB2	9
TWIST	2 REC LEAD	WHT	2 REC	GATE	TB2	8
	#22	GRY	1C**	2	TB2	7
	#22	VIO	1	T2	TB2	10
	#22	BLK	1 REC	C	TB2	5
TWIST	#22	WHT/BLK	1 REC	GATE	TB2	4
	5 REC LEAD	RED	5 REC	C	TB2	3
TWIST	5 REC LEAD	WHT	5 REC	G	TB2	2
	#22	WHT/RED	1C**	1	TB2	1

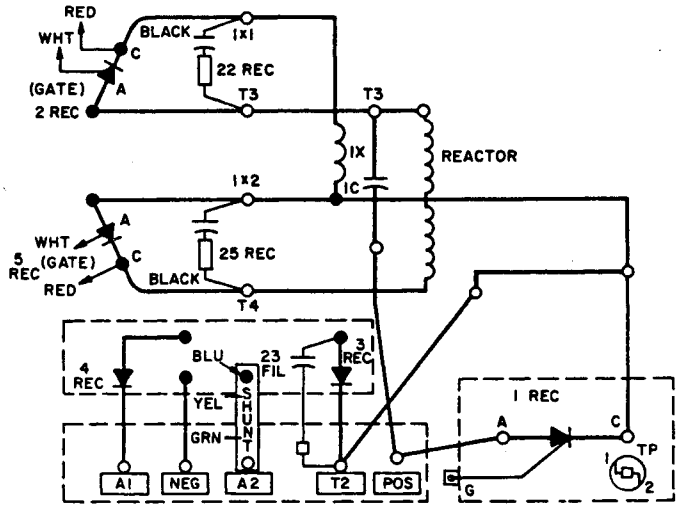
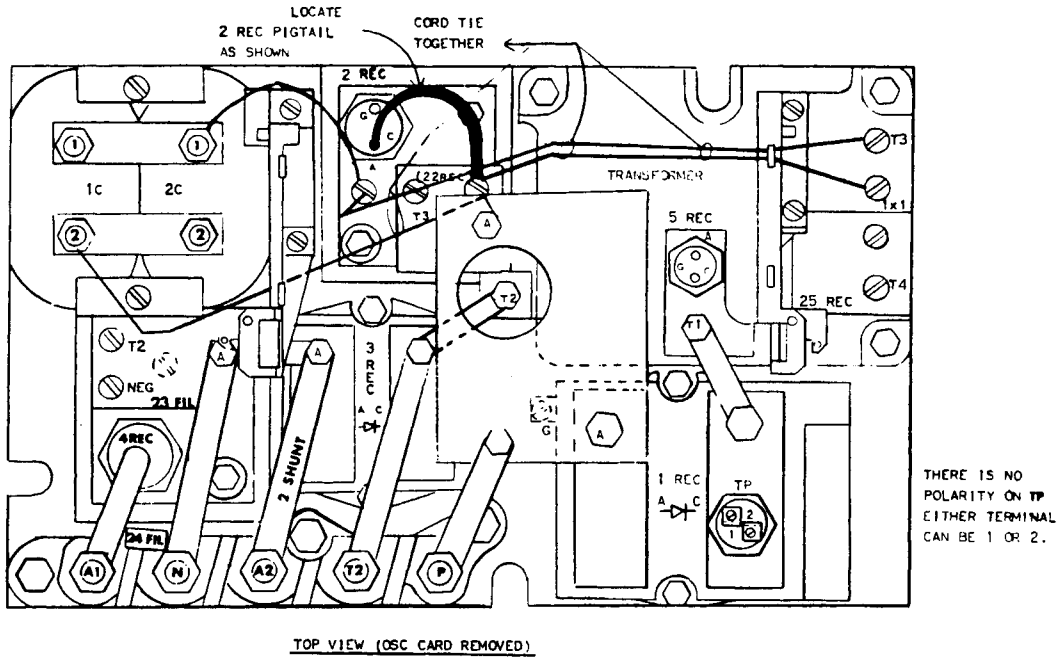
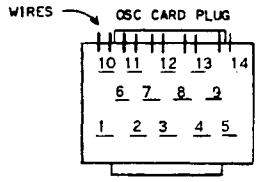


Fig. 16. Model A and B wiring diagram (reactor)



TOP VIEW (OSC CARD REMOVED)



TB2
REAR VIEW WITH
COVER REMOVED

WIRE TABLE

	WIRE NO. OR SIZE	WIRE COLOR	FROM DEVICE	FROM TERM	TO DEVICE	TO TERM
	BUS		4 REC	A	3 REC	A
	BUS		PTB	T2	3 REC	C
	BUS		4 REC	A	PTB	N
	BUS		1 REC	C	T	T1
	BUS		1 REC	A	PTB	P
	BUS		3 REC	C	T	T2
ROUTE AS SHOWN ABOVE *	#8	BLK	22 REC	1X1	T	1X1
ROUTE AS SHOWN ABOVE *	#8	BLK	2 REC	A	T	T3
ROUTE AS SHOWN ABOVE *	#8	BLK	2 REC	A	2C	1
ROUTE AS SHOWN ABOVE *	#8	BLK	1 REC	A	2C	2
	4 REC LEAD		4 REC	C	PTB	A1
	2 REC LEAD		2 REC	C	22 REC	1X1
	5 REC LEAD		5 REC	C	22 REC	T4
TWIST	SHUNT LEAD	YEL	SHT	2	TB2	14
TWIST	SHUNT LEAD	GRN	SHT	1	TB2	13
	#22	BLU	3 REC	A	TB2	6
TWIST	#22	ORN	THY	2	TB2	12
TWIST	#22	BRN	THY	1	TB2	11
	#22	VIO	3 REC	C	TB2	10
TWIST	2 REC LEAD	RED	2 REC	C	TB2	9
TWIST	2 REC LEAD	WHT	2 REC	G	TB2	8
	#22	GRY	2C	1	TB2	7
TWIST	#22	BLK	1 REC	C	TB2	5
TWIST	#22	WHT/BLK	1 REC	G	TB2	4
TWIST	5 REC LEAD	RED	5 REC	C	TB2	3
TWIST	5 REC LEAD	WHT	5 REC	G	TB2	2
	#22	WHT/RED	1C	2	TB2	1
	#22	WHT/GRN	23 FIL	T2	3 REC	C

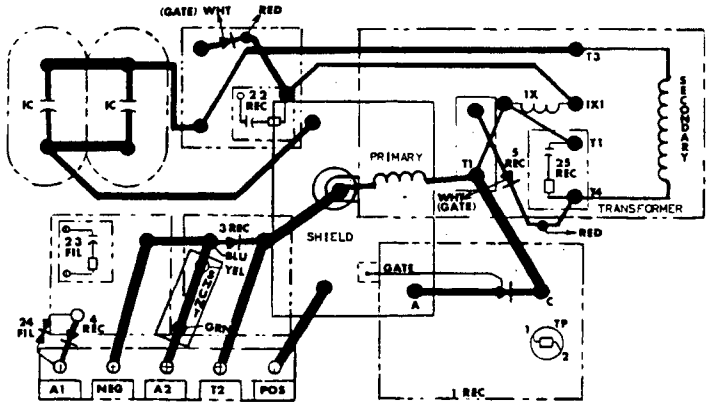
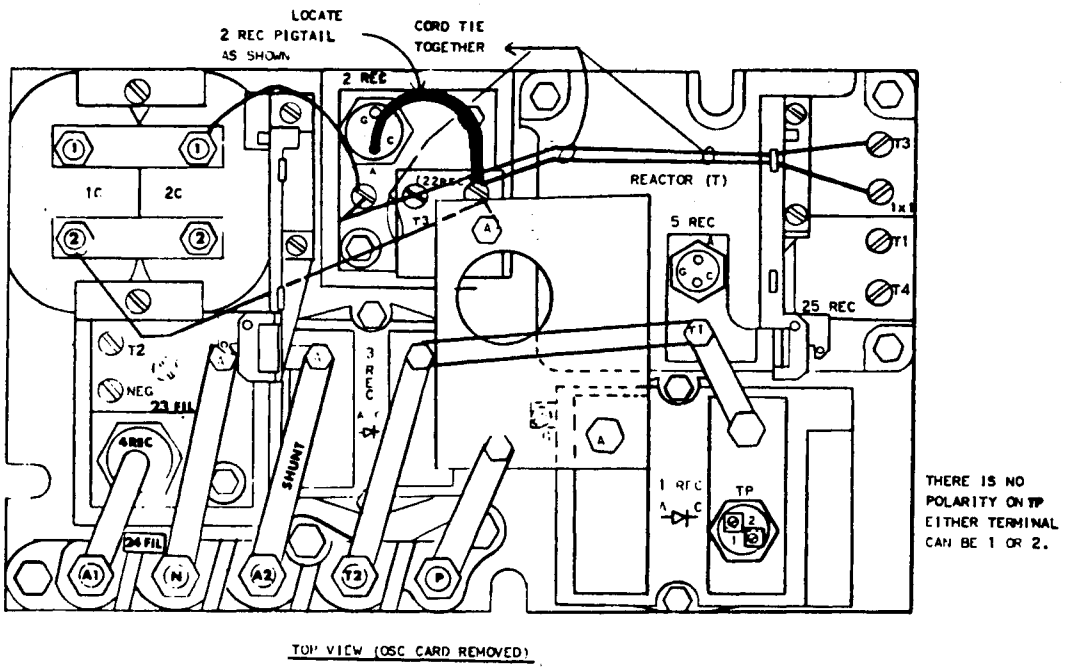
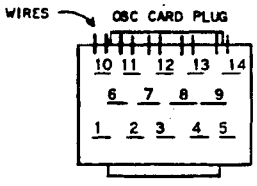


Fig. 17. Model C wiring diagram (transformer)



TOP VIEW (OSC CARD REMOVED)



TB2
REAR VIEW WITH
COVER REMOVED

WIRE TABLE

	WIRE NO. OR SIZE	WIRE COLOR	FROM DEVICE	FROM TERM	TO DEVICE	TO TERM
	BUS		4 REC	A	3 REC	A
	BUS		PTB	T2	3 REC	C
	BUS		4 REC	A	PTB	N
	BUS		1 REC	C	T	T1
	BUS		1 REC	A	PTB	P
	BUS		3 REC	C	T	T1
ROUTE AS SHOWN ABOVE.	#8	BLK	22 REC	1X1	T	1X1
	#8	BLK	2 REC	A	T	T3
	#8	BLK	2 REC	A	2C	1
	#8	BLK	1 REC	A	2C	2
	4 REC LEAD		4 REC	C	PTB	A1
	2 REC LEAD		2 REC	C	22 REC	1X1
	5 REC LEAD		5 REC	C	22 REC	T4
TWIST	SHUNT LEAD	YEL	SHT	2	TB2	14
	SHUNT LEAD	GRN	SHT	1	TB2	13
	#22	BLU	3 REC	A	TB2	6
TWIST	#22	ORN	THY	2	TB2	12
	#22	BRN	THY	1	TB2	11
	#22	VIO	3 REC	C	TB2	10
TWIST	2 REC LEAD	RED	2 REC	C	TB2	9
	2 REC LEAD	WHT	2 REC	G	TB2	8
	#22	GRY	2C	1	TB2	7
TWIST	#22	BLK	1 REC	C	TB2	5
	#22	WHT/BLK	1 REC	G	TB2	4
TWIST	5 REC LEAD	RED	5 REC	C	TB2	3
	5 REC LEAD	WHT	5 REC	G	TB2	2
	#22	WHT/RED	1C	2	TB2	1
	#22	WHT/GRN	23 FIL	T2	3 REC	C

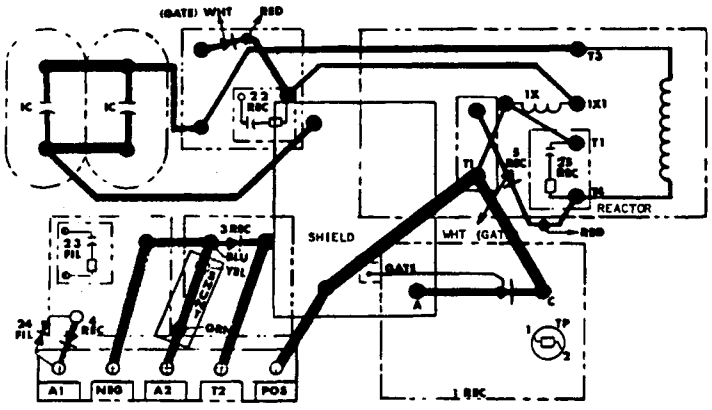
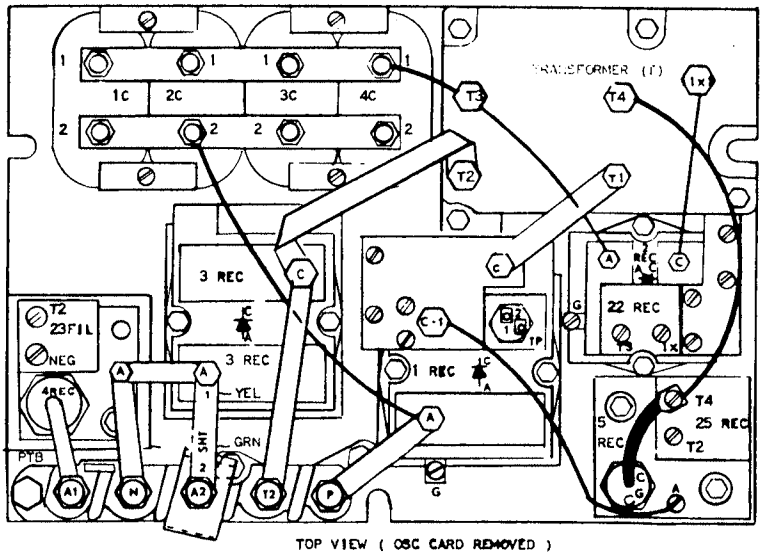
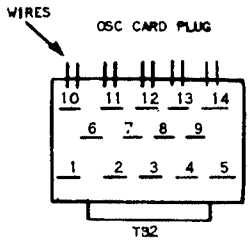


Fig. 18. Model C wiring diagram (reactor)



TOP VIEW (OSC CARD REMOVED)

NOTE-
THERE IS NO POLARITY ON THERMAL PROTECTOR (TP). EITHER TERMINAL CAN BE 1 OR 2.



REAR VIEW WITH COVER REMOVED

WIRE TABLE

	WIRE NO.	COLOR NO. LENGTH ***	FROM DEVICE	FROM TERM	TO DEVICE	TO TERM
ROUTE AS SHOWN	#6	5" LONG	2 REC	C	T	1X1
	#4	3 1/4" LONG	T	T3	4C	1
	#6	5" LONG	T	T3	2 REC	A
	#6	9" LONG	25 REC	T4	T	T4
	#6	7 3/4" LONG	5 REC	A	1 REC	C-1
	#4	9 3/4" LONG	1 REC	A	2C	2
	4 REC LEAD		4 REC	C	PTB	A1
	5 REC LEAD		5 REC	C	25 REC	T4
TWIST	SHUNT LEAD	YEL	SHT	2	TB2	14
	SHUNT LEAD	GRN	SHT	1	TB2	13
	#22	BLU	3 REC	A	TB2	6
TWIST	#22	ORN	THY	2	TB2	12
	#22	BRN	THY	1	TB2	11
	#22	VIO	3 REC	C	TB2	10
TWIST	2 REC LEAD	RED	2 REC	C	TB2	9
	2 REC LEAD	WHT	2 REC	G	TB2	8
	#22	GRY	4C	1	TB2	7
TWIST	#22	BLK	1 REC	C	TB2	5
	#22	WHT/BLK	1 REC	G	TB2	4
TWIST	5 REC LEAD	RED	5 REC	C	TB2	3
	5 REC LEAD	WHT	5 REC	G	TB2	2
	#22	WHT/RED	2C	2	TB2	1
	#22	WHT/GRN	23 FIL	T2	3 REC	C
	BUS		4 REC	A	PTB	N
	BUS		4 REC	A	3 REC	A
	BUS		3 REC	C	PTB	T2
	BUS		1 REC	A	PTB	P
	BUS		3 REC	C	T	T2
	BUS		1 REC	C	T	T1

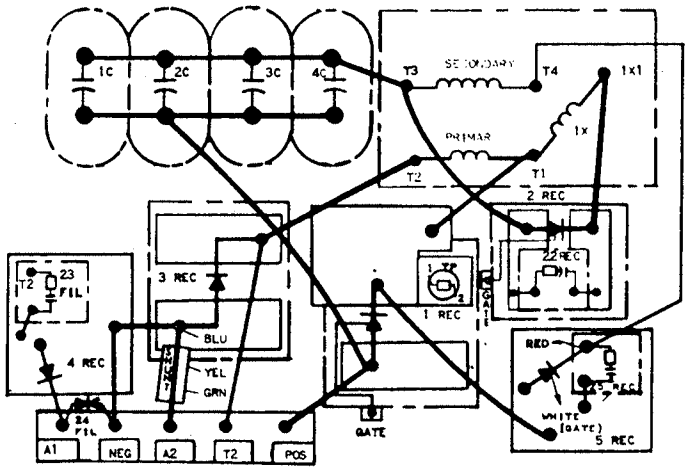
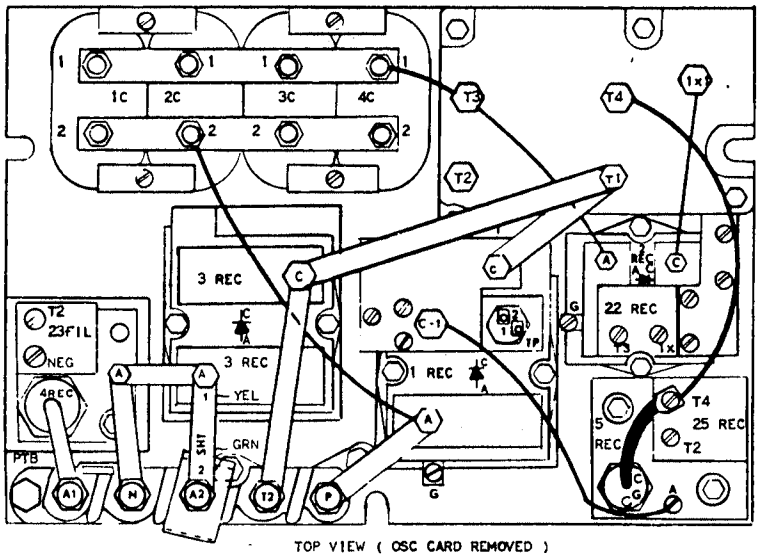
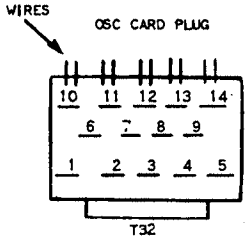


Fig. 19. Model D wiring diagram (transformer)



TOP VIEW (OSC CARD REMOVED)

NOTE:
THERE IS NO POLARITY ON THERMAL PROTECTOR (TP). EITHER TERMINAL CAN BE 1 OR 2.



REAR VIEW WITH COVER REMOVED

WIRE TABLE

	WIRE NO.	COLOR NO. LENGTH ***	FROM DEVICE	FROM TERM	TO DEVICE	TO TERM
ROUTE AS SHOWN	#6	5" LONG	2 REC	C	T	1X1
	#4	3 1/4" LONG	T	T3	4C	1
	#6	5" LONG	T	T3	2 REC	A
	#6	9" LONG	25 REC	T4	T	T4
	#6	7 3/4" LONG	5 REC	A	1 REC	C-1
	#4	9 3/4" LONG	1 REC	A	2C	2
	4 REC LEAD		4 REC	C	PTB	A1
	5 REC LEAD		5 REC	C	25 REC	T4
TWIST	SHUNT LEAD	YEL	SHT	2	TB2	14
	SHUNT LEAD	GRN	SHT	1	TB2	13
	#22	BLU	3 REC	A	TB2	6
TWIST	#22	ORN	THY	2	TB2	12
	#22	BRN	THY	1	TB2	11
	#22	VIO	3 REC	C	TB2	10
TWIST	2 REC LEAD	RED	2 REC	C	TB2	9
	2 REC LEAD	WHT	2 REC	G	TB2	8
	#22	GRY	4C	1	TB2	7
TWIST	#22	BLK	1 REC	C	TB2	5
	#22	WHT/BLK	1 REC	G	TB2	4
TWIST	5 REC LEAD	RED	5 REC	C	TB2	3
	5 REC LEAD	WHT	5 REC	G	TB2	2
	#22	WHT/RED	2C	2	TB2	1
	#22	WHT/GRN	23 FIL	T2	3 REC	C
	BUS		4 REC	A	PTB	N
	BUS		4 REC	A	3 REC	A
	BUS		3 REC	C	T	T1
	BUS		1 REC	A	PTB	P
	BUS		3 REC	C	PTB	T2
	BUS		1 REC	C	T	T1

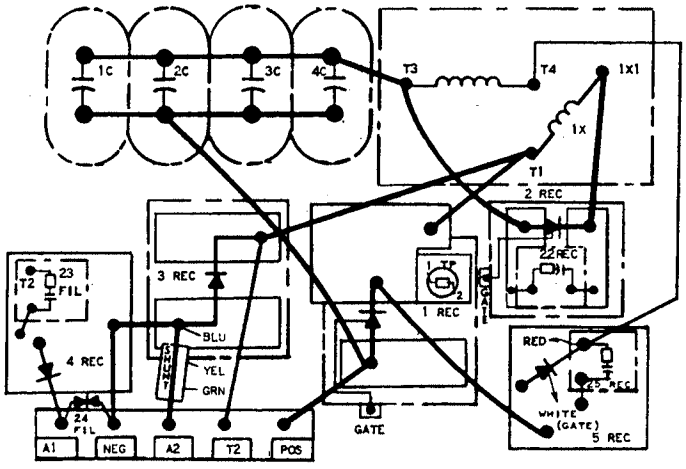


Fig. 20. Model D wiring diagram (reactor)

GENERAL ELECTRIC COMPANY, U.S.A.
INDUSTRIAL CONTROL DEPARTMENT
CHARLOTTESVILLE, VA 22901

GENERAL ELECTRIC

P(7-80)

SECTION 2
Page 1

M O D U L E S E T T I N G S B Y V E H I C L E

EHICLE ODEL	MOTOR HP @ 36 2/1.5	3.5/2.25	24V 5/3.5	BATT VOLT 24	36	48	CONT MODULE EV-1A	EV-1B	CONTACTOR PANEL 75A	150A	EV-1 SCR CONTROL CREEP	C/A	C/L	MODULE SETTINGS 1A TIME	1A DO	PLUG	FW PU	FW DO
2-48	X				X		X		X		7	3	9	7	2-1/2	7-1/2	5	5
2-48		X			X				X		6	5	9	3	3	7	5	5
2-54			X		X			X		X	6	4.5	9	4	2.5	5	5	5
2-56			X		X			X		X	6	5	9	5	3.5	5	5	4
4-51		X		X			X		X		8	3	9	7	3	4	5	5
4-53			X		X			X		X	7	5	9	5	3.8	5	5	5
4-53		X			X		X		X		6	5	9	3	3	5	5	5
4-57			X		X			X		X	7	5	9	5	3.8	5	5	5
4-57		X			X		X		X		6	5	9	3	3	5	5	5
2-49			X		X			X		X	5.5	5	9	5	3.8	4.4	5	5
2-50			X		X			X		X	5.5	5	9	5	3.8	4.4	5	5

SECTION 3
Page 1

GENERAL ELECTRIC SERVICE INFORMATION BULLETIN

GENERAL ELECTRIC EV-1™ SCR CONTROL

SERVICE INFORMATION

Subject: EV-1 Card Damage

Number: 80-1 Date: 5/14/80

As the number of EV-1 controls in use grows, so do the variety of application and maintenance procedures. This letter will list five specific situations which could cause damage to the EV-1 oscillator card. In all of these cases, the card should be replaced, the symptom confirmed and the cause eliminated.

1. Inadvertently apply battery positive to the R6 terminal of the oscillator card with the 1A switch open. This can easily be done by incorrect wiring of the 1A switch versus the start switch. The will cause internal damage to the card.

   The SYMPTOM that would surface in this case is the bypass (1A) function will not operate.

2. Inadvertently apply battery positive to R4 or R5 or R6 terminals of the oscillator card with the 1A switch closed and/or the accelerator pot in the top speed position (min. ohms). This will cause internal damage to the card or the 15 amp control fuse will blow.

   The SYMPTOM that will surface is the 1A/FW contactors pick up when the key switch is closed. If the control fuse opened, then the control will be inoperative.

3. Apply hi-pot voltage (500-1300 volts AC) with as low as 20 milliamps current draw to L3 on the EV-1 oscillator card. This is accomplished by Hi-Potting the vehicle with the oscillator plugged in and an existing short in the control circuit or the truck frame. Realize, that any short to frame in any of the control switches or wiring will cause this problem if the vehicle is Hi-Potted.

   Certain components on the card will be damaged and also possibly the 5REC, 2REC, 1REC and 3REC.

   The SYMPTOM in the case of damage to the 1, 2 or 5 REC's will be no output to the PMT driver and, therefore, no pickup of the Forward and Reverse contactor. If the 3REC is damaged, the power fuse should blow.

   Should this situation occur (after Hi-Potting), the short should be eliminated. EV-1 controls are rated to withstand hi-pot voltages of 1300 volts A.C. The truck (or control) may be hi-potted without damage to the control, if the attached procedure on hi-potting is followed.

4. Forgetting to connect the 14 pin connector in the rear of the oscillator card and applying power will damage certain card components.

   The SYMPTOM in this case will be no 1A function.

SECTION 3
Page 2

5. Probably the most common of these five situations, plugging a working battery charger into the control and closing the key switch will damage the EV-1 card through terminal L3.

   The SYMPTOM in this case is that the truck will not run and in many cases, the situation will be obvious as much smoke and fumes will be evident.

   If the truck doesn't run with no visual evidence of card damage, confirm this situation by checking voltage at card terminal R1 (with respect to battery negative) and the key switch closed. Damage caused by a battery charger will cause a reading of 0 volts at this point.

   The portion of the card damaged in this case is the power supply.

   Other printed circuit cards such as the Battery Discharge Indicator can be damaged also.

   Attached find a sketch of a suggested modification that can be made in order to prevent plugging the charger into the control.

It should be noted that all five of these conditions may invalidate warranty considerations.

Cosmo Mirra

Joe Nash

/gm

SECTION 3
Page 3

GENERAL ELECTRIC

EV-1 HIGH POTTING PRECAUTIONS

A. Protect the SCR panel components from ground fault paths by the following procedure:

1) Short all five SCR power terminals together; A1-NEG-A2-T2-POS
2) Short capacitor terminals together
3) Remove main control card and accessory cards

NOTE: It is important to remember that the practice of shorting SCR terminals/ capacitor and removing oscillator card is done to protect electronic components should a hi-pot failure exist anywhere on the truck.

B. Hi-pot positive and negative to frame using a hi-pot tester with 15 milliamps or better current capacity.

Hi-pot current draw can be broken down in three paths:

1) 3.5 to 5 MA is the typical draw for EV-1 SCR panel. The larger the panel size, the greater the current draw.
2) Current draw in a traction motor normally is in the 4 to 5 MA range.
3) The remainder of truck will make up the rest of current draw.

Clear any faults and continue testing until circuit will hold up hi-pot voltage in test B above.

C. This procedure is suitable for preparation for the U.L. dielectric test.

D. Warranty is voided unless this procedure is followed.

SECTION 3
Page 4

TITLE

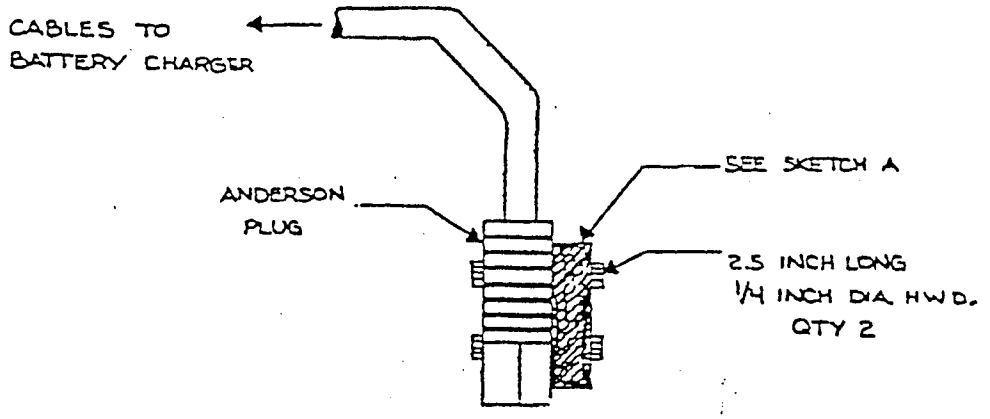
CONT ON SHEET FL. SH NO. 1

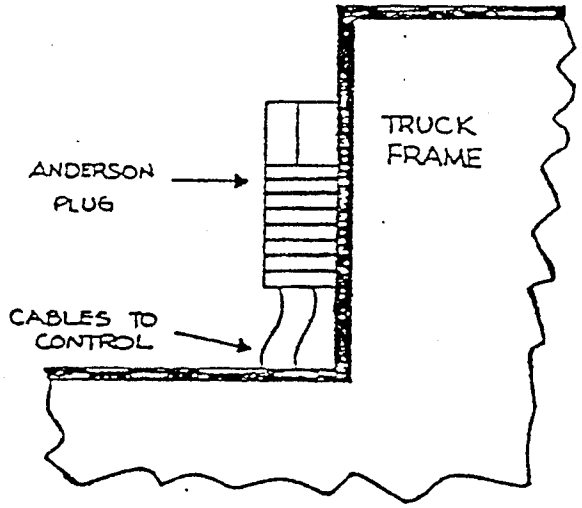
SKJMD82179-A1

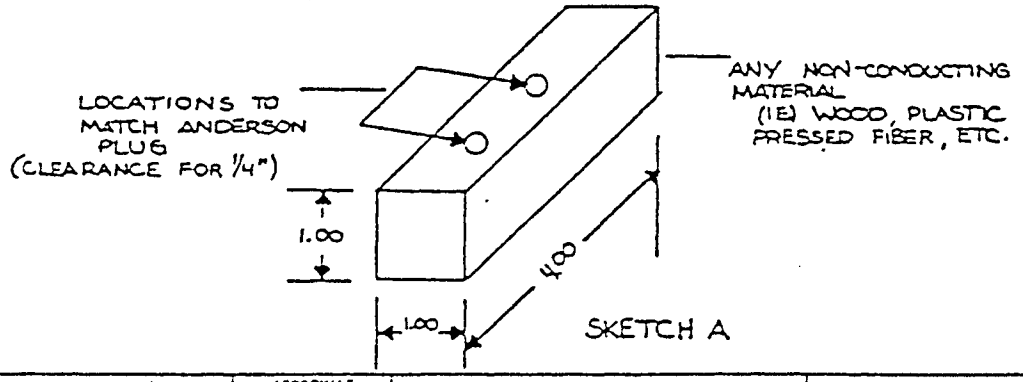
CONT ON SHEET FL. SH NO. 1

FIRST MADE FOR

REVISIO







SKETCH A

PRINTS T

MADE BY JOYCE M DUNBAR

ISSUED

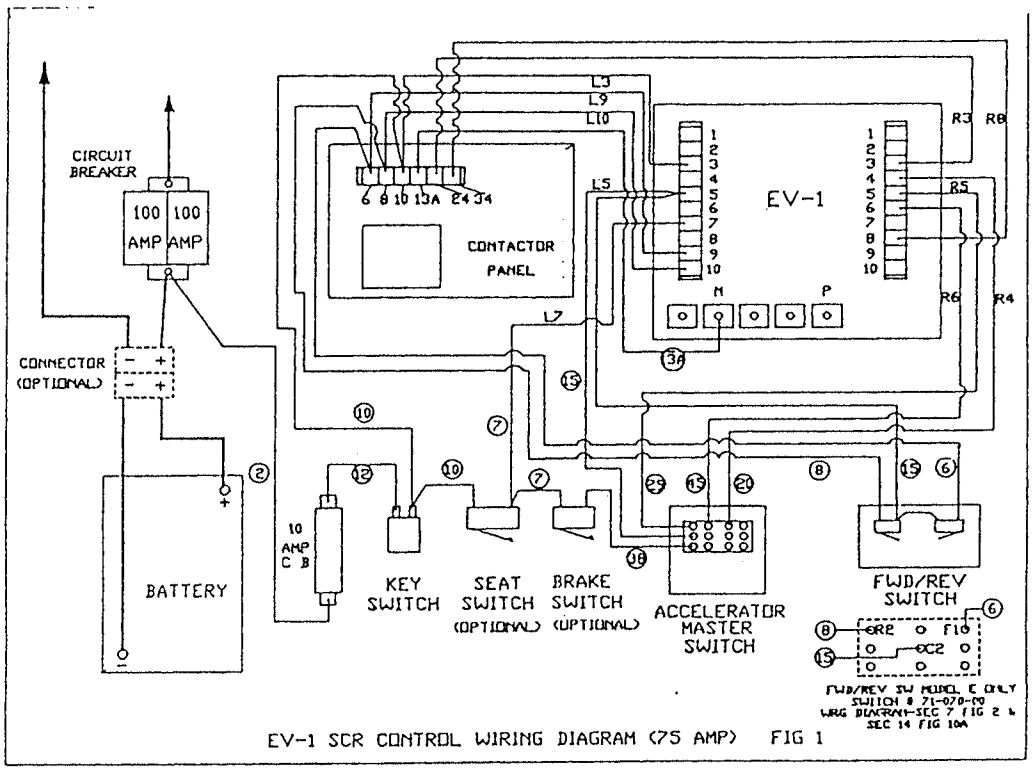
APPROVALS

INDUSTRIAL CONTROL DIV OR DEPT.

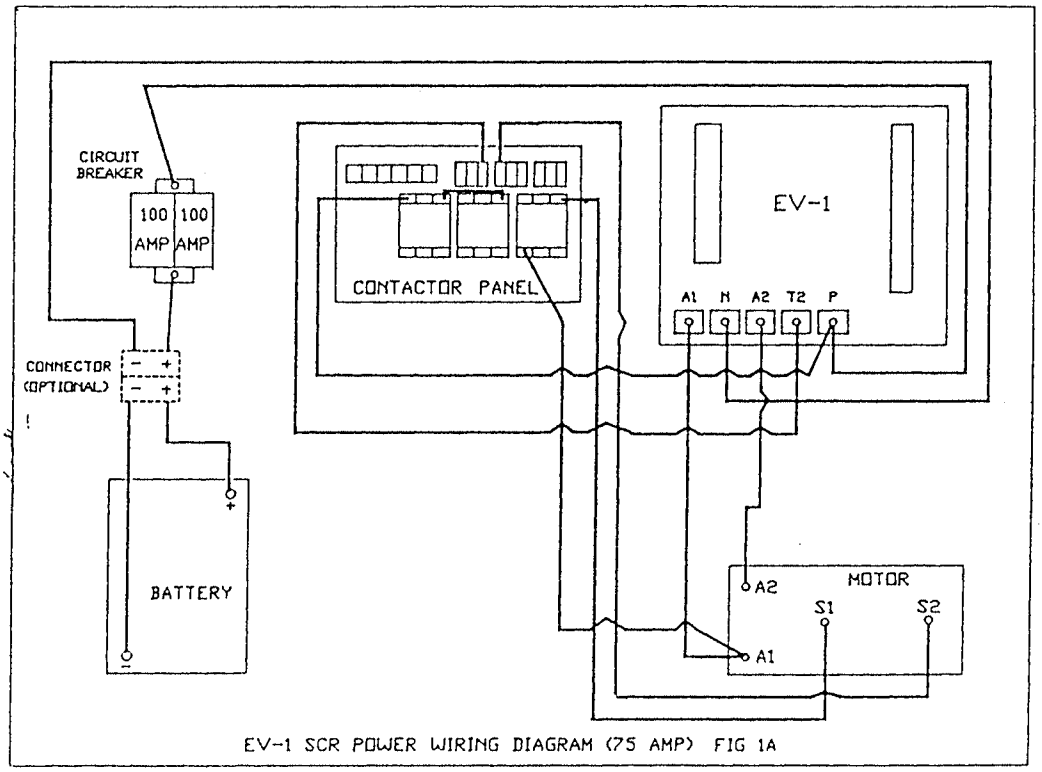
SKJMD82179-A1

SECTION 4
Page 1

WIRING DIAGRAMS

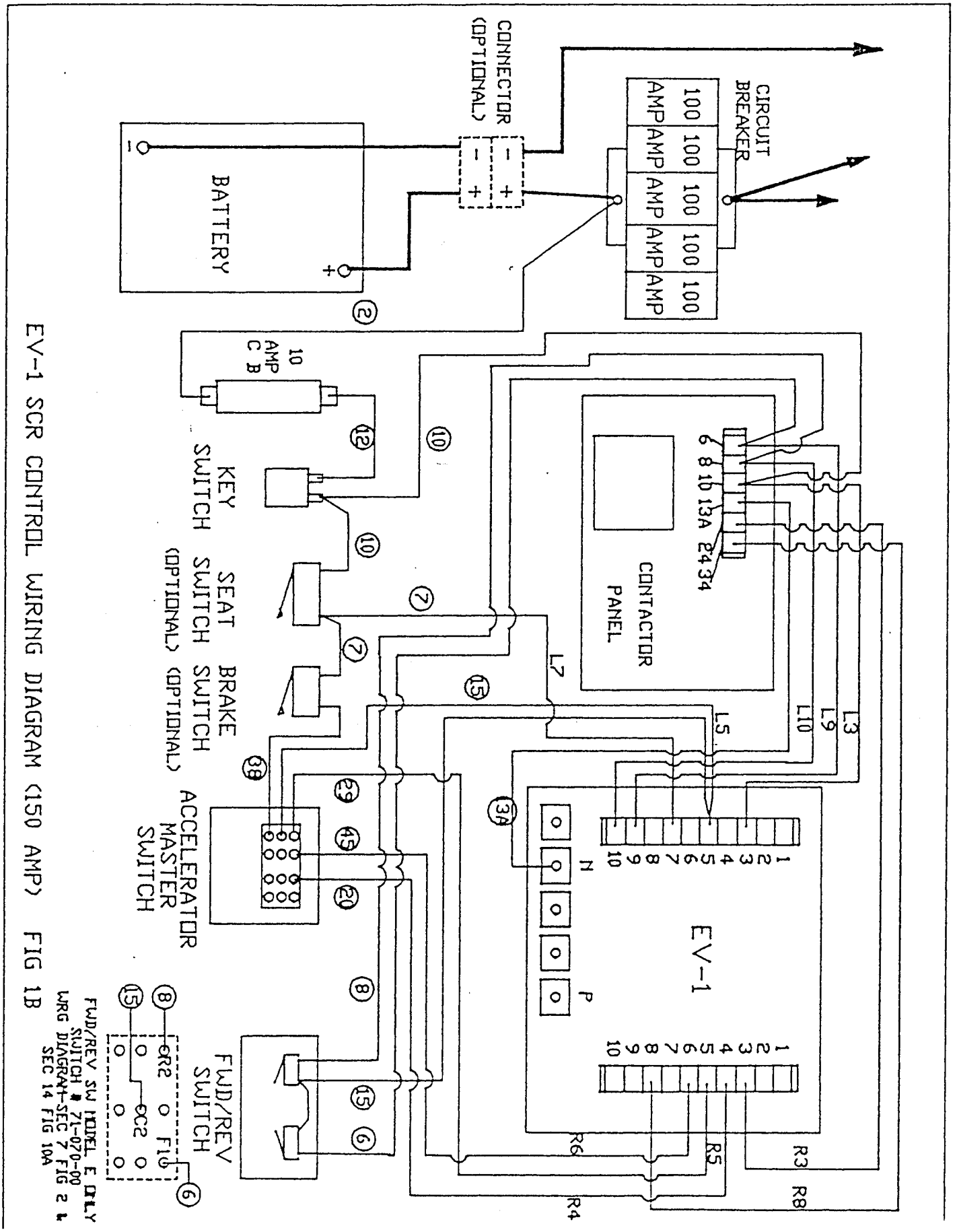


EV-1 SCR CONTROL WIRING DIAGRAM (75 AMP) FIG 1



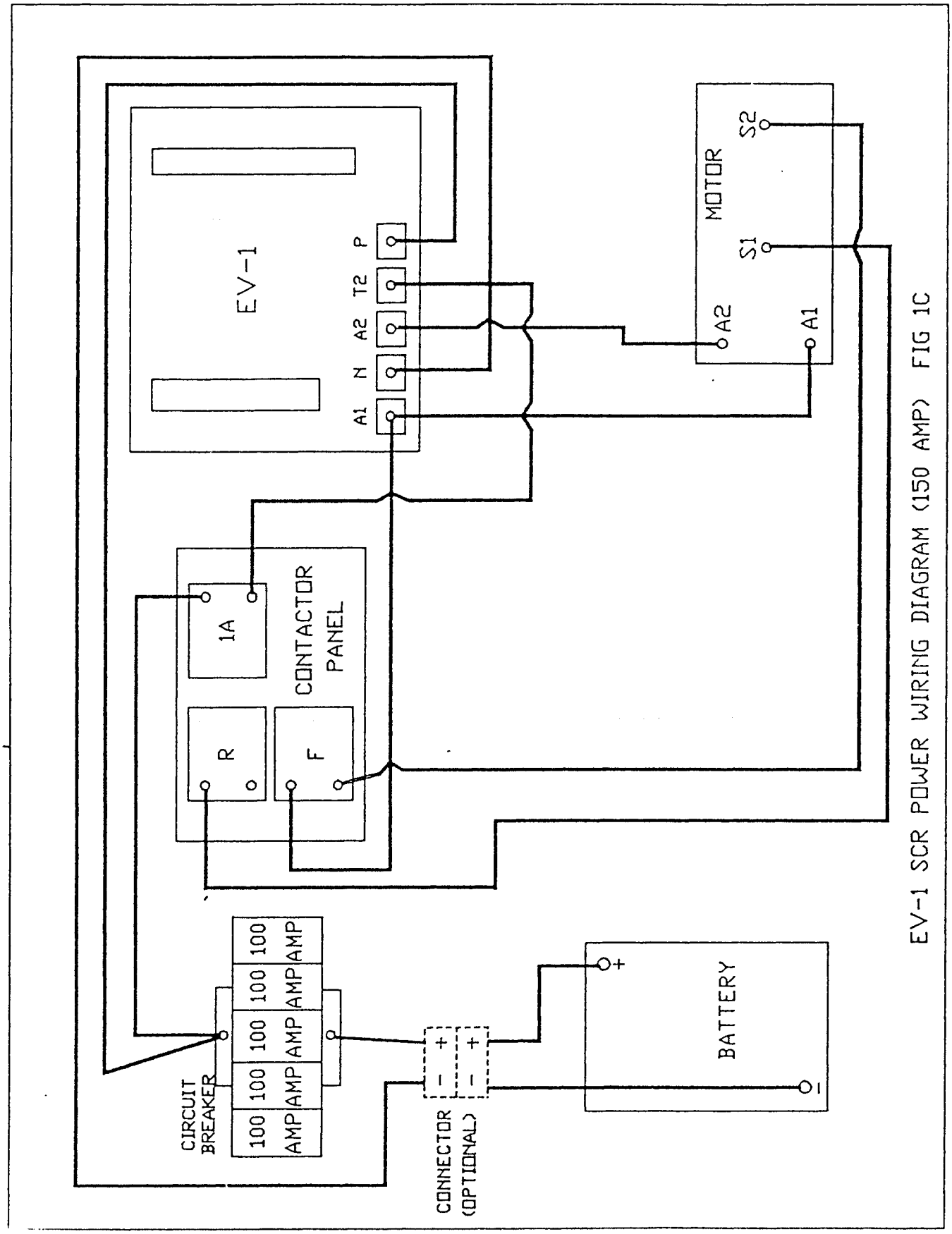
EV-1 SCR POWER WIRING DIAGRAM (75 AMP) FIG 1A

SECTION 4
Page 2



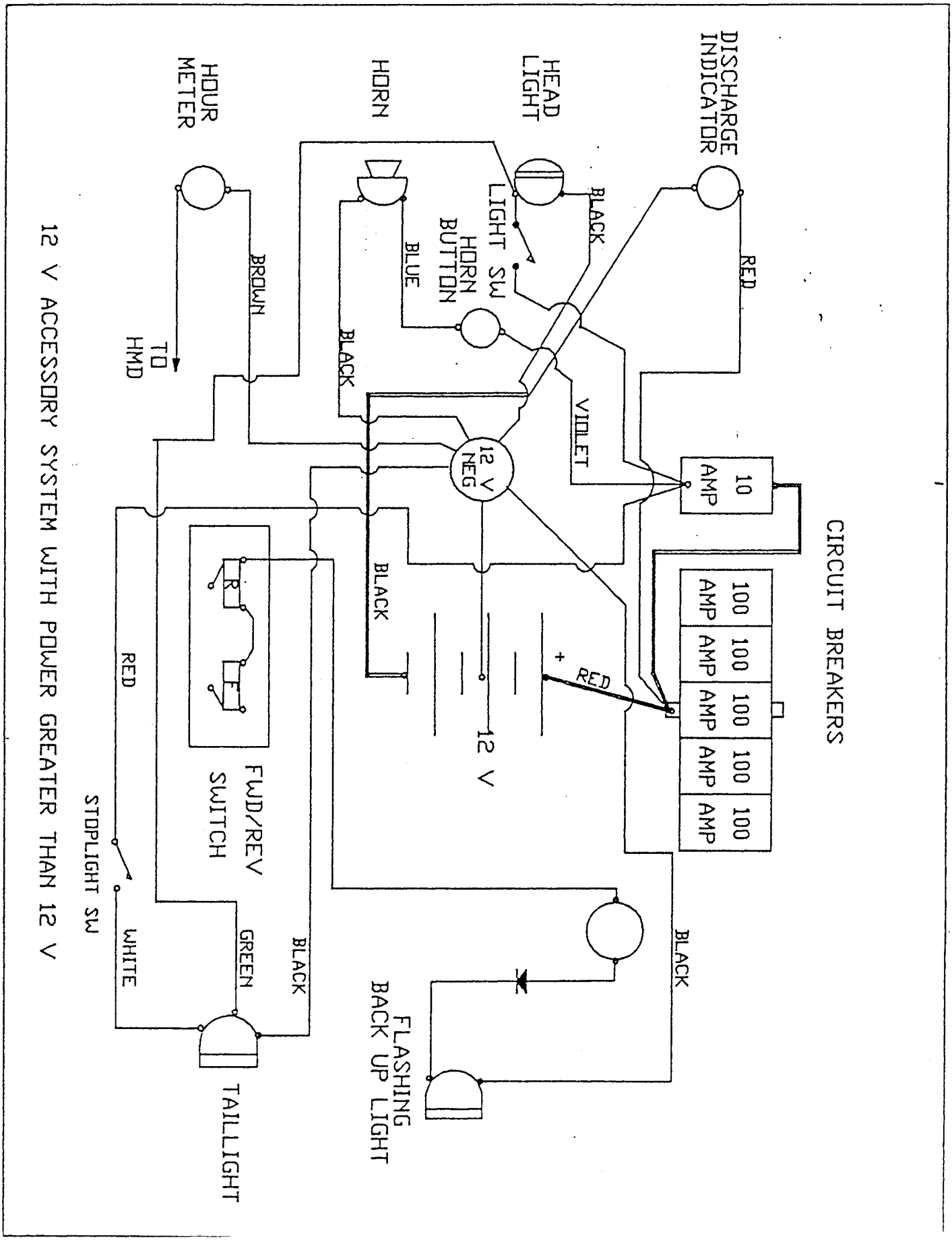
EV-1 SCR CONTROL WIRING DIAGRAM (150 AMP) FIG 1B

SECTION 4
Page 3

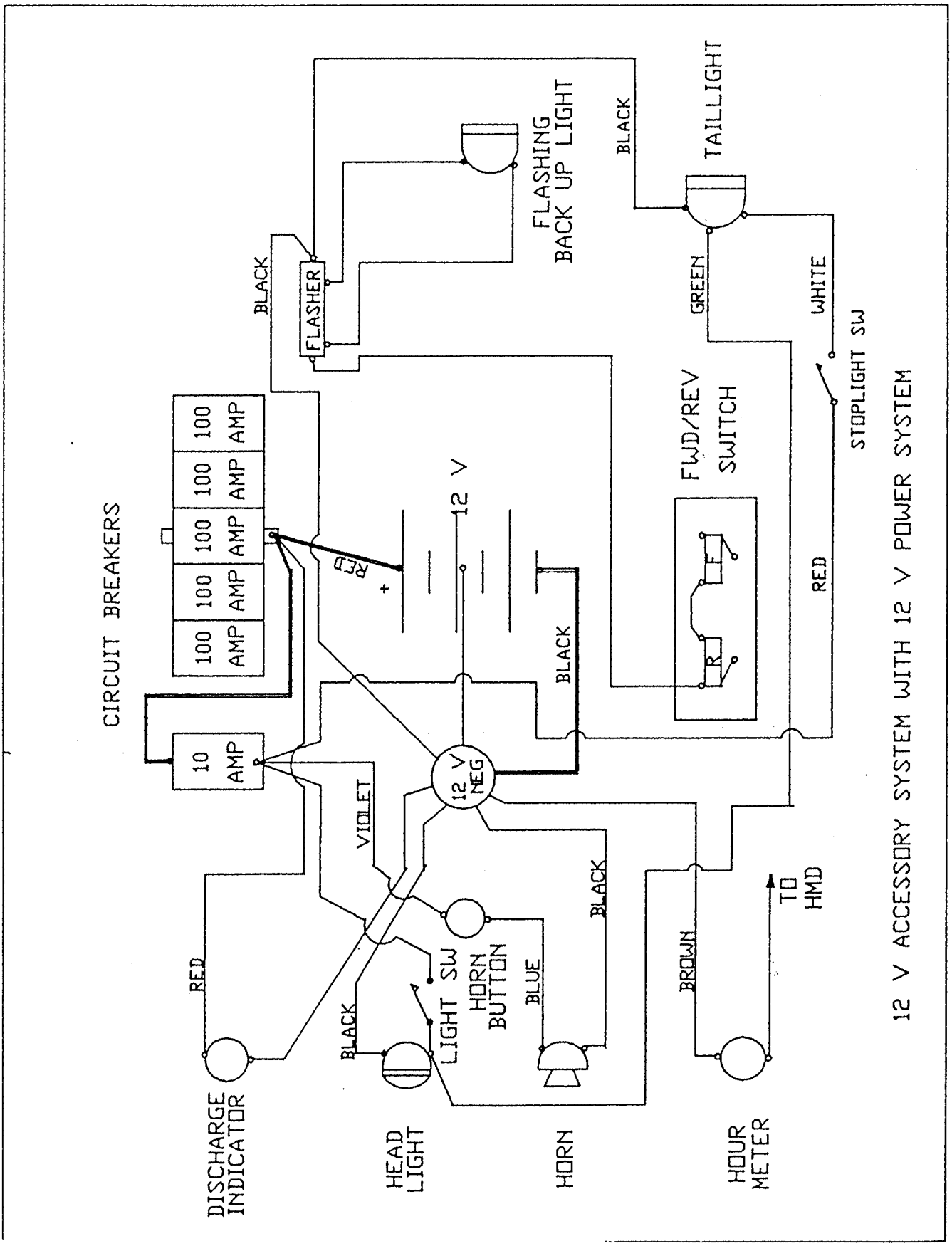


EV-1 SCR POWER WIRING DIAGRAM (150 AMP) FIG 1C

SECTION 4
Page 4



SECTION 4
Page 5



SECTION 5
Page 1

SERVICE AND ADJUSTMENT
EV-1 FORWARD/REVERSE SWITCH
REFER TO FIGURE 3

CAUTION: Whenever service work is to be conducted on the switch or any part of the vehicle wiring system, disconnect the positive lead at the battery or unplug power leads on vehicles so equipped.

REPLACEMENT OF MICROSWITCH

1. Remove (1) screw from center of handle and hub assembly. Remove handle and hub assembly from cover.
2. Remove (2) screws attaching cover to frame. Remove cover from frame.
3. Carefully note the position of wires and mark their respective locations.
4. Remove switch terminal screws and wires.
5. Remove (2) screws attaching switch to frame assembly.
6. Install new switch, replacing screws and wires in reverse order. Switch position retaining screws should be snug, not tight, for the moment.
7. With switch roller riding on top of cam lobe, insure that .010" clearance exist between roller arms and switch body, and tighten switch retaining screws.
8. Insure that replaced switch operates correctly in "NC" and "NO" positions.
9. Check adjoining switch for correct adjustment.
10. Replace cover and handle assembly in reverse order.
11. Check for proper operation.

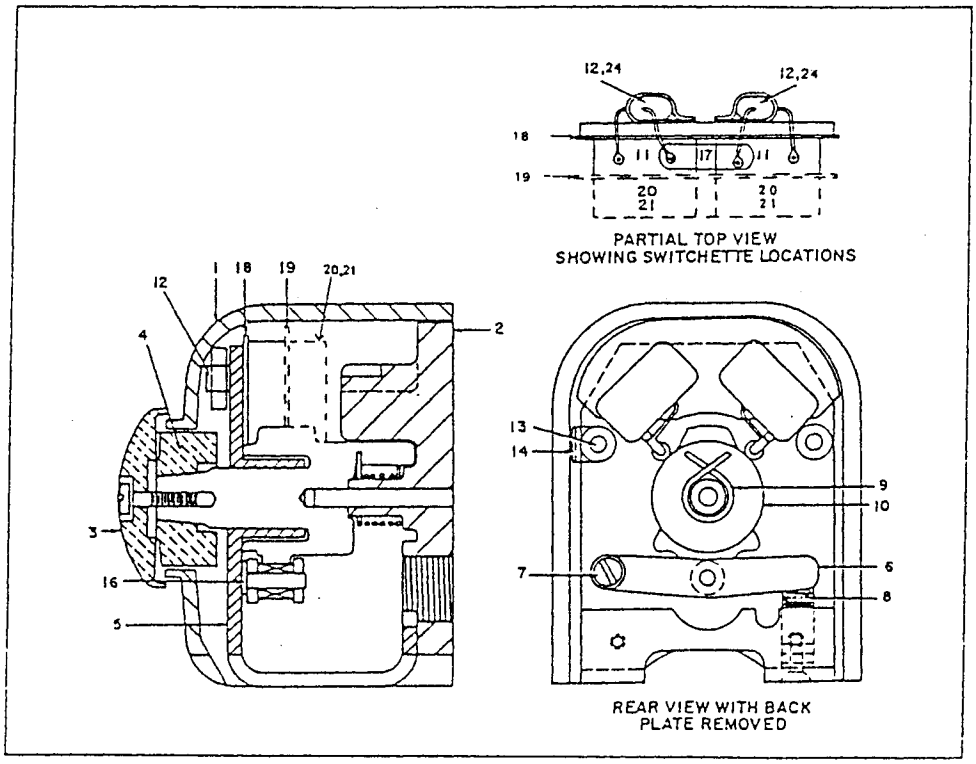


FIGURE 3

SECTION 5
Page 2

FORWARD / REVERSE SWITCH
EV-1 SCR CONTROL
REFER TO FIGURE 3

FIG. I.D.	T-D PART NO.	DESCRIPTION	QTY.
3-Ø	71-Ø91-ØØ	FORWARD/REVERSE SWITCH	1
3-1	71-Ø91-51	COVER	1
3-2	71-Ø91-52	BACK PLATE	1
3-3	71-Ø91-53	HANDLE AND HUB	1
3-4	71-Ø91-54	STOP	1
3-6	71-Ø91-56	CAM FOLLOWER	1
3-7	71-Ø91-57	SPACER	1
3-8	71-Ø91-58	SPRING FOR CAM FOLLOWER	1
3-1Ø	71-Ø91-59	STAR WHEEL CAM	1
3-11	71-Ø91-6Ø	SWITCH, FORWARD & REVERSE	2
3-12	71-Ø91-61	CAPACITOR ASSEMBLY	2
3-13	71-Ø91-62	SPACER	2
3-14	71-Ø91-63	WIRE CLIP	1
3-16	71-Ø91-65	WASHER	1
3-17	71-Ø91-66	JUMPER	1
3-18	71-Ø91-67	INSULATION	1
3-19	71-Ø91-68	INSULATION (OPTIONAL)	1
3-2Ø	71-Ø91-6Ø	SWITCH (OPTIONAL), FOR SPECIAL ORDER ACCESS.	1
3-21	71-Ø91-7Ø	SWITCH (OPTIONAL), FOR SPECIAL ORDER ACCESS.	1
NOT SHOWN	71-Ø91-71	STEERING COLUMN MOUNTING CLAMP	1
3-24	71-Ø91-72	CAPACITOR CLAMP	2

NOTE: Standard hardware items listed below are not normally stocked by Taylor-Dunn but can be purchased locally.

SCREWS

1Ø-32, 5/8" FLAT HEAD	4-4Ø, 1/4" PAN HEAD
4-4Ø, 3/4" PAN HEAD	4-4Ø, 1-1/4" PAN HEAD
4-4Ø, 1-3/4 PAN HEAD	6-32, 3/4" PAN HEAD
8-32, 3/4" PAN HEAD	8/32, 7/8" PAN HEAD
1Ø-32, 1/2" PAN HEAD	1Ø-32, 2-1/2" PAN HEAD

LOCK WASHERS	PLAIN WASHERS	NUTS
FOR #4 SCREW	FOR #4 SCREW	4-4Ø HEX
FOR #8 SCREW	FOR #8 SCREW	1Ø-32 HEX

SECTION 6
Page 1

ACCELERATOR SWITCH, GE SUPPLEMENT, FIGURE 4, PARTS LIST

INSTRUCTIONS

GEH.4470A

EV-1* SCR CONTROL
ACCELERATOR SWITCH
IC4485ACC1

Before any adjustments, servicing, parts replacement or any other act is performed requiring physical contact with the electrical working components or wiring of this equipment, JACK WHEELS OFF FLOOR, DISCONNECT THE BATTERY AND DISCHARGE CAPACITOR(S).

DESCRIPTION

The IC4485ACC1 is a family of accelerator master switches that may be either foot-operated through a pedal and linkage system or hand-operated by a suitable handle arrangement. This master switch offers a wide variety of options so that it may be customized to fit the user requirements. The master switch contains a switchette which closes at the beginning of travel to energize the control circuit, a switchette at the end of travel to bypass the control for maximum speed and torque, and a unique unidirectional potentiometer to vary the speed in between. The potentiometer is controlled by mechanical linkage to turn in only one direction so that it is independent of handle movement. This feature simplifies the setting of the potentiometer to provide consistent performance in both directions.

A single molded cam is used for the foot-operated CW and CCW forms. Direction of rotation can be changed in the field by changing the position of the start switchette and relocating the OFF-position stop.

A different molded cam is used for the hand-operated forms.

INSTALLATION

A conduit plate can be located on either side. The four mounting holes are symmetrical relative to the shaft; only three need be used.

When an external linkage is used, a separate external return spring is required. Any external linkage that can be operated forcibly should also have an external mechanical stop.

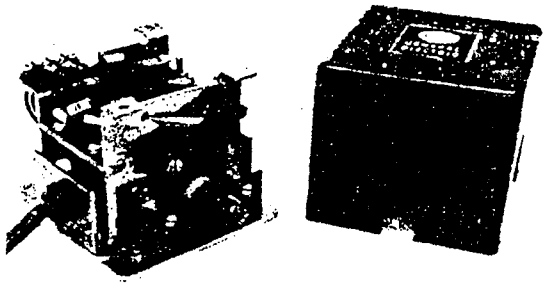


Fig. 1. IC4485ACC1 master switch with cover removed

TABLE 1

CURRENT RATING OF SWITCHETTES

Voltage Inductive	Current-Amperes	
	Make and Break	Carry
6	10.0	10
12	6.0	10
18	4.0	10
24	3.5	10
30	3.0	10
36	2.5	10
48	2.0	10
72	1.0	10

The ratings in Table 1 are for single circuits (i.e., normally open contact only). Voltages above 72 require capacitor-type filters, in accordance with factory recommendations.

MAINTENANCE

Oil-less bearings are used on both ends of the main operating shaft and thus eliminate the need for any lubrication of the switch.

* Trademark of General Electric Company

SECTION 6
Page 2

SWITCHETTE ADJUSTMENT

Fig. 2. Switchette adjustment, view from shaft end

Unlock locknut (see Fig. 2) and turn screw CW to make the normally open switchette close at less travel. The start switch should close at 5 to 8 degrees and reset at a minimum of 1-degree travel from the OFF position. The 1A switch should close at 26 to 29 degrees and reset at a minimum of 22 degrees travel from the OFF position. Total travel is 30 degrees.

POTENTIOMETER ADJUSTMENT

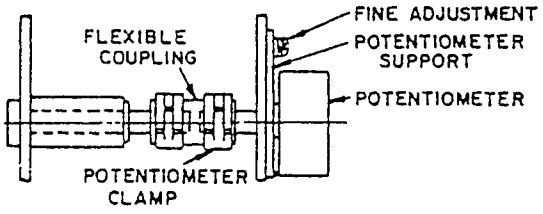


Fig. 3. Potentiometer and clamps

To remove the potentiometer, remove the wires from the terminal board, loosen the clamps on the flexible coupling with duck-bill pliers, and move both clamps to the left (see Fig. 3). Remove the potentiometer and its support by removing the two "fine-adjustment" screws. Retain the potentiometer support.

To replace, mount the new potentiometer on the support, locating the tab in the hole of the support, and secure with the lockwasher and nut. With an ohmmeter on the potentiometer terminals (R x 100 scale), turn the shaft clockwise until the point where the resistance starts to reduce below the level (4800- to 6000-ohm) portion of the curve (see Fig. 4). This corresponds to the START position.

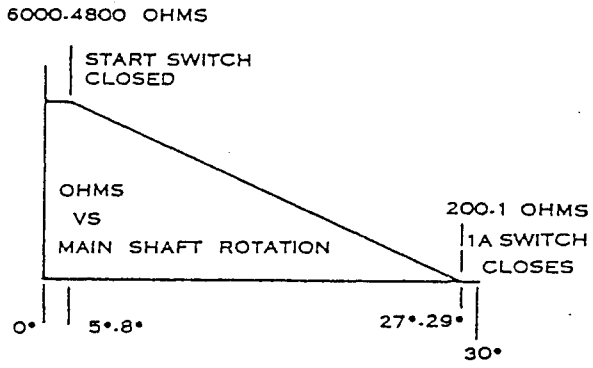


Fig. 4. Potentiometer resistance curve

With the potentiometer clamp moved to the left and the master switch in the START position, line up the potentiometer shaft with the flexible coupling and center the fine-adjustment slots with the fine-adjustment tapped holes. Push the potentiometer until the support is against the frame. Assemble, but do not tighten, the fine-adjustment screws. Release the coupling clamp with duck-bill pliers and slide the clamp into position.

Rotate the master switch shaft until the START switchette operates (a slight click at about 7 degrees). The ohmmeter should be 4800 to 6000 ohms. Continue rotating the shaft until the 1A switchette operates (a slight click at about 28 degrees). The ohmmeter should be less than 200 ohms and remain above 1 ohm, when the shaft is rotated fully.

If the ohms are too low when the start switch closes, loosen the fine-adjustment screws and rotate the potentiometer support CCW.

If the ohms are too high when the 1A switch closes, loosen the fine-adjustment screws and rotate the potentiometer support CW.

If the fine adjustment is not enough to bring the resistance values within limits, return the master switch to the OFF position, release the potentiometer clamp with duck-bill pliers, and turn the potentiometer shaft with needle-nose pliers a slight amount. (Clockwise from shaft end of potentiometer to reduce ohms.) Recheck resistances at START and 1A and use fine adjustment as described previously if necessary.

Check that coupling clamps are in position and the fine-adjustment screws are tight.

* Trademark of General Electric Company

SECTION 6
Page 3

FIELD MODIFICATION OF FOOT-OPERATED SWITCH

If the direction of rotation of a foot-operated switch needs to be changed, the location of the OFF-position stop, the switchette and the cam must be changed. (See Figs. 5 and 6 and Table 2.)

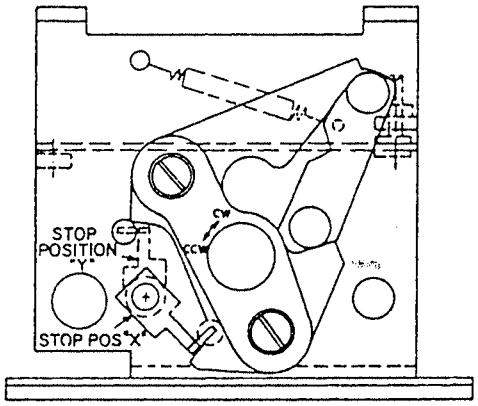


Fig. 5. OFF-position stop

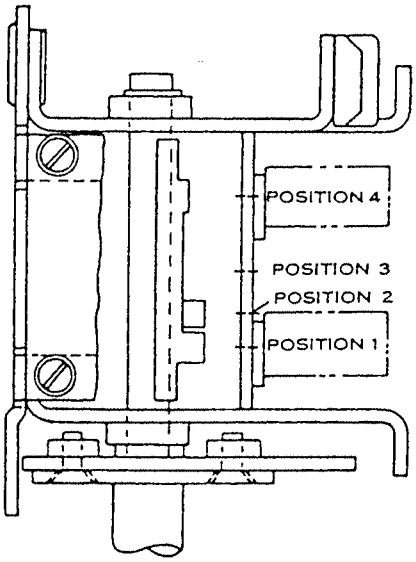


Fig. 6. Switchette position

TABLE 2

OFF-POSITION STOP AND SWITCHETTE POSITION

Switch Rotation	Switchette Position (See Fig. 6)		Stop Position (See Fig. 5)	Use Cam
	Start	1A		
CW	2	4	Y	194B8333P1
CCW	3	4	X	171B3172P1
CW and CCW	1 and 3	4	Stop not used	171B3172P1

* Trademark of General Electric Company

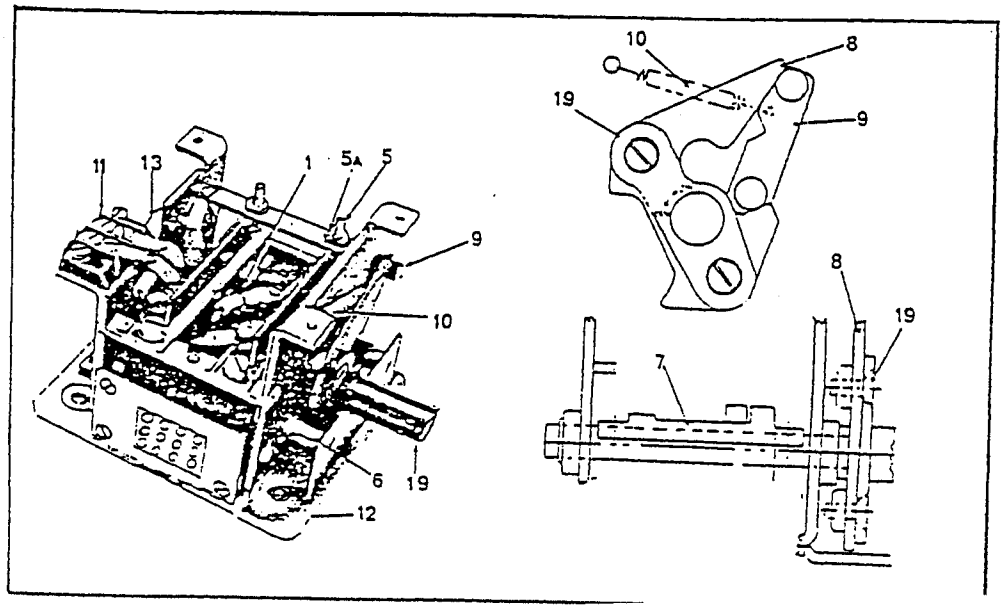
SECTION 6
Page 4

ACCELERATOR SWITCH EV-1 SCR
REFER TO FIGURE 4

FIG. I.D.	T-D PART NO.	DESCRIPTION	QTY.
4-Ø	61-912-ØØ	ACCELERATOR SWITCH COMPLETE	1
4-1	61-912-51	SWITCH ASSEMBLY	2
4-5	61-912-55	SCREW, ADJUSTING FOR SWITCH	2
4-5A	88-Ø49-8Ø	NUT, HEX 1Ø-32	2
4-6	61-912-57	STOP	1
4-7	61-912-58	CAM	1
4-8	61-912-59	CAM SHIFT ASSEMBLY	1
4-9	61-912-6Ø	POTENTIOMETER OPERATING ARM & SHAFT	1
4-1Ø	61-912-61	SPRING, RETURN	1
4-11	61-912-62	TERMINAL BOARD	1
4-12	61-912-63	SWITCH SUPPORT BASE	1
4-13	61-912-64	POTENTIOMETER 5K, WITH MOUNTING BRACKET	1
NOT SHOWN	61-912-65	WIRING HARNESS COMPLETE WITH 12 POINT PLUG	1
NOT SHOWN	61-912-66	HOSE	1
NOT SHOWN	61-912-67	CLAMPS, HOSE	2
NOT SHOWN	61-912-68	COVER	1
NOT SHOWN	61-912-69	PLATE, COVER	1
NOT SHOWN	61-912-7Ø	PLUG, RUBBER (FITS IN COVER PLATE)	1
4-19	61-912-71	SHAFT ASSEMBLY	1
	NOTE:	The standard hardware items listed below are not normally stocked by Taylor-Dunn but can be purchased locally.	

SCREW WITH SPRING LOCK WASHER	SCREWS
6-32, 1/2" PAN HEAD	6-32, 3/8" FLAT HEAD
8-32, 3/8" PAN HEAD	1Ø-32, 1/2" FLAT HEAD
8-32, 1/2" PAN HEAD	

PLAIN WASHERS	RETAINING RINGS	FLAT HEAD LOCK WASHER
#6 SCREW	EXTERNAL "E" RING FOR 1/4" DIA. SHAFT	1Ø-32 SCREW
#8 SCREW	EXTERNAL "E" RING FOR 3/8" DIA. SHAFT	
#1Ø SCREW		



SECTION 7
Page 1

INSTRUCTIONS

GEH-3099A

75-AMPERE ELECTRIC-VEHICLE CONTROL CONTACTORS

IC2800-M601, -M610, -M611

Before any adjustments, servicing, parts replacement or any other act is performed requiring physical contact with the electrical working components or wiring of this equipment, the POWER SUPPLY MUST BE DISCONNECTED.

GENERAL

These d-c contactors are designed for 36-volt maximum, intermittent-duty operation, such as found in battery-powered lift trucks and golf-cart services. The shunt-operating coils are rated for 50-percent time-on intermittent duty. The contactors are self-contained units suitable for mounting on the vertical surfaces of either metal or insulated bases. All terminals and mounting holes are accessible from the front of the device.

TABLE I

IDENTIFICATION

Nomenclature IC2800	Power Circuits
-M601	1-NC
-M610	1-NO
-M611	1-NO – 1-NC (DPDT)

TABLE II

CURRENT RATINGS OF POWER CONTACTS

Amperes	Duty Cycle Percent Time-on	Maximum Time-on
50	100*	Continuous*
75	50	5 Minutes
250	5	30 Seconds
500†	2	5 Seconds

* For continuous applications, the operating coil must be de-rated or a holding resistor must be inserted in series with the operating coil.

† The maximum interrupting rating of these contactors is 300 amperes at 36 volts with an inductive load such as a motor.

ARCING CLEARANCES

During installation, it is important that certain minimum clearance be maintained between the contactor and other surrounding components. See Fig. 3.

CONNECTIONS

As a rule, the normally open power connections and the coil terminal connections are at the top of the contactor, with the normally closed power connections at the bottom. (See Figs. 1 and 2). Certain special forms have other configurations. A quick visual check can be made as shown in Fig. 2.

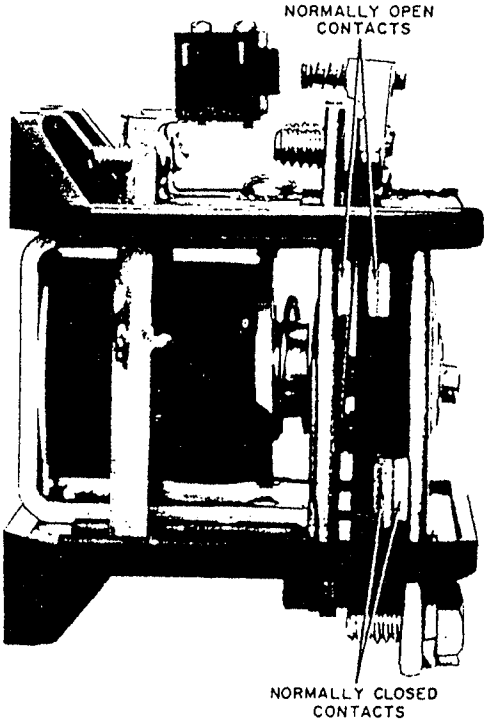


Fig. 1. IC2800-M611 contactor for electric-vehicle applications.

Forms of the IC2800-M611 (DPDT) are available with a tie between one of the normally open stationary contacts and one of the normally closed

SECTION 7
Page 2

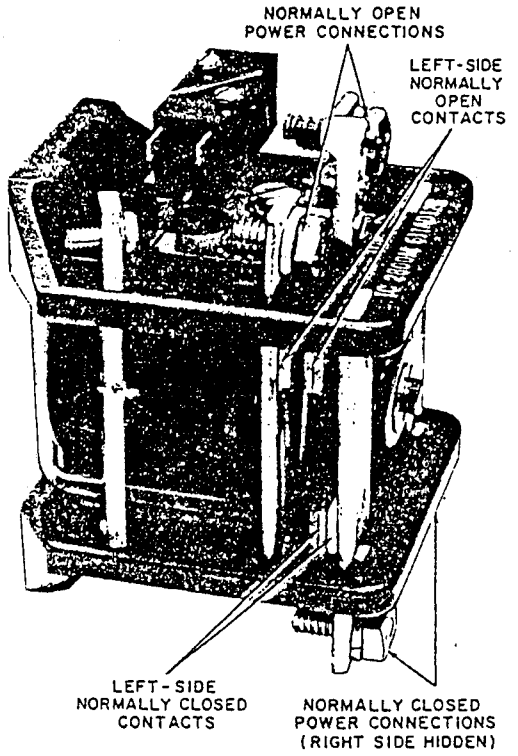


Fig. 2. IC2800-M611 contactor with CR1070C143C3 interlock.

stationary contacts. This tie or common connection is available either on the left or the right side of the contactor. A typical application of these contactors is as a reversing pair.

The power connections are 1/4 - 20 screws, which should be tightened to 45 to 60 inch-pounds (5.1 to 6.8 newton meters [N·m]). It is recommended that this tightening be done with a screw driver, spin tight, or a socket on a shaft extension. If a wrench is used, take care that the head or body of the wrench does not come in contact with the molded side plate (see Fig. 4). That is, do not use the molded side plate as a pivot point.

VOLTAGE SPIKE SUPPRESSION

When these contactors are used in conjunction with static control, it is often necessary to suppress the voltage spike which results when coil current is interrupted. This is done to prevent damage to static components such as silicon controlled rectifiers, transistors, etc.

Use only those voltage spike suppressors which are factory specified and supplied by the truck manufacturer.

When connecting the suppressors across the coil, polarity must be maintained in accordance with Fig. 5.

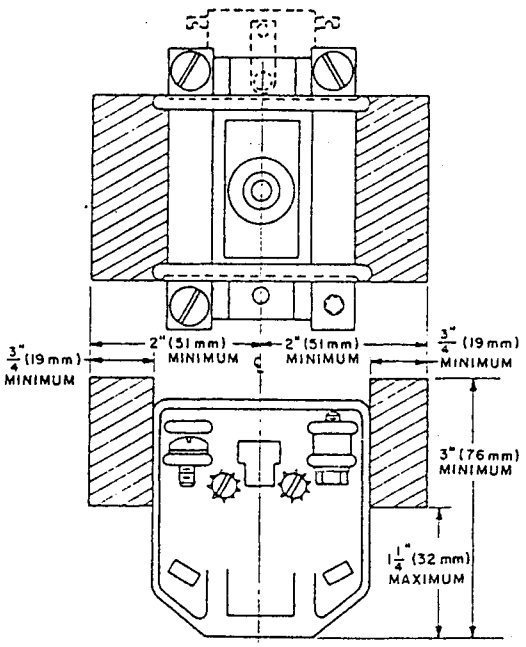


Fig. 3. Installation clearances. For proper operation the shaded area should be free of any obstructions.

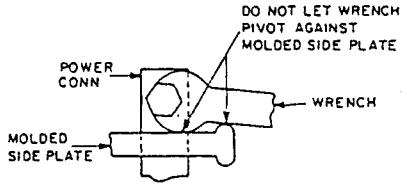


Fig. 4. Proper use of a wrench when tightening power contacts.

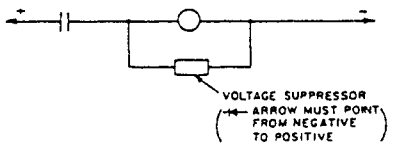


Fig. 5. Polarity maintenance.

MAINTENANCE AND ADJUSTMENTS

The following information is intended to assist during periods of normal maintenance and to provide checks to determine if the contactors are in proper operating condition.

As these devices are adjusted, inspected, and tested at the factory, they should not normally require further adjustments. However, any time a part has been replaced, the following checks should be made.

SECTION 7
Page 3

POWER CONTACTS

In normal operation, the contacts will become blackened, discolored, and roughened. This will not interfere with proper operation and cleaning is not necessary. The contacts should be replaced before the silver-alloy contact facing is completely eroded through to the backing material, or before the wipe is reduced to zero. The silver alloy may transfer from one contact and cause buildup on the mating contact. This can be expected under certain conditions and does not require contact dressing or filing. When replacing only one contact of a mating pair, remove any high peaks or beads of material on the contact that is not replaced.

POWER CONTACTS ADJUSTMENTS

With the contactor mounted or held in its normal operating position (see Fig. 3), check the contact wipes and gaps. These checks are most easily made with small rods or drills of a diameter equal to the dimensions given below. These contactors are double break (two sets of contacts per circuit) and the gaps must be measured on both sets of contacts.

Normally open gap – 0.050 inches (1.27 mm) minimum each side

Normally closed gap – 0.050 inches (1.27 mm) minimum each side

Normally open wipe – 0.040 inches (1.0 mm) minimum

Normally closed wipe – no check

NOTE: *The normally open wipe measurement given is with new contacts and will decrease as the contacts wear.*

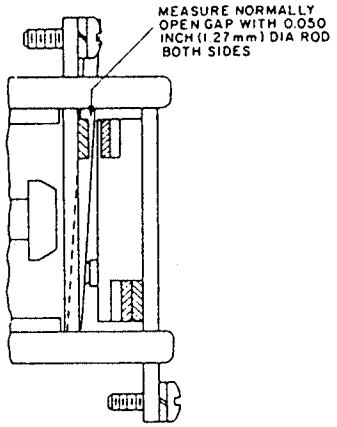


Fig. 6. Contactor in de-energized position.

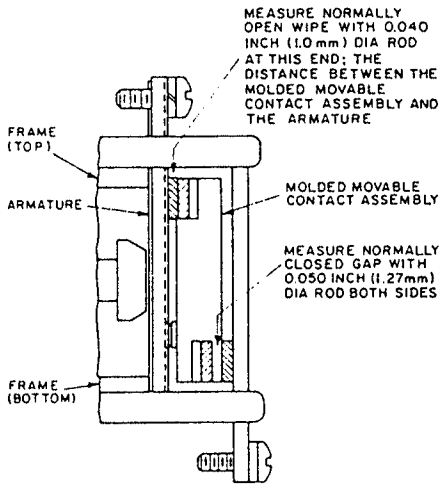


Fig. 7. Contactor in energized position with armature firmly seated against the frame at top and bottom.

Figures 6 and 7 show de-energized and energized positions, and where to measure.

The only means of adjusting to obtain these measurements is by moving the side plates in or out on the frame. If adjustment is necessary, make sure that the side plates are relatively square with respect to each other and with the U-frame. Recheck the electrical interlock adjustments and, if necessary, re-adjust per the section on Electrical Interlocks in this instruction publication.

REPLACEMENT OF PARTS

It is necessary to disassemble these devices in order to replace any part except the electrical interlock or its operator. For this reason, you may find it to your advantage to replace the entire contactor whenever a complete set of contacts or a new coil is needed. However, if you desire to replace a part, use the following procedures:

1. Disconnect the contactor and remove it from the vehicle.

2. To replace the coil, first unsolder the coil leads from the coil terminal strips; then remove the screws which fasten the molded side plates to the frame.

3. Now, slide the frame and coil out from between the molded side plates. If the core does not have a head, it is now possible to remove the coil without disassembling the core and the frame. If

SECTION 7
Page 4

the core does have a head, you must remove the screw which holds the core to the frame. It may be necessary to hold the core with a pair of pliers.

4. Replace the coil, and reassemble the core to the frame. Be sure the special conical lockwasher is in place and that the screw is tightened.

5. Slide the frame and coil assembly back between the molded side plates with the armature spring positioned as shown in Fig. 8.

6. Replace the screws in the side plates, making sure the stationary contacts and the coil terminal strips are positioned in their respective slots in the side plates.

7. Check the power contact gaps and wipes per the Power Contact Adjustments section of this instruction publication. Also, check the electrical interlock and, if necessary, readjust per the section on Electrical Interlock Adjustments in this instruction publication. Make sure the armature spring is properly seated as shown in Fig. 8.

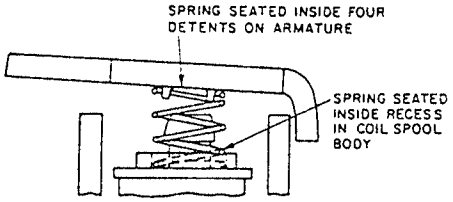


Fig. 8. Outline drawing of armature spring.

8. The side plates can be moved by the amount the holes are larger than the screws. Try to align the side plates as squarely as possible with the frame.

9. To replace a worn contact or set of contacts, first disconnect the contactor and remove it from the vehicle.

a. Remove the bottom molded side plate. Note that by leaving the top molded side plate attached to the frame, the normally open contact adjustments and the electrical interlock adjustments will not be changed.

b. Replace the worn contacts and reassemble the contactor, taking care that the stationary contact strips, the coil terminal strips, and the armature tongues are all properly positioned in their respective slots in the side plates. Make sure the armature spring is positioned as shown in Fig. 8.

c. Check the contact gaps and wipes and the electrical interlock adjustments and if necessary, re-adjust per the applicable sections in this instruction publication.

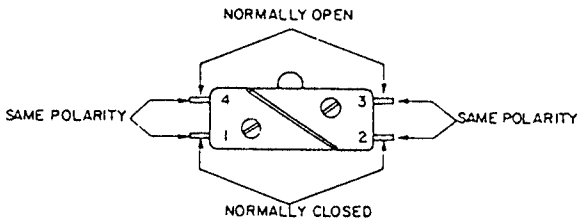


Fig. 9. CR1070C143C3 interlock connections.

ELECTRICAL INTERLOCKS

An auxiliary snap-action electrical interlock can be mounted on most forms of these contactors (see Fig. 1). This electrical interlock has one normally open pole and one normally closed pole. It must be adjusted to operate in the following manner.

1. With a 0.010-inch (0.25 mm) thick shim or rod between the armature and the U-frame at the top, the interlock must operate when the coil is energized or when the armature is manually operated.

2. With an 0.030-inch (0.76 mm) thick shim or rod, using the same procedure, the interlock should not operate. The interlock mounting bracket has slotted mounting holes and can be moved in or out to obtain these requirements. If it is necessary to do this, recheck the contact adjustments per this instruction publication.

TABLE III

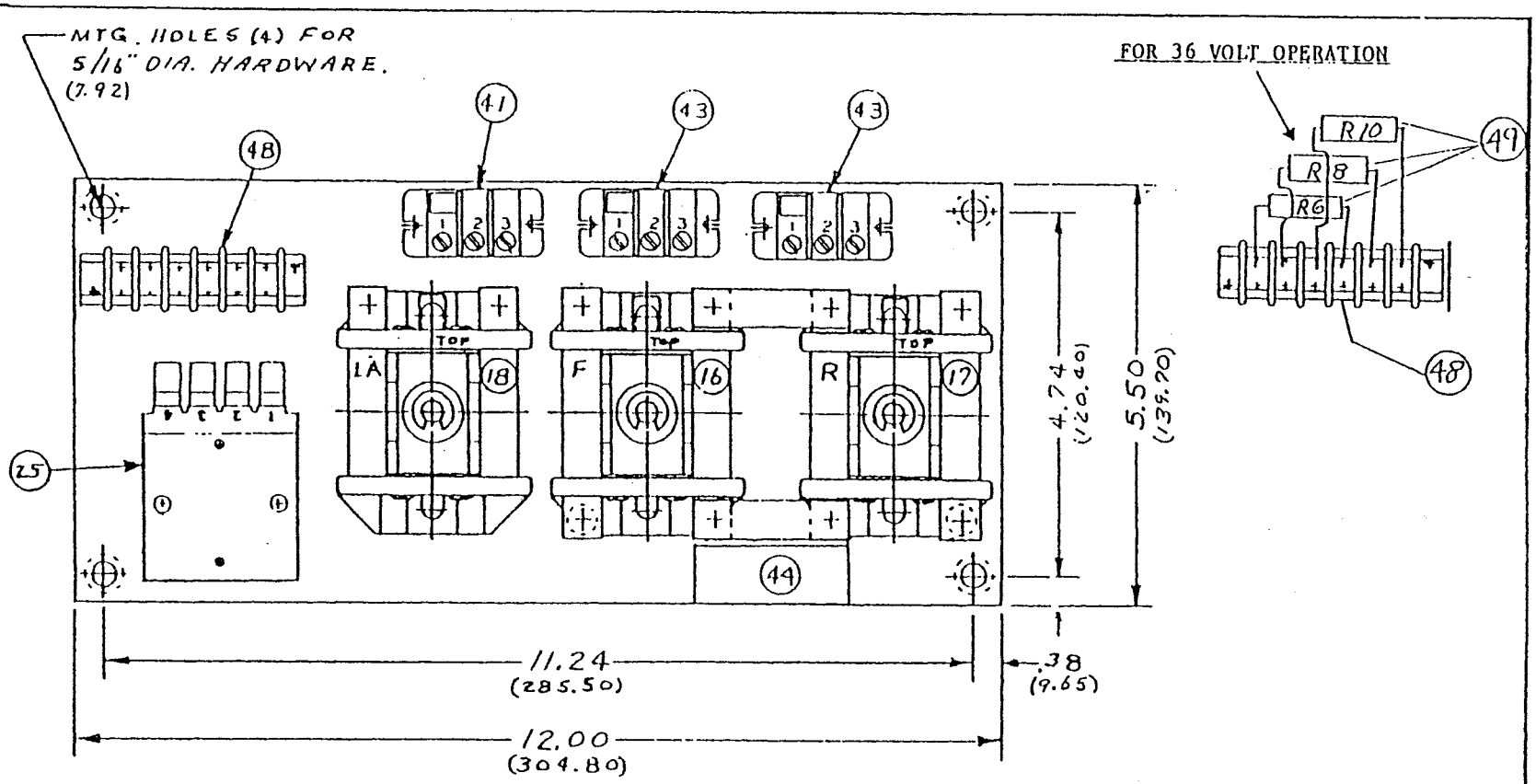
INTERLOCK RATINGS (RECOMMENDED)

Voltage Inductive	Current-Amperes	
	Make and Break	Carry
6	10.0	10
12	6.0	10
18	4.0	10
24	3.5	10
30	3.0	10
36	2.5	10

Ordinarily, any one circuit will control two of the coils used in these contactors. Coils may be connected either in series or parallel.

RENEWAL PARTS

When ordering renewal parts, address the nearest General Electric Company sales office, specify the quantity required, and give the catalog number or describe the required parts in detail. Give the complete nameplate rating of the equipment.



NOTE: MOUNTING HARDWARE MUST NOT PROTUDE MORE THAN .19" (4.83) BEYOND BACK SURFACE OF PANEL.

DIMENSIONS IN ( ) ARE MILLIMETERS.

NO.	DESCRIPTION	LENGTH	QUAN.	REVISED DATE	REVISION
TOL. FRAC. ±	DEC. ±	FIGURE 5	EV-1 SCR 75 AMP-24/36VOLT CONTACTOR PANEL	TAYLOR DUNN MFG. CO. 2114 West Ball Rd. Anaheim, Calif.	
SCALE	NONE				
DRAWN BY	J.B.				
DATE	2-2-77				

SECTION 7
Page 5

SECTION 7
Page 6

EV-1 SCR 75 AMP CONTACTOR PANEL
REFER TO FIGURE 5

FIG. I.D.	T-D PART NO.	DESCRIPTION	QTY.
5-0	71-306-00	CONTACTOR PANEL ASSEMBLY (75 AMP/24 VOLT COIL)	1
5-16	71-306-51	CONTACTOR, FWD., SINGLE POLE, DOUBLE THROW	1
5-17	71-306-58	CONTACTOR, REV., SINGLE POLE, DOUBLE THROW	1
5-18	71-306-52	CONTACTOR, 1A BY-PASS, SINGLE POLE, SINGLE THROW	1
5-25	71-305-54	CONTACTOR DRIVER	2
5-25	79-731-00	HOUR METER DIODE BLOCK (OPTIONAL)	1
5-41	71-306-53	FILTER BLOCK, 1A	1
5-43	71-306-54	FILTER BLOCK, FORWARD/REVERSE	2
5-44	71-305-55	NAME PLATE (SPECIAL ORDER ITEM)	1
5-48	79-864-00	TERMINAL BOARD (6 POSITION)	2
5-49	78-306-55	RESISTOR (FOR 36 VOLT USE)	3

*** MOUNTING HARDWARE OBTAINED THROUGH LOCAL PURCHASE

SECTION 8
Page 1

INSTRUCTIONS

GEH-4469

150- AND 300-AMPERE ELECTRIC-VEHICLE CONTROL CONTACTORS

IC4482-CTR A700, A800 SERIES

Before any adjustments, servicing, parts replacement or any other act is performed requiring physical contact with the electrical working components or wiring of this equipment, DISCONNECT THE BATTERY, DISCHARGE CAPACITOR(S), AND JACK WHEELS OFF FLOOR.

DESCRIPTION

GENERAL

These d-c contactors are designed for low-voltage, intermittent-duty operation such as found in battery truck service.

PURPOSE OF INSTRUCTIONS

The purpose of these instructions is to instruct the user on proper care and maintenance to obtain satisfactory service from these devices. The manufacturer of the electric vehicle has tested and applied these contactors according to the requirements of his vehicle. No modifications or changes should be made in the layout, physical arrangement or electrical connections without his permission.

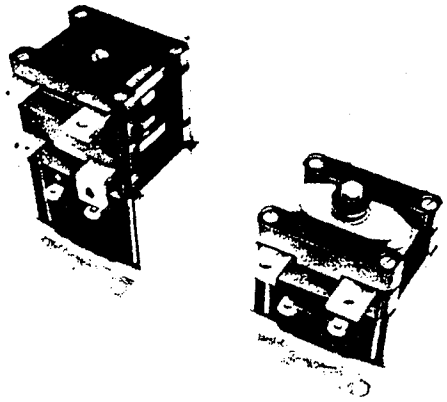


Fig. 1. Right - Single-pole, single-throw type (one normally open contact)
Left - Single-pole, double-throw type (one normally open and one normally closed contact)

MOUNTING

These contactors are designed to mount on a vertical surface or on a horizontal surface.

DISASSEMBLY AND ASSEMBLY

Two main categories of these contactors are available. The single-pole normally open types, and the single-pole double-throw types which have one normally open and one normally closed contact (Fig. 1). The assembly and disassembly of these devices will be covered individually.

Single-pole, Double-throw Type (One Normally Open and One Normally Closed Contact)

DISASSEMBLY

(Refer to Fig. 2, page 2 for exploded view and parts index).

1. Remove all electrical connections and remove the contactor from the vehicle for easier servicing.

2. Loosen the four long bolts in each corner, remove the top contact retainer, and the long bolts.

3. Remove the two top stationary normally closed contacts.

4. Remove the two contact spacers.

5. Remove the two bottom stationary contacts.

6. Remove armature and movable-contact assembly.

7. Remove magnet frame and coil from base.

8. Loosen and remove the 10-32 nut from the armature and movable-contact assembly using a 3/8-inch socket or nut driver. Note the order in which the parts are removed from the stud.

SECTION 8
Page 2

GEH-4469, 150- and 300-Ampere Electric-vehicle Control Contactors

PARTS INDEX

1. Long bolt with #8 lock washer
2. Top contact retainer
3. Top stationary contact
4. Contact spacer
5. Bottom stationary contact
6. Armature and movable-contact assembly
   a. 10-32 nut
   b. No. 10 lock washer
   c. No. 10 flat washer
   d. Movable-contact carrier
   e. Shim
   f. Movable contact
   g. Spring cup (snaps into 6f)
   h. Contact spring
   i. Bottom stationary-contact support
   j. Armature
   k. Spiral return spring
7. Magnet frame
8. Coil
9. Base
10. Bus connector

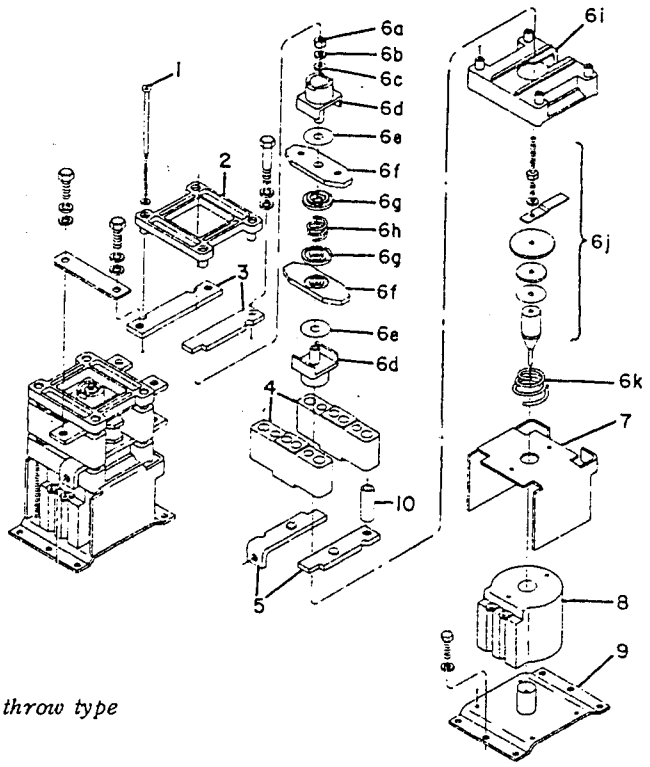


Fig. 2. Assembly of single-pole, double-throw type

PARTS INDEX

1. Long bolt with #8 lock washer
2. Contact spacer
3. Stationary contacts
4. Armature and movable-contact assembly
   a. 10-32 nut
   b. No. 10 lock washer
   c. No. 10 flat washer
   d. Contact spring retainer
   e. Contact spring
   f. Movable contact
   g. Shim
   h. Movable-contact carrier
   i. Stationary-contact support
   j. Armature
   k. Spiral return spring
5. Magnet frame
6. Coil
7. Base

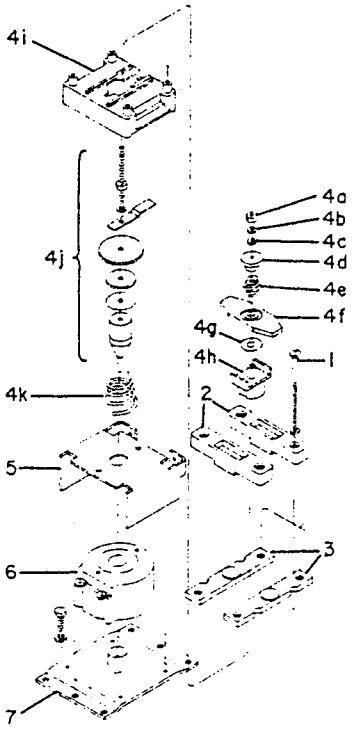


Fig. 3. Assembly of single-pole, single-throw type

SECTION 8
Page 3

ASSEMBLY

(Refer to Fig. 2, page 2 for exploded view and parts index).

Before assembly, all parts should be cleaned, inspected for wear and replaced if required. Assembly is performed in reverse order from disassembly with the following precautions required:

1. Force the small end of the spiral spring over the small diameter on the armature assembly. See Fig. 4, page 3.

2. Reassemble the armature parts 6a to 6k and tighten the 10-32 nut to 14 to 18 inch-pounds torque (1.6 to 2.0 Newton meters).

3. Locate the projections on the magnet frame in the indentations on top of the coil with frame oriented as in Fig. 2.

4. Add the armature and moveable-contact assembly.

5. Properly seat the stationary contacts in the slots of the molded stationary contact support and add the two contact spacers.

6. Add the two top stationary contacts and top contact retainer. Insert bus connector before proceeding to Step 7.

7. Tighten the four long bolts in a uniform manner using a diagonal tightening sequence. Tighten the bolts with 14 to 18 inch-pounds torque (1.6 to 2.0 Newton meters).

DISASSEMBLY AND ASSEMBLY

Single-pole, Single-throw Type
(One Normally Open Contact)

DISASSEMBLY

(Refer to Fig. 3, page 2 for exploded view and parts index).

1. Remove all electrical connections and remove the contactor from the vehicle for easier servicing.

2. Loosen the four long bolts in each corner and remove the two contact spacers.

3. Remove the two stationary contacts.

4. Remove armature and movable-contact assembly.

5. Remove magnet frame and coil from the base.

6. Loosen and remove the 10-32 nut from the armature and movable contact assembly using a 3/8-inch socket or nut driver. Note the order in which the parts are removed from the stud. See Fig. 3, page 2.

ASSEMBLY

(Refer to Fig. 3, page 2 for exploded view and parts index).

Before assembly all parts should be cleaned and inspected for wear and replaced if required. The assembly is performed in the reverse order from the disassembly with the following precautions required:

1. Force the small end of the spiral spring over the small diameter on the armature assembly. See Fig. 4, page 3.

2. Reassemble the armature parts 4a to 4k and tighten the 10-32 nut to 14 to 18 inch-pounds torque (1.6 to 2.0 Newton meters).

3. Locate the projections on the magnet frame in the indentations on top of the coil with frame oriented as in Fig. 3.

4. Add the armature and moveable-contact assembly.

5. Properly seat the stationary contacts in the slots of the molded stationary-contact support and add the two contact spacers.

6. Tighten the four long bolts with 14 to 18 inch-pounds torque (1.6 to 2.0 Newton meters).

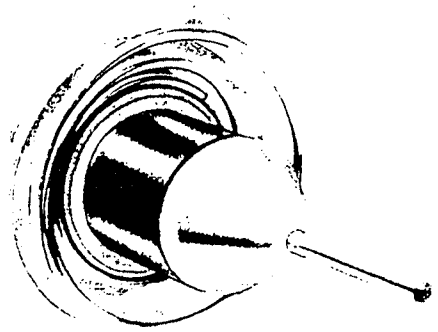


Fig. 4. Spiral spring attached to small diameter on cone head

SECTION 8
Page 4

AUXILIARY CONTACTS

Auxiliary contacts or electrical interlocks are available for the contactors as shown mounted on the contactor in Fig. 5. The auxiliary contact block is operated by de-energizing the contactor. Figures 6 and 7, page 4, illustrate the operations.

To obtain proper operation of the contact block, the gap between the auxiliary contact operator and the button on the contact block should be as shown in Fig. 7. This gap can be obtained by loosening the adjustment screws and moving the interlock support. The slots in the support permit this adjustment. The screws should be retightened to 14 to 18 inch-pounds torque (1.6 to 2.0 Newton meters).

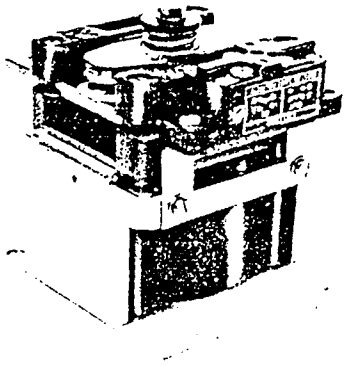


Fig. 5. Contactor with an auxiliary contact

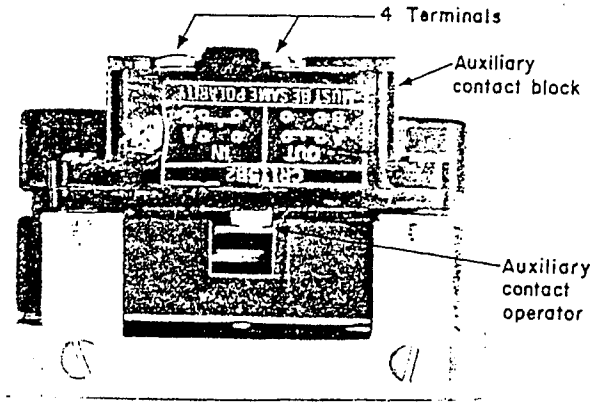


Fig. 6. Auxiliary contact shown in the operated position by the de-energized contactor

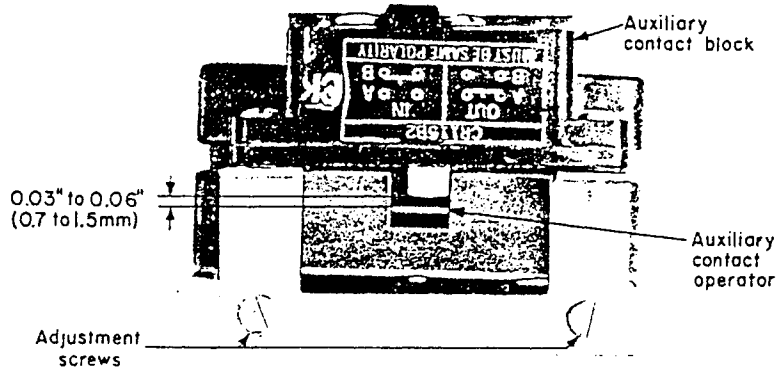


Fig. 7. Auxiliary contact shown in the normal position by the energized contactor

SECTION 8
Page 5

GEH-4469, 150- and 300-Ampere Electric-vehicle Control Contactors

Maintenance And Inspection Of Parts

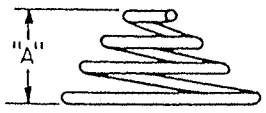
CONTACTS

Contacts must be replaced before they have worn through contact button to the base copper material.

SPIRAL RETURN SPRING

The free length should be between the limits shown in the table and should be replaced if it shows signs of corrosion.

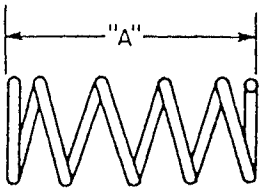
Contactor	Free Length "A" In inches (mm)
700, 710	0.73 to 0.79 (18.5 to 20.1)
701, 711, 712, 801, 702, 802, 811, 812	0.67 to 0.73 (17.3 to 18.5)
800, 810	0.80 to 1.00 (20.3 to 25.5)



CONTACT SPRING

The free length should be between the limits shown in the table and should be replaced if it shows signs of having been overheated or of corrosion.

Contactor	Free Length "A" In inches (mm)
700, 701, 711, 712, 801, 702, 802, 811, 812	0.38 to 0.40 (9.6 to 10)
800, 810	0.37 to 0.39 (9.4 to 9.9)



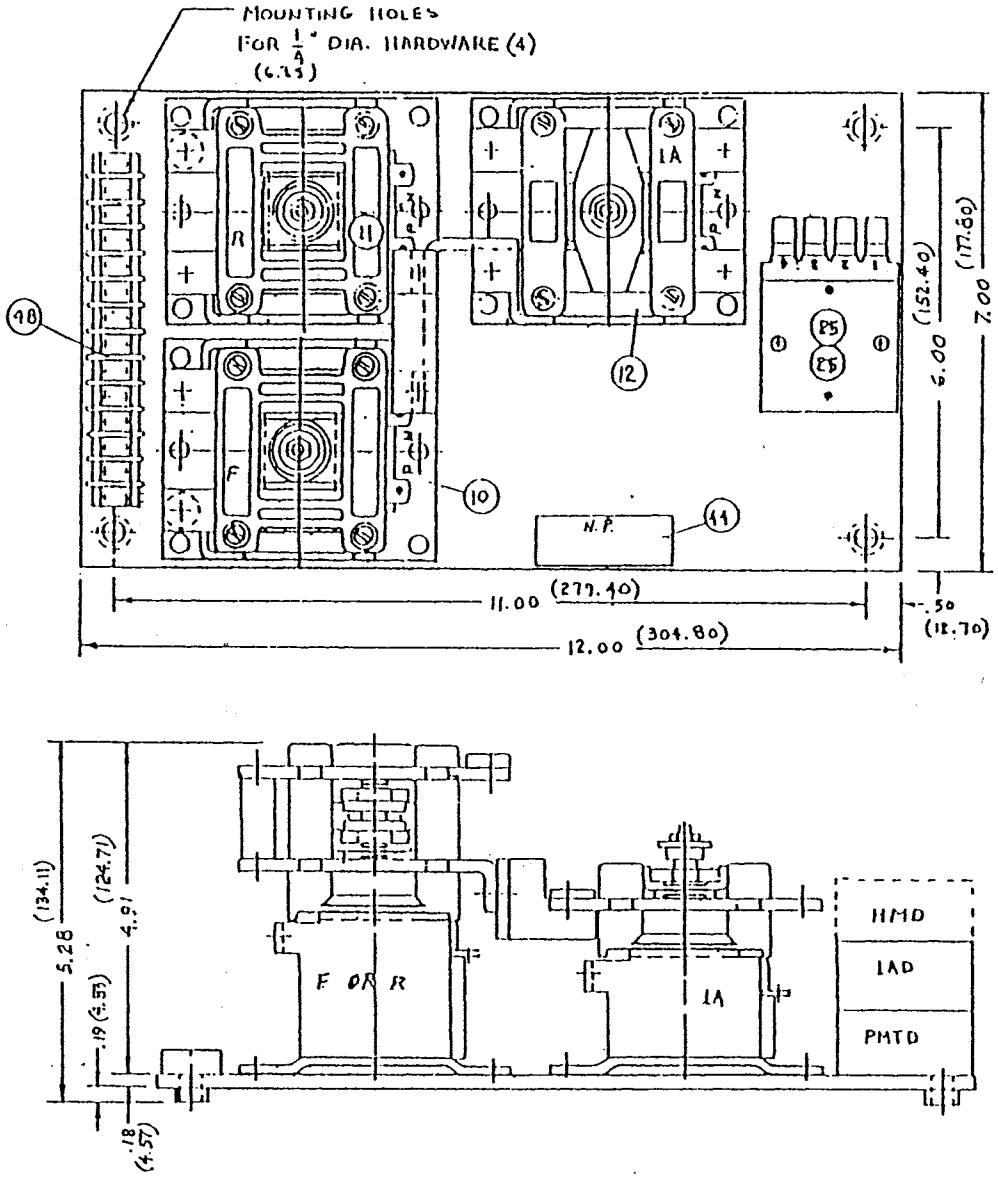
COILS

CAUTION: *The coils have voltage suppression cast integral with the coil. If a test voltage is applied in the wrong direction or if the coil is connected backwards, permanent damage may result. Observe the polarity mark on the coil during maintenance.*

If the contactor fails to operate, measure the voltage being applied to the coil terminals. The coils on the contactor have been designed to actuate the contactor on reduced battery voltage and with approximately three volts drop in the electronic circuit so that all contactors should operate at or below 65 percent of rated battery voltage. Replace the coil if the contactor does not operate to the full stroke on 65-percent voltage or if the coil shows signs of being overheated.

RENEWAL PARTS

Only factory specified parts should be used. These parts should be obtained from the truck manufacturer through his normal service channels.



NOTE: MOUNTING HARDWARE MUST NOT PROTUDE MORE THAN .19" (4. BEYOND BACK OF PA

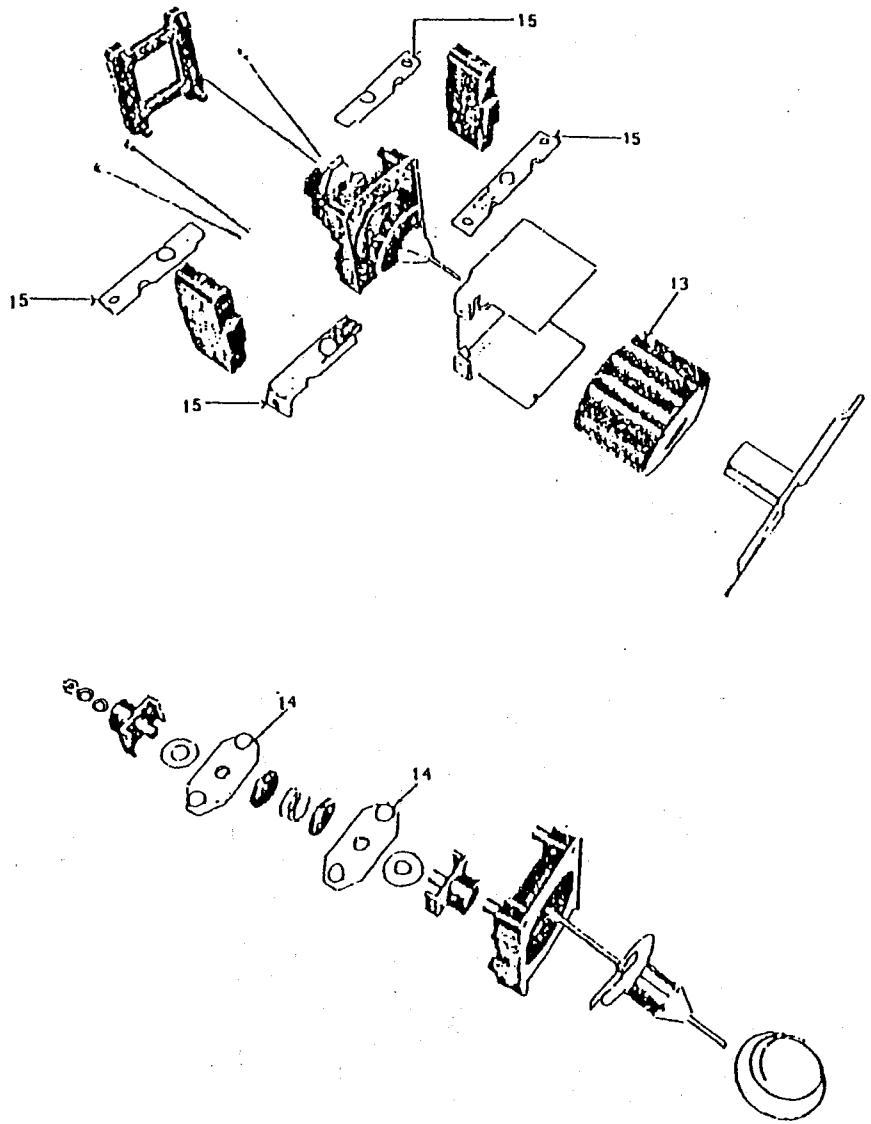
DIMENSIONS IN (ARE MILLIMETERS.

NO.	DESCRIPTION	LENGTH	QUAN.	REVISED DATE	REVISION
TOL. FRAC.±	DEC.±				
SCALE	NONE				
DRAWN BY	J.B.				
DATE	2-2-77				

FIGURE 6

EV-1 SCR 150 AMP-24/36/48VOLT CONTACTOR PANEL

TAYLOR DUNN MFG.
2114 West Ball Rd
Anaheim, Calif.



NO.	DESCRIPTION	LENGTH	QUAN.	REVISED DATE	REVISION

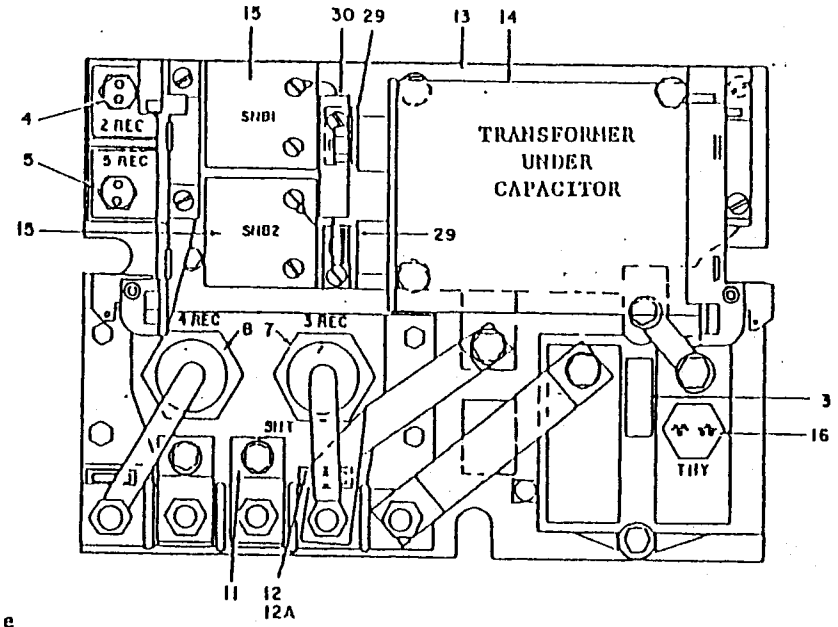
TOL. FRAC. ± DEC. ±	FIGURE 7	EV-1 SCR 150AMP-24/36/48VOLT CONTACTOR PANEL	TAYLOR DUNN MFG. CO.
SCALE NONE			2114 West Ball Rd.
DRAWN BY J.B.			Anaheim, Calif.
DATE 3-1-77			

SECTION 8
Page 7

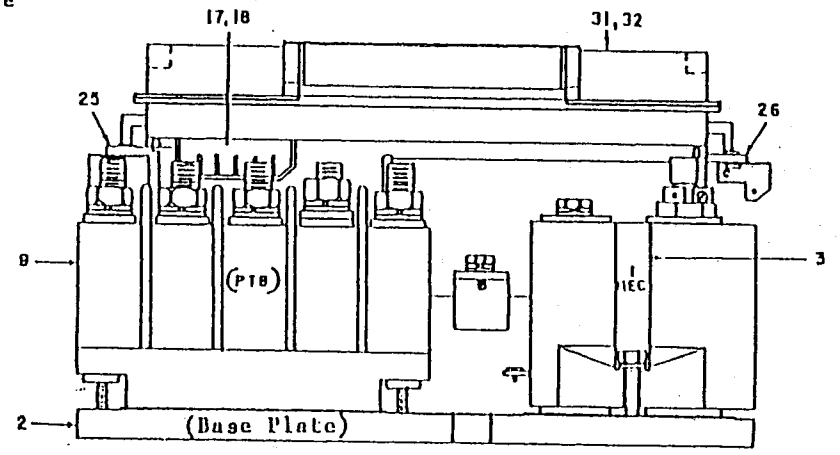
SECTION 8
Page 8

EV-1 SCR 150 CONTACTOR CONTROL
REFER TO FIGURE 6

FIG. I.D.	T-D PART NO.	DESCRIPTION	QTY.
6-0	71-305-00	CONTACTOR PANEL ASSEMBLY	1
6-10	71-305-70	CONTACTOR, FWD., SINGLE POLE, DOUBLE THROW	1
6-11	71-305-80	CONTACTOR, REV., SINGLE POLE, DOUBLE THROW	1
6-12	71-305-90	CONTACTOR, 1A., SINGLE POLE, SINGLE THROW	1
6-25	71-305-54	CONTACTOR DRIVER	2
NOT SHOWN	79-731-00	HOUR METER DIODE BLOCK (OPTIONAL)	1
6-44	71-305-55	NAMEPLATE (SPECIAL ORDER ITEM)	1
6-48	71-305-56	TERMINAL BOARD, 12 POSITION	1
		REFER TO FIGURE 7 FOR CONTACTOR PARTS	
FWD/REV CONTACTOR COMMON PARTS (EXCEPT AS NOTED):			
7-13	71-305-71	COIL, 36/48 VOLT, FWD/REV CONTACTORS	2
7-13	71-305-72	COIL, 24 VOLT, FWD/REV CONTACTORS (OPTIONAL)	2
7-14	71-305-73	MOVING TIP ASSEMBLY, FWD/REV CONTACTORS	2
NOT SHOWN	71-305-79	SPACER, FWD/REV CONTACTORS	2
NOT SHOWN	71-305-78	MOUNTING BOLT, SPACER, FWD/REV CONTACTORS	2
FORWARD CONTACTOR:			
7-15	71-305-74	TERMINAL, L.H. TOP, FWD CONTACTOR	1
7-15	71-305-75	TERMINAL, R.H. TOP, FWD CONTACTOR	1
7-15	71-305-76	TERMINAL, L.H. BOTTOM, FWD CONTACTOR	1
7-15	71-305-77	TERMINAL, R.H. BOTTOM, FWD CONTACTOR	1
REVERSE CONTACTOR:			
7-15	71-305-75	TERMINAL, L.H. TOP, REV CONTACTOR	1
7-15	71-305-81	TERMINAL, R.H. TOP, REV CONTACTOR	1
7-15	71-305-82	TERMINAL, L.H. BOTTOM, REV CONTACTOR	1
7-15	71-305-83	TERMINAL, R.H. BOTTOM, REV CONTACTOR	1
1A CONTACTOR:			
7-13	71-305-91	COIL, 36/48 VOLT, 1A CONTACTOR	1
7-13	71-305-92	COIL, 24 VOLT, 1A CONTACTOR (OPTIONAL)	1
7-15	71-305-93	TERMINAL, L.H., 1A CONTACTOR	1
8-15	71-305-94	TERMINAL, R.H., 1A CONTACTOR	1
8-14	71-305-95	MOVING TIP ASSEMBLY, FWD/REV CONTACTOR	1



NOTE: Use heat conductive grease, T-D Part #94-422-00, under all moulded assemblies that mount to the base except the power block (PTB).



NOTE: Apply a thin coating of heat conductive grease T-D Part #94-422-00 to the bottom of the Control Module (Base Plate) before mounting Module on vehicle.

SECTION 9
Page 1

NO.	DESCRIPTION	LENGTH	QUAN.	REVISED DATE	REVISION

TOL. FRAC. ± DEC. ±	FIGURE 8	EV-1 SCR CONTROL MODULE MODELS "A" OR "B"	TAYLOR DUNN MFG. CO. 2114 West Ball Rd. Anaheim, Calif.
SCALE NONE			
DRAWN BY J.B.			
DATE 2-2-77			

SECTION 9
Page 2

EV-1 CONTROL MODULES - A & B

REFER TO FIGURE 8

FIG. I.D.	T-D PART NO.	DESCRIPTION	QTY. REQ. A	B
	62-002-00	EV-1 SCR CONTROL MODULE - A	1	
	62-011-00	EV-1 SCR CONTROL MODULE - B		1
8-3	62-002-53	RECTIFIER ASSEMBLY (1 REC)	1	
8-3	62-011-51	RECTIFIER ASSEMBLY (1 REC)		1
8-4	62-002-54	RECTIFIER ASSEMBLY (2 REC)	1	
8-4	62-011-52	RECTIFIER ASSEMBLY (2 REC)		1
8-5	62-002-54	RECTIFIER ASSEMBLY (5 REC)	1	1
8-7	62-002-56	RECTIFIER ASSEMBLY (3 REC)	1	
8-7	62-011-53	RECTIFIER ASSEMBLY (3 REC)		1
8-8	62-002-56	RECTIFIER ASSEMBLY (4 REC)	1	
8-8	62-011-54	RECTIFIER ASSEMBLY (4 REC)		1
8-9	62-002-58	TERMINAL BLOCK ASSEMBLY	1	1
8-11	62-002-59	SHUNT ASSEMBLY	1	
8-11	62-011-55	SHUNT ASSEMBLY		1
8-12,12A	62-002-60	CAPACITOR	1	1
8-13	62-002-61	TRANSFORMER	1	
8-13	62-01-56	TRANSFORMER		1
8-14	62-002-62	CAPACITOR, COMMUTATING 200 VOLT	1	1
8-15	62-002-63	SNUBBER ASSEMBLY	2	2
8-16	62-002-64	THERMAL PROTECTOR	1	1
8-17	62-002-65	CONTROL TERMINAL BLOCK	1	1
8-18	62-002-66	COVER, TERMINAL BLOCK	1	1
8-25	62-002-67	SUPPORT, CARD BOX (LEFT HAND)	1	1
8-26	62-002-68	SUPPORT, CARD BOX (RIGHT HAND)	1	1
8-29	62-002-69	BUS	2	2
8-30	62-002-70	RESISTOR	1	1
8-31	62-002-51	CARD ASSEMBLY W/FLD. WEAKENING, SERIAL #IC3645OSC1C3	1	1
8-32	62-002-52	CARD ASSEMBLY W/O FLD. WEAKENING SERIAL #IC3645OSCC1D3	1	1
	94-422-00	GREASE, HEAT SINK	1	1

SECTION 10
Page 1

SUGGESTED SPARE PARTS LIST

FIG. I.D.	T-D PART NO.	DESCRIPTION	QTY 1-20 UNITS
		REFER TO FIGURE 1, FORWARD/REVERSE SWITCH	
1-3	71-091-53	HANDLE AND HUB ASSEMBLY	1
1-1	71-091-51	COVER	1
1-8	71-091-58	SPRING, CAM FOLLOWER	1
1-11	71-091-60	SWITCH, FORWARD AND REVERSE	2
1-12	71-091-61	CAPACITOR ASSEMBLY	2
NOT SHOWN	71-091-71	MOUNTING CLAMP, STEERING COLUMN	1
		REFER TO FIGURE 4, ACCELERATOR SWITCH	
4-1	61-912-51	SWITCH ASSEMBLY	2
4-10	61-912-61	SPRING, RETURN	2
4-13	61-912-64	POTENTIOMETER 5K, W/MOUNTING CLAMP	1
4-8	61-912-59	CAM SHAFT ASSEMBLY	1
NOT SHOWN	61-912-68	COVER	1
NOT SHOWN	61-912-66	HOSE	4
NOT SHOWN	61-912-67	CLAMP, HOSE	4
		REFER TO FIGURE 5, 75A/24V CONTACTOR PANEL	
5-16	71-306-51	CONTACTOR, FWD, SINGLE POLE, DOUBLE THROW	1
5-17	71-300-58	CONTACTOR, REV, SINGLE POLE, DOUBLE THROW	1
5-18	71-306-52	CONTACTOR, 1A BY-PASS, SIN. POLE, SIN. THROW	1
5-49	78-306-00	RESISTOR	2
5-41	71-306-53	FILTER BLOCK, 1A	2
5-43	71-306-54	FILTER BLOCK, FWD/REV	2
		REFER TP FIGURE 6 & 7, 150A-36/48V CONTACTOR PANEL	
6-10	71-305-70	CONTACTOR, FWD, SINGLE POLE, DOUBLE THROW	1
6-11	71-305-80	CONTACTOR, REV, SINGLE POLE, DOUBLE THROW	1
6-12	71-305-90	CONTACTOR, 1A, SINGLE POLE, DOUBLE THROW	1
6-25	71-305-54	CONTACTOR DRIVER	2
7-13	71-305-71	COIL, 36/48V., FWD/REV CONTACTORS	1
7-14	71-305-73	MOVING TIP ASSEMBLY, FWD/REV CONTACTORS	1
7-15	71-305-74	TERMINAL, L.H. TOP, FWD CONTACTOR	1
7-15	71-305-75	TERMINAL, R.H. TOP, FWD CONTACTOR	1
7-15	71-305-76	TERMINAL, L.H. BOTTOM, FWD CONTACTOR	1
7-15	71-305-77	TERMINAL, R.H. BOTTOM, FWD CONTACTOR	1
7-14	71-305-92	COIL, 24VOLT, 1A CONTACTOR	1
7-15	71-305-81	TERMINAL, R.H TOP, REVERSE CONTACTOR	1
7-15	71-305-82	TERMINAL, L.H. BOTTOM, REV CONTACTOR	1
7-15	71-305-83	TERMINAL, R.H. BOTTOM, REV CONTACTOR	1
7-13	71-305-91	COIL, 36/48, 1A CONTACTOR	1
7-15	71-305-93	TERMINAL, L.H., 1A CONTACTOR	1
7-15	71-305-94	TERMINAL, R.H., 1A CONTACTOR	1
7-14	71-305-95	MOVING TIP ASSEMBLY, 1A CONTACTOR	1
NOT SHOWN	71-305-61	KIT, 24 VOLT CONVERSION FOR 150 AMP CONTACTOR PANEL	1 (OPT)

SECTION 10
Page 2

REFER TO FIGURE 8, MODELS "A & B" CONTROL MODULES

FIG. I.D.	T-D PART NO.	DESCRIPTION	A	B
8-3	62-002-53	RECTIFIER ASSEMBLY, (1 REC)	1	
8-3	62-011-51	RECTIFIER ASSEMBLY, (1 REC)		1
8-4	62-002-54	RECTIFIER ASSEMBLY, (2 REC)	1	
8-4	62-011-52	RECTIFIER ASSEMBLY, (2 REC)		1
8-7	62-002-56	RECTIFIER ASSEMBLY, (3 REC)	1	
8-7	62-011-53	RECTIFIER ASSEMBLY, (3 REC)		1
8-11	62-002-59	SHUNT ASSEMBLY,	1	
8-8	62-011-54	RECTIFIER ASSEMBLY, (4 REC)		1
8-11	62-011-55	SHUNT ASSEMBLY		1
8-12,12A	62-002-60	CAPACITOR	1	1
8-13	62-002-61	TRANSFORMER	1	
8-13	62-011-56	TRANSFORMER		1
8-14	62-002-62	CAPACITOR, COMMUTATING 200 VOLT	1	1
8-15	62-002-63	SNUBBER ASSEMBLY	2	2
8-16	62-002-64	THERMAL PROTECTOR	1	1
8-17	62-002-65	CONTROL TERMINAL BLOCK	1	1
8-18	62-002-66	COVER, TERMINAL BLOCK	1	1
8-25	62-002-67	SUPPORT, CARD BOX (LEFT HAND)	1	1
8-26	62-002-68	SUPPORT, CARD BOX (RIGHT HAND)	1	1
8-30	62-002-70	RESISTOR	1	1
8-31	62-002-51	CARD ASSEMBLY W/FIELD WEAKENING, SERIAL IC36450SC1C3	1	1
8-32	62-002-52	CARD ASSEMBLY W/O FIELD WEAKENING SERIAL IC36450SCC1D3	1	1
	94-422-00	GREASE, HEAT SINK		

SECTION 11
Page 1

GENERAL ELECTRIC PARTS

T-D PART	DESCRIPTION	QTY.
	MODEL B 2-48	
71-610-00	BRACKET, CIRCUIT BREAKER	3
71-610-10	BRACKET FOR MOUNTING CIRCUIT BREAKER BRACKETS TO VEHICLE	1
78-106-00	BUSS BAR, TERMINAL CONNECTING, 2 POLE, FOR CIRCUIT BREAKERS	2
79-843-10	CIRCUIT BREAKER, 90 AMP, SINGLE POLE	2
	MODEL B 2-54	
71-610-00	BRACKET, CIRCUIT BREAKER	4
71-610-10	BRACKET FOR MOUNTING CIRCUIT BREAKER BRACKET TO VEHICLE	1
78-107-00	BUSS BAR, TERMINAL CONNECTING, 3 POLE, FOR CIRCUIT BREAKERS	2
79-843-00	CIRCUIT BREAKER, 100 AMP, DOUBLE POLE	1
79-843-11	CIRCUIT BREAKER, 100 AMP, TRIPLE POLE	1
	MODEL B 2-56	
71-610-00	BRACKET, CIRCUIT BREAKER	3
78-107-00	BUSS BAR, TERMINAL CONNECTING, 3 POLE FOR CIRCUIT BREAKERS	2
79-843-00	CIRCUIT BREAKER, 100 AMP, DOUBLE POLE	1
79-843-11	CIRCUIT BREAKER, 100 AMP, TRIPLE POLE	1
	MODEL E 4-51 (24 VOLT)	
71-610-00	BRACKET, CIRCUIT BREAKER	2
78-106-00	BUSS BAR, TERMINAL CONNECTING, 2 POLE, FOR CIRCUIT BREAKER	2
79-843-00	CIRCUIT BREAKER, 100 AMP, DOUBLE POLE	1
79-843-11	CIRCUIT BREAKER, 100 AMP, TRIPLE POLE	1
	MODEL E 4-53 & E 4-57 36 VOLT 3.5 H.P. MOTOR	
71-610-00	BRACKET, CIRCUIT BREAKER	2
78-106-00	BUSS BAR, TERMINAL CONNECTING, 2 POLE FOR CIRCUIT BREAKERS	2
79-843-00	CIRCUIT BREAKER, 100 AMP DOUBLE POLE	1
79-843-11	CIRCUIT BREAKER, 100 AMP TRIPLE POLE	1
	MODEL E 4-53 & E 4-57 36 VOLT 5.0 H.P. MOTOR	
71-610-00	BRACKET CIRCUIT BREAKER	3
78-107-00	BUSS BAR, TERMINAL CONNECTING, 3 POLE FOR CIRCUIT BREAKERS	2
79-843-00	CIRCUIT BREAKER, 100 AMP DOUBLE POLE	1
79-843-11	CIRCUIT BREAKER, 100 AMP TRIPLE POLE	1
	MODEL P 2-49	
71-610-00	BRACKET, CIRCUIT BREAKER	4
78-107-00	BUSS BAR, TERMINAL CONNECTING, 3 POLE FOR CIRCUIT BREAKERS	2
	NOTE: The following parts apply to those vehicles equipped with ev-1 SCR and optional equipment such as horns, windshield wipers, heaters, etc.	
78-500-00	HASH FILTER	
79-842-00	CIRCUIT BREAKER, 10 AMP, SINGLE POLE	
79-839-00	CIRCUIT BREAKER, 30 AMP, SINGLE POLE	
79-843-00	CIRCUIT BREAKER, 100 AMP, DOUBLE POLE	
79-843-11	CIRCUIT BREAKER, 100 AMP, TRIPLE POLE	

SPEED CONTROLLER

This page is intentionally left blank.

Table of Contents

LIST OF FIGURES

LIST OF ILLUSTRATIONS

LIST OF TABLES

INTRODUCTION

The all-new speed controller is developed and available only from Taylor-Dunn and is warranteed for one (1) year. However, modifications to the control unit, drive or power system will void the warranty.

Your electronic controller is a solid-state voltage regulator designed specifically for use on electric vehicles. The control function is to regulate the power fed from the battery to the motor so as to provide full control of the vehicle speed under all operating conditions.

The controller regulates motor power by switching the current on and off at high speed. The average voltage applied to the motor is varied by adjusting the ON time with respect to the OFF time, in response to power demand from the accelerator.

This technique, done with power transistors, is called Pulse Width Modulation. It results in a smooth transition from full stop to full speed, without any discernible steps in-between. Also, power loss to control components is extremely low, resulting in greater driving range per battery charge.

Questions regarding your Taylor-Dunn speed controller can be answered by the Taylor-Dunn dealer in your area, who will also assist you should you need service. Any credit returns and/or warranty requests to Taylor-Dunn are also handled by the authorized dealer.

SPEED CONTROL SYSTEM

Table 1, shown below, shows the controller installed for each vehicle. Each controller system consists of the contro panel assembly, wire harnesses and accelerator module (Part No. 62-033- 00).

All controllers can operate on 24 or 36 Volts DC. The 62-204-00 is for smaller vehicles. The 62-204-40 is sufficient for medium size burden carriers providing an "on demand". output of 400 amps. The largest controller, 62-205-00, is for heavy-duty burden carriers and tow tractors.

SPEED CONTROL SYSTEM					
VEHICLE MODEL	SPEED CONTROL	HARNESS CONTROL	HARNESS POWER	SOLENOIDS	
				ISOLATOR	FWD/REV
B 2-10 (36V)	62-204-40	75-148-78	75-149-78	72-501-38	72-501-39
B 2-38 (36V)	62-205-00	75-148-29	74-149-26	72-501-38	72-501-39
B 2-48 (36V)	62-205-00	74-148-29	75-149-26	72-501-38	72-501-39
B 2-80 (24V)	62-205-00	75-148-50	75-149-50	72-501-38	72-501-39
C 4-10 (36V)	62-205-00	75-148-74	75-149-77	72-501-38	72-501-39
C 4-15 (36V)	62-205-00	75-148-22	75-149-22	72-501-38	72-501-39
C 4-32 (36V)	62-205-00	75-148-23	75-149-23	72-501-36	72-501-37
C 4-33 (24V)	62-205-00	75-148-23	75-149-23	72-501-24	72-501-25
E 4-51 (24V)	62-205-00	75-148-12	75-149-12	72-501-24	72-501-25
R 3-80 (36V)	62-204-40	75-148-76	75-149-76	72-501-36	72-501-37
AN 1-71 (24V)	62-204-00	75-148-18	75-149-18	72-501-24	72-501-25
SC 1-59 (24V)	62-204-00	75-148-77	75-149-25	72-501-24	72-501-25
SC 1-75 (24V)	62-204-00	75-148-15	75-149-16	72-501-24	72-501-25
SS 5-34 (24V)	62-204-00	75-148-26	75-149-25	72-501-24	72-501-25

FEATURES

- Current Limit - Cold current limit is 275A for the 62-204-00 and 62-204-40, but the latter is capable of sustaining up to 400A for short periods of time (30 seconds or less). The 62-205-00 has a cold current limit of 400A.
- Thermal Roll-back - The controller will heat up if it is continuously overloaded. Above 150° F (65° C), the controller will shut down. When it cools down, full current limit and performance will return. As current rolls back, oscillation frequency will change so that the motor will generate a whining noise.

Note: *Thermal roll-back will not damage the controller. If it happens often, however, the controller is probably undersized for the operation, and another model with a higher current capacity should be used.*

Note: *Motor whine indicates overheating, most likely from overloading or system fault.*

- Acceleration Limit - Built-in acceleration ramp to prevent jackrabbit starts. It is permanently set to between 1 and 3 seconds, depending on the vehicle.
- High Pedal Disable - If the accelerator pedal is depressed at the time the controller is turned on, the controller will inhibit current output to the motor. The pedal has to be released and reapplied before the motor will run. This safety feature requires the operator to accelerate smoothly from a standing start.

CIRCUITS AND OPERATION

CIRCUITS

There are two circuits included in the operation of the controller - the control circuit and the power circuit.

The control circuit (light gauge wire) connects the key switch, seat switch (available on some models only), accelerator module, solid-state controller, forward-reverse switch and solenoids.

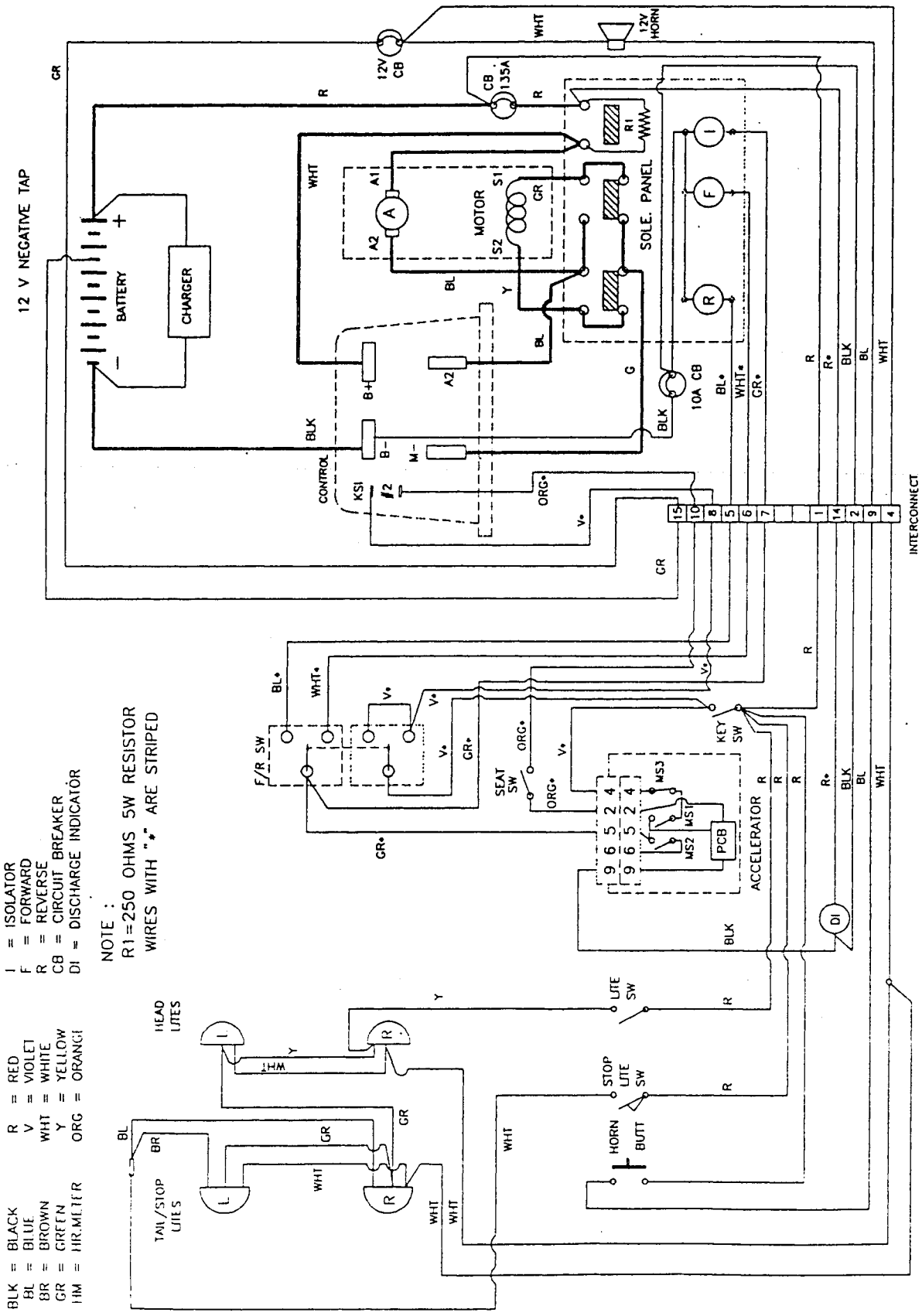
The power circuit (heavy gauge wire) connects the batteries, controller, solenoids, and motor.

OPERATION

To put your vehicle in operation, turn the ignition key to "ON". Select travel direction by moving the forward-reverse switch to the desired position. Release the park brake. Slowly depress the accelerator pedal until the vehicle is moving at desired speed.

You will notice your vehicle has a smooth transition from start to high speed operation. This is a built-in characteristic of the speed controller avoiding jackrabbit starts.

It is recommended when starting the vehicle to always turn the ignition key on first, then select travel direction with the forward-reverse switch BEFORE depressing the accelerator pedal.


12 V NEGATIVE TAP
BATTERY
CHARGER
12V CB
CB 135A
12V HORN
R1 WW
SOLE. PANEL
MOTOR
A1
A2
S1
S2
B+
B-
M-
CONTROL
KSI
10A CB
INTERCONNECT
F/R SW
SEAT SW
KEY SW
ACCELERATOR
PCB
MS1
MS2
MS3
LITE SW
STOP LITE SW
HORN BUTT
HEAD LITES
TAIL/STOP LITES
DI
I = ISOLATOR
F = FORWARD
R = REVERSE
CB = CIRCUIT BREAKER
DI = DISCHARGE INDICATOR
BLK = BLACK R = RED
BL = BLUE V = VIOLET
BR = BROWN WHT = WHITE
GR = GREEN Y = YELLOW
HM = HR.METER ORG = ORANGE
NOTE :
R1=250 OHMS 5W RESISTOR
WIRES WITH "•" ARE STRIPED

PREVENTIVE MAINTENANCE

WARNING!

Before working on the controller units or any part of the vehicle system, disconnect both the main positive and negative battery leads. Place the forward-reverse switch in neutral, turn off and remove the key. Always set the parking brake.

Be sure the ignition key is in the "ON" position before depressing the accelerator pedal. DO NOT depress the pedal before turning on the key - this is unsafe operation.

Caution!

Do not steam clean or spray with water.

Make sure all wire connections are secure.

When returning the vehicle to pre-service configuration make certain batteries are properly connected to avoid damage.

REPAIR OR REPLACEMENT OF PARTS

a. Wiring - the positions of all wires and lugs should be noted and marked prior to removal to avoid confusion on replacement.

b. Connection - Check all connections for tightness on completion.

c. Final Checks - Prior to the first switch on, check battery polarity. Use testlight to ensure safety.

Replace solenoids only with the same Taylor-Dunn part as originally supplied.

Replace accelerator module 62-033-00 as a unit, except for the spring. It is NOT designed to be serviced in the field.

Replace the controller as a complete unit. There are no user-servicable parts inside.

Accelerator Module

The accelerator module was designed to increase the reliability of the control system. The module requires very low maintenance and the components give solid state performance.

Note: *There are no adjustments that need to be made to the accelerator module. However, make sure the accelerator pedal is up and the accelerator lever is resting against the accelerator bracket. This is the off position.*

Speed Control Module

The speed control module consists of:

- Solenoids
- Speed controller
- Circuit breakers

Solenoid Assembly

WARNING!

Disconnect the main battery leads and remove the key before working on any part of the vehicle's electrical system.

Note: *Mark the position of all wires and buss bars prior to removal. Make sure they are put back in their original position.*

Speed Controller

The controller is designed specifically for use with electric vehicles. Its function is to provide full control of the vehicle's speed under all operating conditions.

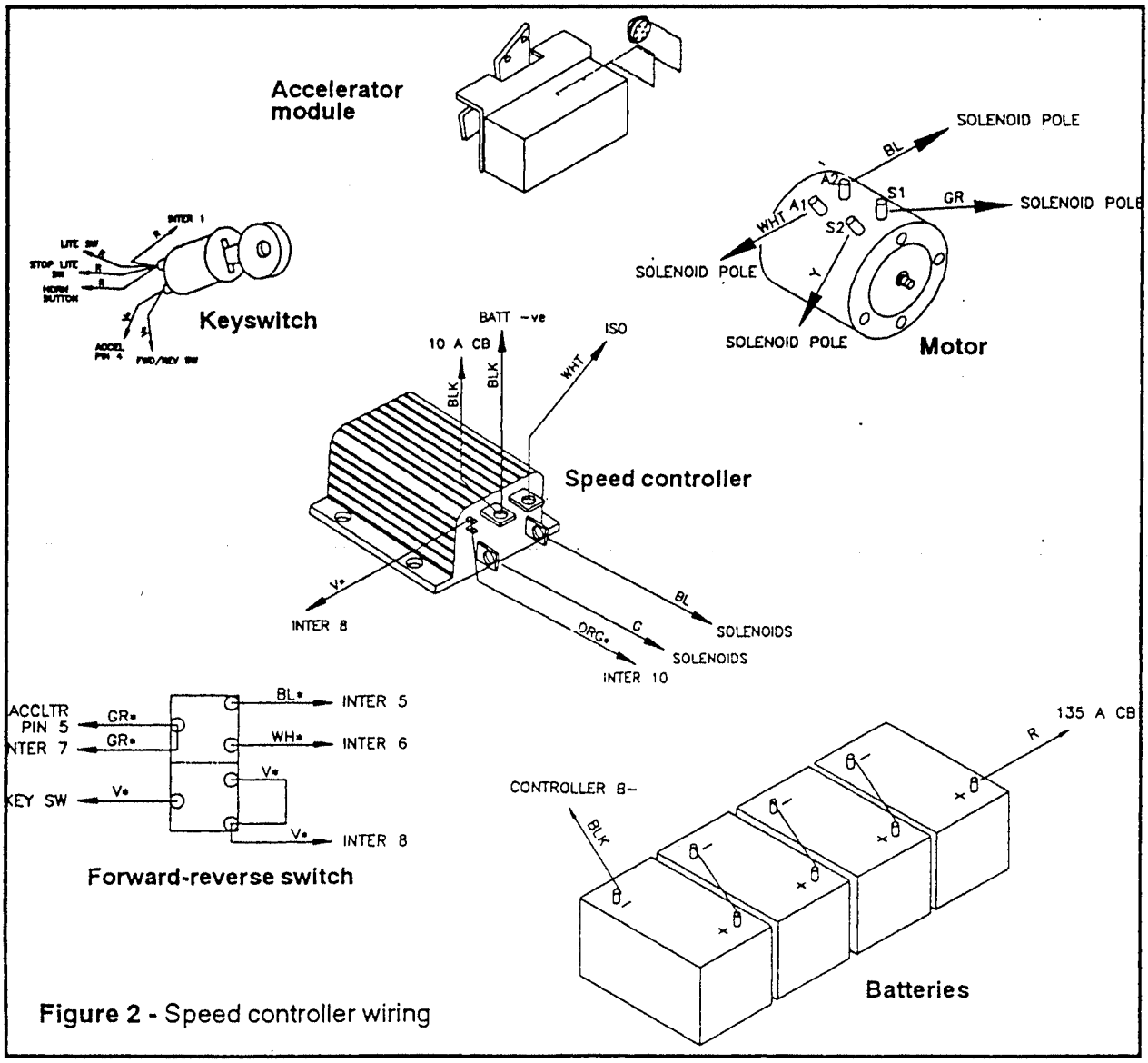


Figure 2 - Speed controller wiring

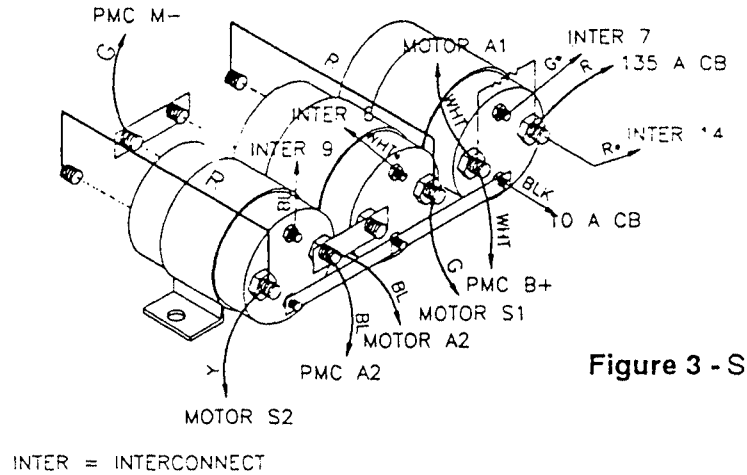


Figure 3 - Solenoid detail

TROUBLESHOOTING GUIDE

Note: *Before proceeding with any trouble-shooting, understand the basic principles of operation and be familiar with component testing and replacement procedures.*

WARNING!

Disconnect the main battery leads and remove the key before working on any part of the electrical system.

Testing the Accelerator Module

To test accelerator module do the following:

1. Visually inspect the accelerator spring. Replace in case of cracks or damage.
2. Visually inspect the bushings. Replace if worn or damaged.
3. Unplug the accelerator wire harness.
4. Using an accelerator module test box (Part Number 62-027-30), plug in the accelerator module pigtail.
5. Connect the B+ and B- terminals on the test box to the battery main positive and negative terminals.

Note: *Make sure the batteries are in good condition and fully charged.*

6. Set the V.O.M. to DC volt range to make the measurements. All readings must agree with the following tables.
7. With the pedal up, the following measurements should be found.

Pin Position	Pedal Up
2	0 Volts
4	Battery Voltage
5	0 Volts
6	0 Volts

8. Slowly depress the pedal. When pin No. 5 first measures battery voltage, the following measurements should be found:

Pin Position	#5 at Battery Voltage
2	6.0 - 6.3 Volts
4	Battery Voltage
5	Battery Voltage
6	0 Volts

9. With the pedal fully depressed, the following measurements should be found:

Pin Position	Pedal Fully Depressed
2	11.0 - 11.5 Volts
4	Battery Voltage
5	Battery Voltage
6	Battery Voltage

10. If the accelerator module fails it will need to be replaced.
11. Unplug the test pigtail and plug in the accelerator wire harness.

Test for Solenoid Operation

WARNING!

Raise and brace the rear of the vehicle. The drive wheels must not touch the ground. Always use jack stands of adequate capacity when supporting the vehicle. Perform this operation only on a flat, level surface.

To check for solenoid operation do the following:

1. Disconnect the wire that connects the motor S1 lead to the solenoids. Install a test light (Part # 62-027-00) in place of this wire.
2. Place the forward/reverse switch in the off position.
3. Turn the ignition key on and depress the pedal until the first microswitch in the accelerator module operates.
4. The lamp should go smoothly from full off to full on. If it does not, the controller is bad and should be replaced.
5. Measure the voltage across the coil terminals on the isolator solenoid. You should measure full battery voltage.
5. Place the forward/reverse switch in reverse.
6. Measure the voltage across the reverse solenoid. You should measure full battery voltage.
7. Place the forward/reverse switch in forward.
8. Measure the voltage across the forward solenoid. You should measure full battery voltage.
9. If the voltage reading is low, check for loose, faulty or misconnected wires, keyswitch, or forward/reverse switch .
10. If the solenoid coils and keyswitch input are getting voltage, make sure the solenoids are working by connecting the voltmeter across the power terminals. Contacts should show no voltage drop.
11. If a voltage reading indicates bad or worn contacts, replace the solenoid.

Testing Speed Controller Wiring

WARNING!

Raise and brace the rear of the vehicle. The drive wheels must not touch the ground. Always use jack stands of adequate capacity when supporting the vehicle. Perform this operation only on a flat, level surface.

To test controller power, do the following:

Caution!

Check the batteries' polarity. Severe damage to the controller will result if battery polarity is reversed.

Note: *Make sure the batteries are fully charged before proceeding.*

1. Make sure that the keyswitch is in the off position.
2. Check to see that the negative (-) battery terminal is connected to the B- terminal of the controller.
3. Connect the negative (-) voltmeter lead to the controller B- terminal.
4. Connect the positive (+) voltmeter lead to the battery side of the isolator solenoid.
5. The measurement should be full battery voltage.

Note: *If voltage is not present, check for loose wires, bad batteries, or faulty main circuit breaker.*

6. Connect the positive (+) voltmeter lead to the controller B+ terminal.
7. The voltmeter should have a voltage reading of 1 to 5 volts less than full battery voltage.

Note: *If the voltage is zero or close to zero, the trouble is either a defective controller, a defective resistor across the isolator solenoid, or the wire between the isolator solenoid and the controller. If the voltmeter reads full battery voltage, then the isolator has welded and must be replaced.*

8. Trace the wire to make sure it is connected correctly.
9. Remove and test the resistor on the isolator solenoid with an ohmmeter. The ohmmeter should read 250 ohms.

Testing Controller Output

Note: *This test assumes that the accelerator module has been previously tested and is known to be functioning properly.*

Note: *The test is best performed with an analog voltmeter. Digital meters may provide erratic readings.*

1. Raise and brace the rear of the vehicle and support it. The drive wheel must not touch the ground.

WARNING!

Always use jack stands of adequate capacity when supporting the vehicle. Perform this procedure ONLY on a flat, level surface.

2. Connect the positive (+) voltmeter lead to the controller M- terminal.
3. Connect the negative (-) voltmeter lead to the controller B- terminal.
4. Turn on the keyswitch.
5. Put the forward/reverse switch in forward or reverse.
6. Operate the accelerator over its full travel while monitoring the voltmeter. The voltmeter should read nearly full battery voltage with the pedal at minimum speed and drop smoothly to near zero volts with the pedal all the way down. It also should be noted that the speed of the rear wheels progressively increases as the accelerator pedal is depressed.
7. If no voltage or low voltage readings are observed and the wheel speed is low, check the wiring, connections, solenoid, and motor for poor connections or open circuits.
8. If the voltage reading is correct at the top of the pedal travel but does not drop, check the accelerator module input to the controller. It should vary from 6 to 11 volts with respect to the B- terminal over the full travel of the accelerator module.
9. Check for battery voltage on the KSI terminal on the controller.
10. Measure the current in the M- lead while operating the accelerator over its full travel. The current should gradually increase as the accelerator is depressed to a level of 25-60 amps.

    Tip: *Use a shunt/meter setup or a clamp-on DC ammeter to measure the current.*

11. If current is flowing in the M- lead but the wheel speed is not correct, there is probably a short in the motor or wiring.

If the results of these tests are normal but the vehicle does not operate properly, the free wheeling or plug diode in the controller may be faulty.

Checking the Plug Diode

To check the plug diode do the following:

1. Disconnect the battery leads.
2. Disconnect the A2 terminal on the controller.
3. Connect an ohmmeter capable of testing silicon diodes between the A2 and the B+ terminals on the controller.

   The ohmmeter should show a low resistance with the leads connected one way and a high resistance with the leads reversed.

Checking the Freewheeling Diode

To check the freewheeling diode, do the following:

1. Disconnect the cable from the M- terminal on the controller.
2. Connect the ohmmeter between the M- and B+ terminals on the controller.
3. The ohmmeter should show a low resistance with the leads connected one way and a high resistance with the leads reversed.
4. If either of the diodes appear to be defective, replace the controller.

Controller Bench Test

EQUIPMENT

To test the controller on the bench will require the simple setup shown below. You will need the following:

1. A power supply with voltage equal to the rating of the controller to be tested. This can be a string of batteries or a regulated line operated power supply. Since only low power tests will be described, a 10 amp fuse should be wired in series with the batteries to protect both operator and controller against accidental shorts.

WARNING!

A battery charger should not be used alone as a power supply, since without a battery load its output voltage may exceed the rating of the controller.

2. A controlled input source. Use a 62-033-00, solid-state accelerator input configuration, wired as shown.
3. A solenoid with a 250 ohm, 5 watt resistor across its contacts, and a toggle switch to turn it on and off.
4. A test load, test light (62-027-00) set to the same voltage as your power supply.
5. A general purpose volt ohmmeter or digital voltmeter.

BENCH TEST PROCEDURE

1. Pick up the controller and shake it. If anything in it rattles, it must be considered defective. Do not proceed with any more testing.
2. Hook up the controller as shown, and connect the voltmeter leads to the controller B+ and B- terminals.
3. Turn on the power supply (not the solenoid) and watch the voltmeter. Its reading should build up slowly over several seconds to full battery voltage. If the voltage does not come up, the controller is bad.
4. The lamp should not come on at this point. If it does, the controller is bad.
5. Turn on the switch operating the solenoid and the keyswitch input to the controller.
6. Move the accelerator arm and watch the lamp brightness. The lamp should go smoothly from full off to full on. If it does not, the controller is bad.

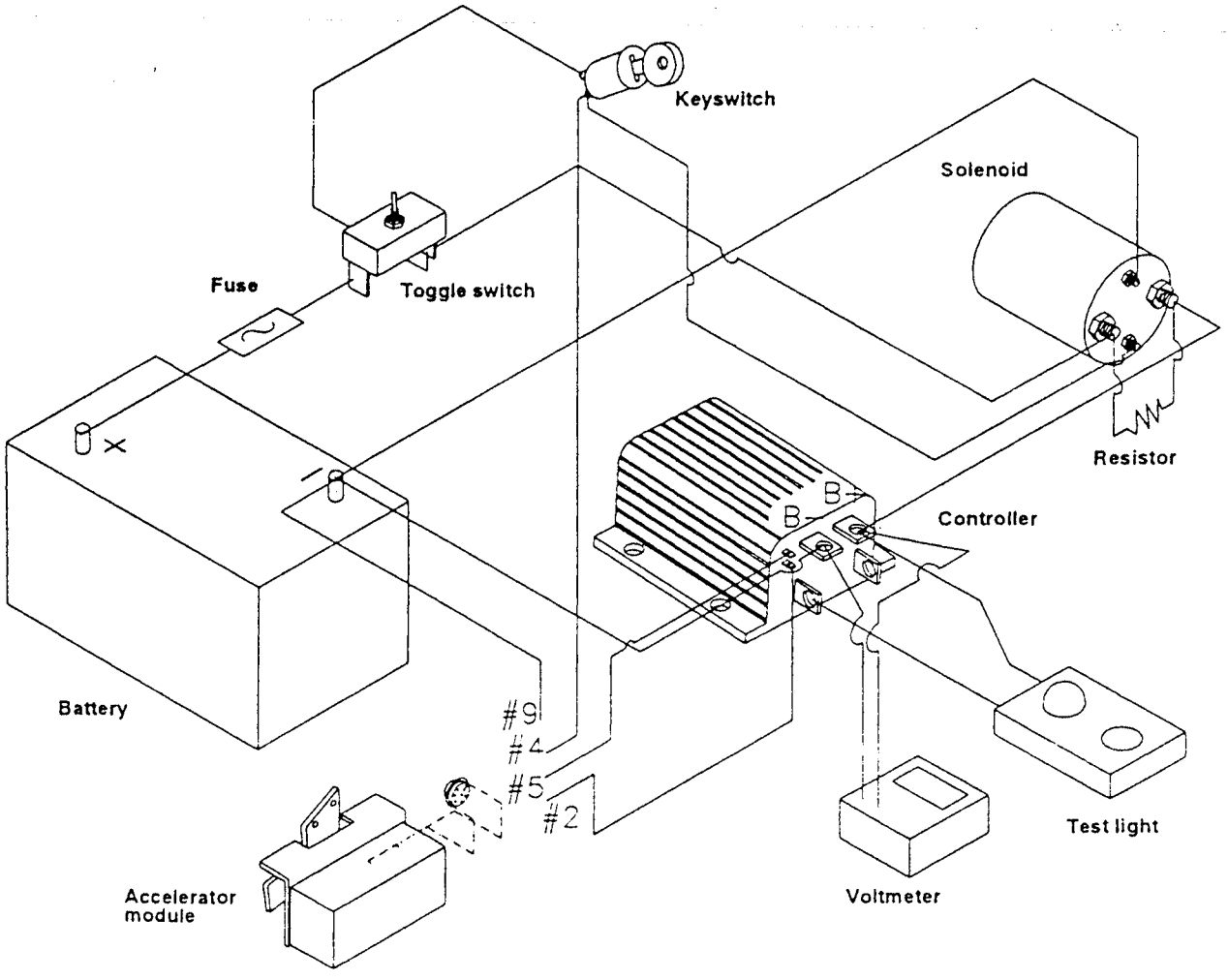
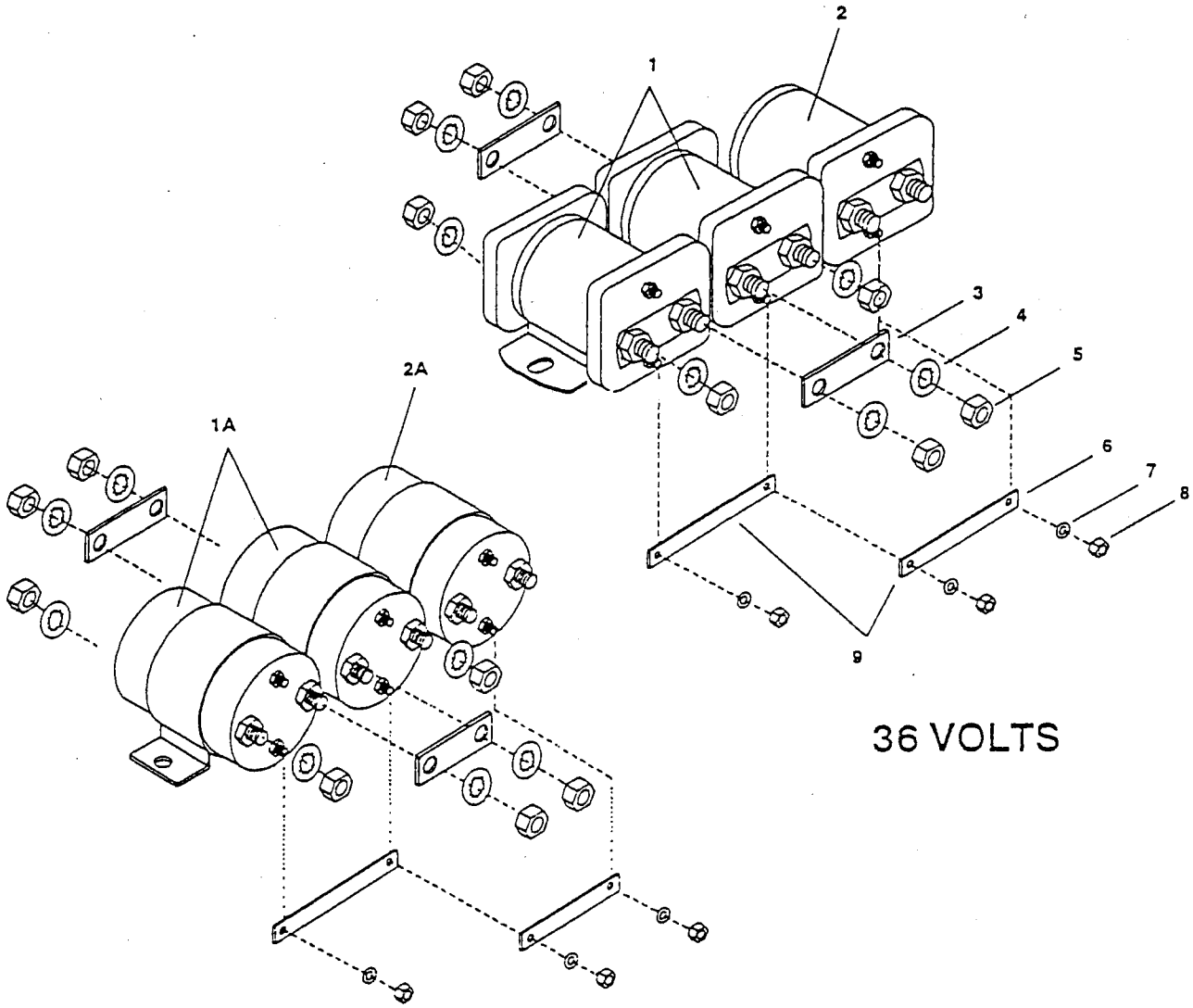


Figure 4 - Controller bench test set up

This page is intentionally left blank.

SOLENOIDS

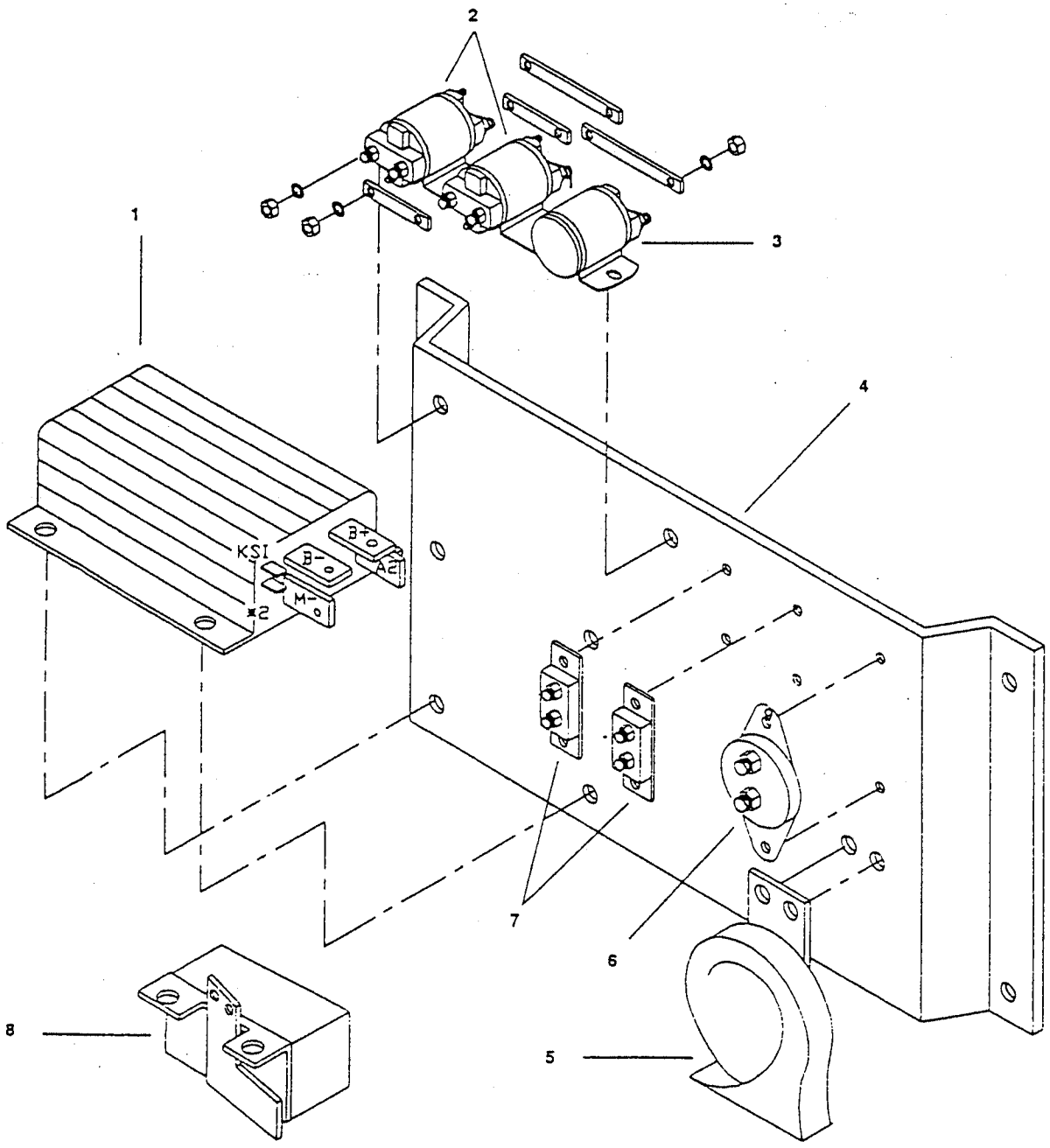


36 VOLTS

24 VOLTS

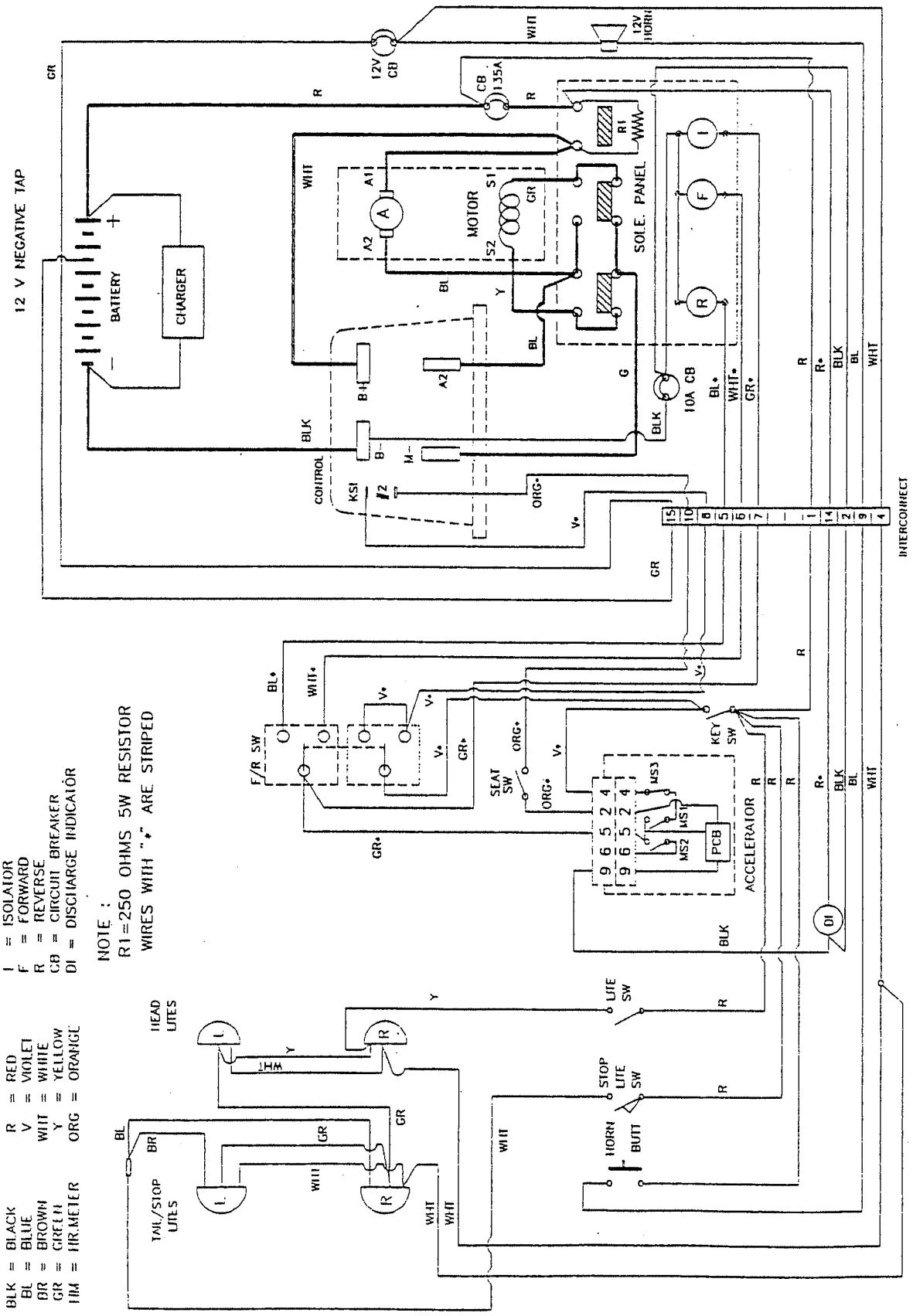
ASSEMBLY, SOLENOID, 36/24V			
ITEM #	PART NO.	DESCRIPTION	QTY
1	~~72-501-25~~	~~SOLENOID, SPDT 24V, 100A~~ N/A	2
1A	72-501-37	SOLENOID, SPDT 36V, 100A	2
1B	72-501-39	SOLENOID, SPDT, 36V, 200A	2
2	~~72-501-24~~	~~SOLENOID, SPST 24V, 100A~~ N/A	1
2A	72-501-36	SOLENOID, SPST 36V, 100A	1
2B	72-501-38	SOLENOID, SPST, 36V, 200A	1
3	61-838-41	Buss Bar, 5/8 X 1 1/2 HC	1
4	88-088-63	5/16 Lockwasher, INT	8
5	88-049-80	Nut, Hex Head	6
6	61-838-42	Buss Bar, 3/8 X 2 5/8 HC	2
7	88-048-62	#10 Lockwasher	5
8	88-099-91	5/16 Thin Pattern Nut	8

CONTROL PANEL



SPEED CONTROL PANEL			
ITEM #	PART NUMBER	DESCRIPTION	QTY.
1	62-204-00	Controller, 275 A	1
1A	62-204-40	Controller, 275/400 A	1
1B	62-205-00	Controller, 400 A	1
2	SEE "SOLENOID ASSEMBLY," pp. 18-19		2
3			1
4	01-534-80	Panel, Control Mounting	1
5	73-004-20	Horn, 12V, Short Mount	1
6	79-844-00	Breaker, Klaxon, Auto Reset	1
7	79-840-00	Breaker, 10 amp, Auto Reset	2
7A	79-844-20	Breaker, 200 amp, Auto Reset	2
8	62-033-00	Accelerator Module	1
9	75-148-25	Harness, Control Panel (Not Shown)	1

CONTROLLER PARTS NOT ILLUSTRATED		
PART #	DESCRIPTION	QTY
71-120-00	Key switch	1
71-501-00	Horn button	1
76-020-00	Battery connector	2
71-039-00	Forward/Reverse switch	1
94-301-00	Dash plate	1
74-009-10	Battery status indicator (optional)	1
74-000-00	Hour meter (optional)	1
88-817-07	Dash panel screw	6
71-122-10	Foot interlock switch	1


12 V NEGATIVE TAP
BATTERY
CHARGER
12V CB
CB 135A
12V HORN
MOTOR
SOLE. PANEL
10A CB
INTERCONNECT
CONTROL
F/R SW
SEAT SW
KEY SW
ACCELERATOR
PCB
HEAD LITES
TAIL/STOP LITES
LITE SW
STOP LITE SW
HORN
BUTT
NOTE :
R1=250 OHMS 5W RESISTOR
WIRES WITH "•" ARE STRIPED
I = ISOLATOR
F = FORWARD
R = REVERSE
CB = CIRCUIT BREAKER
DI = DISCHARGE INDICATOR
BLK = BLACK
BL = BLUE
BR = BROWN
GR = GREEN
HM = HR.METER
R = RED
V = VIOLET
WHT = WHITE
Y = YELLOW
ORG = ORANGE

N O T I C E O F C H A N G E

WE WANT OUR MANUALS TO BE USEFUL AND CORRECT. IF YOU DISCOVER AN ERROR OR WISH TO SUGGEST CHANGES, PLEASE FILL OUT THIS SHEET AND MAIL IT TO TAYLOR-DUNN.

MANUAL NO. _____ SERIAL NO. _____ DATE: _____

* AN ERROR(S) EXISTS ON THE FOLLOWING SECTION(S) AND PAGE(S) NO.

SECTION _____ PAGE NO. _____ LINE OR ITEM _____

_____

_____

_____

* **EXAMPLE:** Section 13, Page 5, Item 5.
PART NO. 41-350-55 KIT, CYLINDER REPAIR SHOULD BE PART NO. 41-350-66.

MAIL TO: TAYLOR-DUNN
ATTN: ENGINEERING
2114 W. BALL ROAD
ANAHEIM, CA 92804

==========

N O T I C E O F C H A N G E

WE WANT OUR MANUALS TO BE USEFUL AND CORRECT. IF YOU DISCOVER AN ERROR OR WISH TO SUGGEST CHANGES, PLEASE FILL OUT THIS SHEET AND MAIL IT TO TAYLOR-DUNN.

MANUAL NO. _____ SERIAL NO. _____ DATE: _____

* AN ERROR(S) EXISTS ON THE FOLLOWING SECTION(S) AND PAGE(S) NO.

SECTION _____ PAGE NO. _____ LINE OR ITEM _____

_____

_____

_____

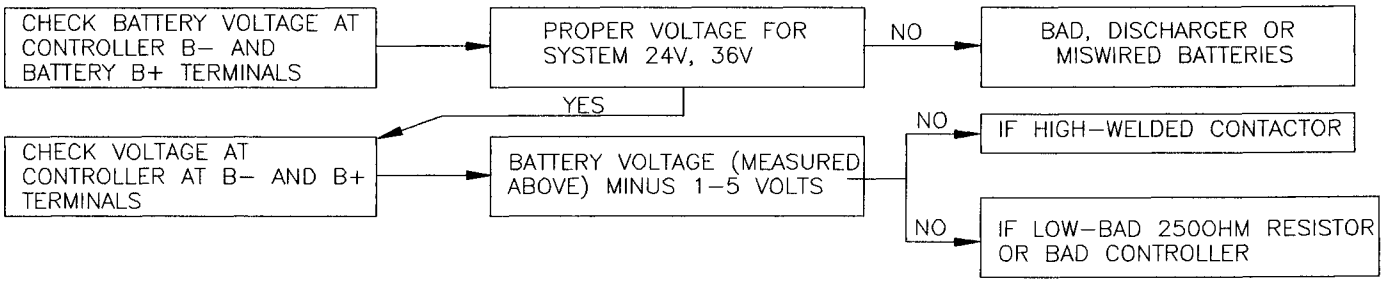
* **EXAMPLE:** Section 13, Page 5, Item 5.
PART NO. 41-350-55 KIT, CYLINDER REPAIR SHOULD BE PART NO. 41-350-66.

MAIL TO: TAYLOR-DUNN
ATTN: ENGINEERING
2114 W. BALL ROAD
ANAHEIM, CA 92804

SECTION 14
Page 9

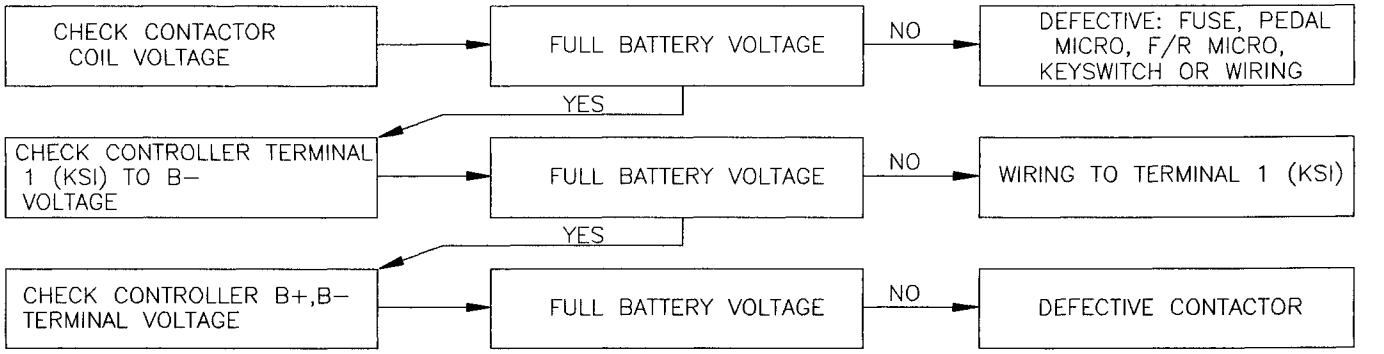
TROUBLE SHOOTING CHART

SET–UP: Key Switch Off



TESTING CONTROL WIRING

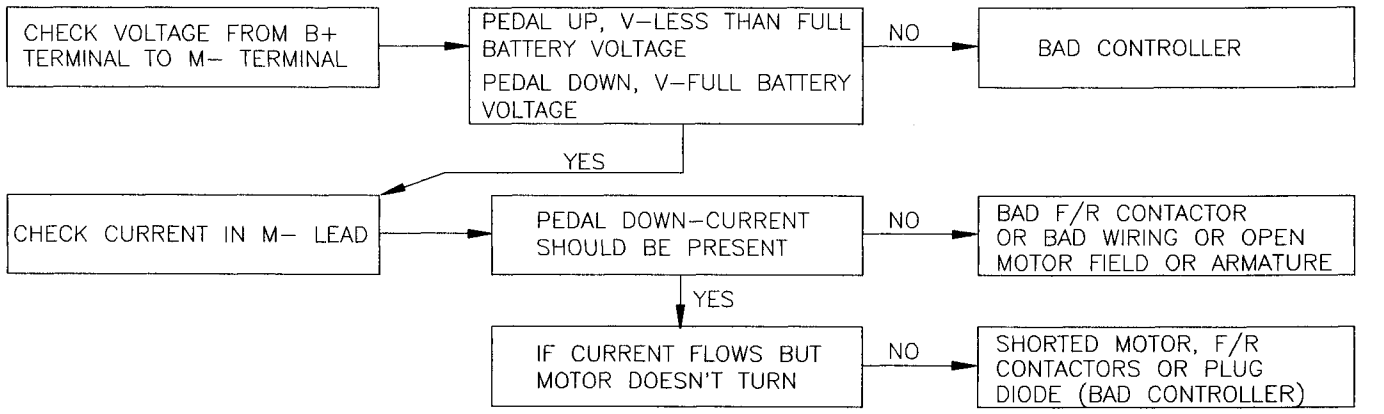
SET–UP: Key Switch On, F/R in Forward, Depress Pedal Until Microswitch Clicks



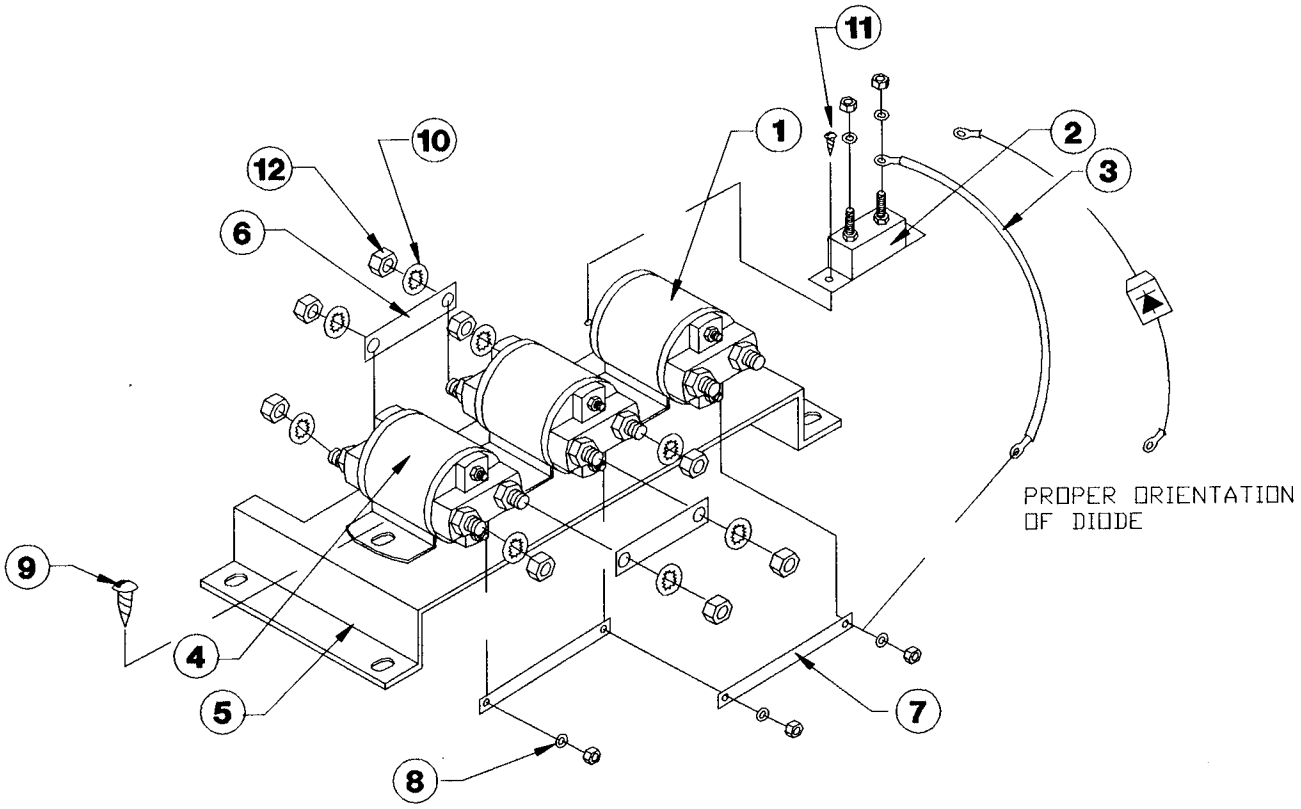
TESTING CONTROLLER OUTPUT

SET–UP: Key Switch On, F/R in Neutral

–If Main Contactor is De–Energized in Neutral it Must be Wired to Turn on for this Test



SECTION 14
Page 6



ASSEMBLY, SOLENOID PANEL, 24VOLT
PART NUMBER 72-560-80

ITEM	PART NO.	DESCRIPTION	QTY.
1	72-501-24	SOLENOID, SPST 24V, 200A	1
2	79-840-00	CIRCUIT BREAKER, 10A, AUTO	1
3	75-224-10	JUMPER, W/DIODE	1
4	72-501-25	SOLENOID, 24V, SPDT, 200 A	2
5	72-560-55	PANEL MTG, BRACKET, SOLENOID	1
6	61-838-41	BUS BAR, 5/8 X 1-1/2 HC	2
7	61-838-42	BUS BAR, 3/8 X2-5/8 HC	2
8	88-048-62	LOCK	5
9	88-838-06	#14 X 1/2 PAN HEAD SCREW	4
10	88-088-63	5/16 LOCK WASHER, INT	8
11	88-818-06	#8 X 1/2 PAN HEAD SCREW	2
12	88-099-91	5/16 NF THIN PATTERN NUT	8

SECTION 14
Page 2

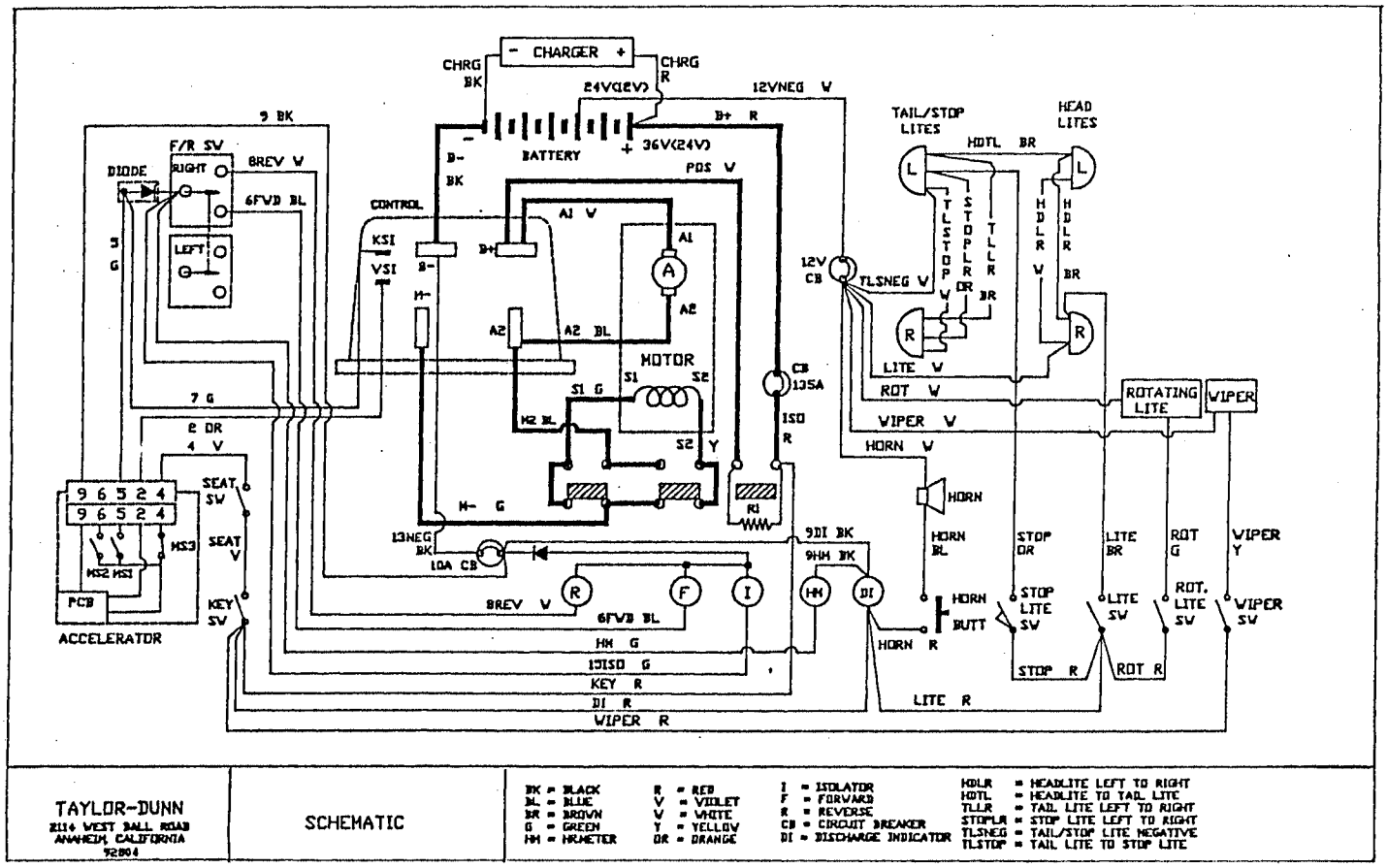


Figure 1

CIRCUITRY AND OPERATION

There are two circuits included in the operation of the controller, the control circuit and the power circuit.

The control circuit (light gauge wire) includes: key switch, seat switch, MS-1; activated by the accelerator module, the solid state controller, forward-reverse switch and solenoid panel.

The power circuit (heavy gauge wire) includes the batteries, forward reverse switch and motor.

SECTION 12
Page 4

D. C. MOTOR

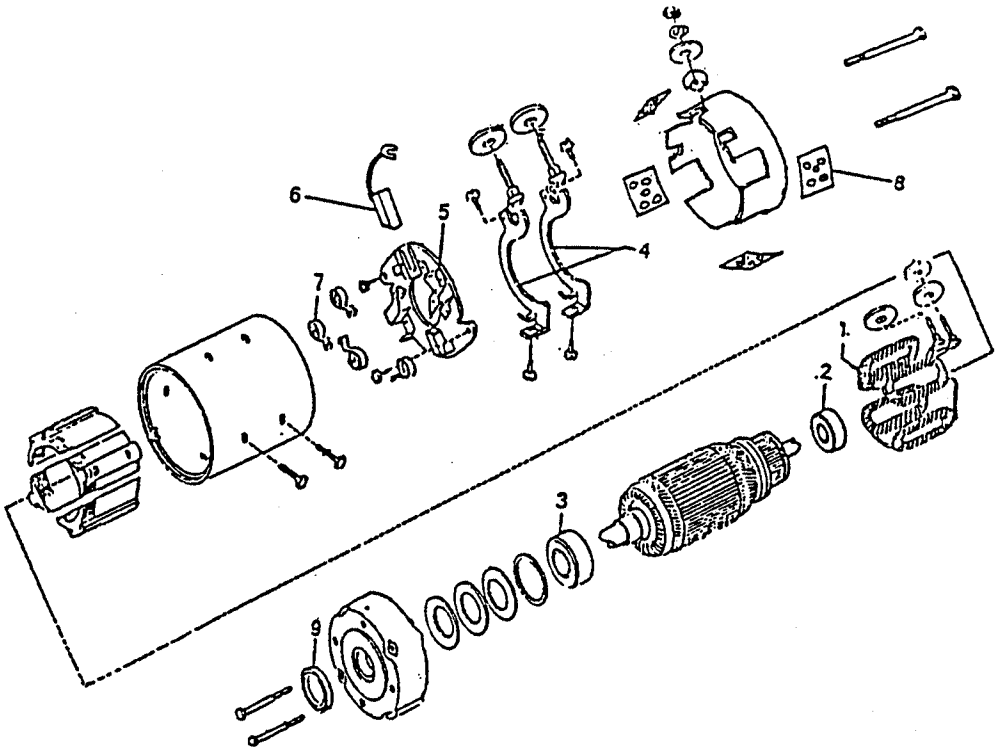
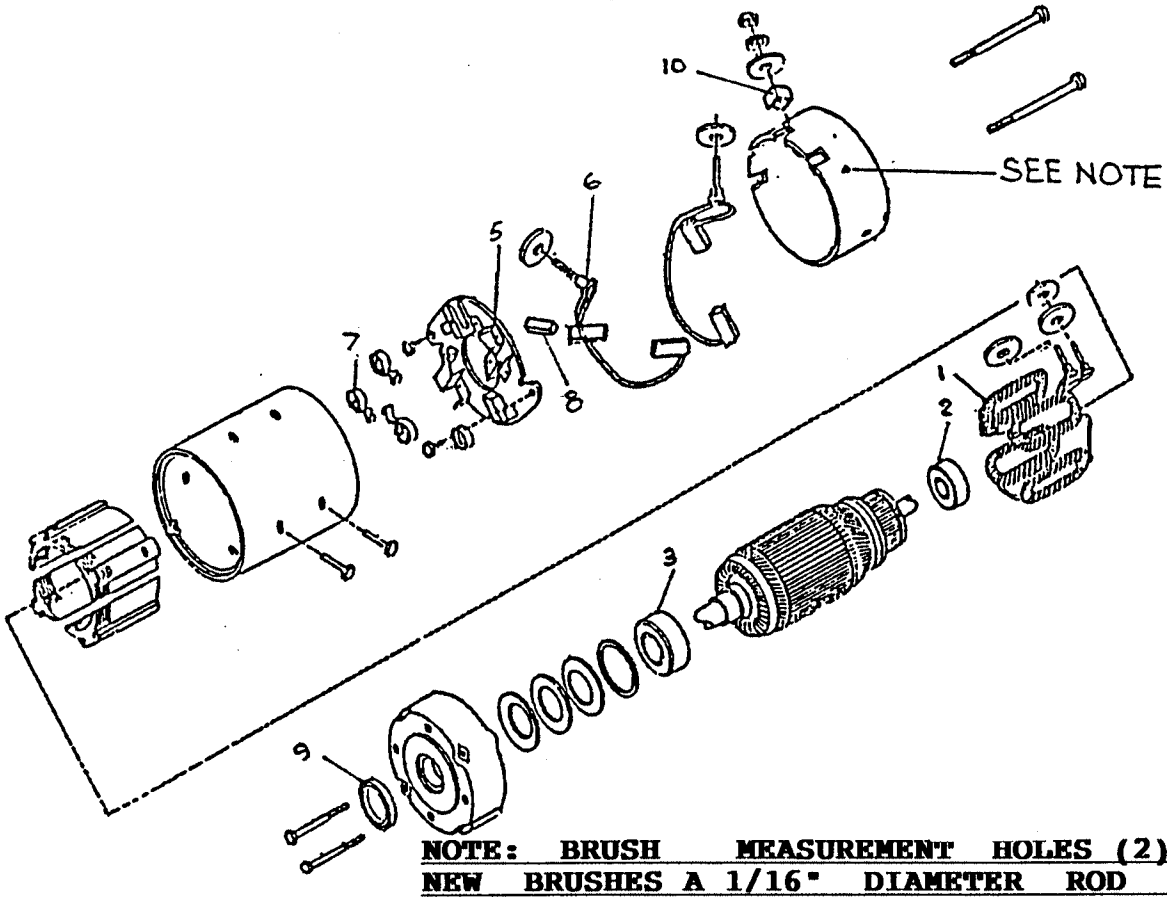


FIG.	I.D.	T-D PART NO.	DESCRIPTION	QTY.
	70-054-00		D.C. MOTOR 6.7 / 10.0 HP G.E 5BC49JB399	1
1.		70-203-10	FIELD COIL SET	1
2.		80-200-00	BALL BEARING, COMMUTATOR END	1
3.		80-504-00	BALL BEARING, PULLEY END	1
4.		70-195-10	ARMATURE TERMINAL TO BRUSH	2
5.		70-188-00	BRUSH HOLDER ASSEMBLY	1
6.		70-105-00	MOTOR BRUSH	4
7.		85-412-00	BRUSH EXTENSION SPRING	4
8.		30-802-00	BRUSH EXTENSION COVER	4
9.		45-508-00	OIL SEAL	1
10.		70-210-62	MOTOR TERMINALS INSULATOR KIT	1

SECTION 12
Page 3

D. C. MOTOR



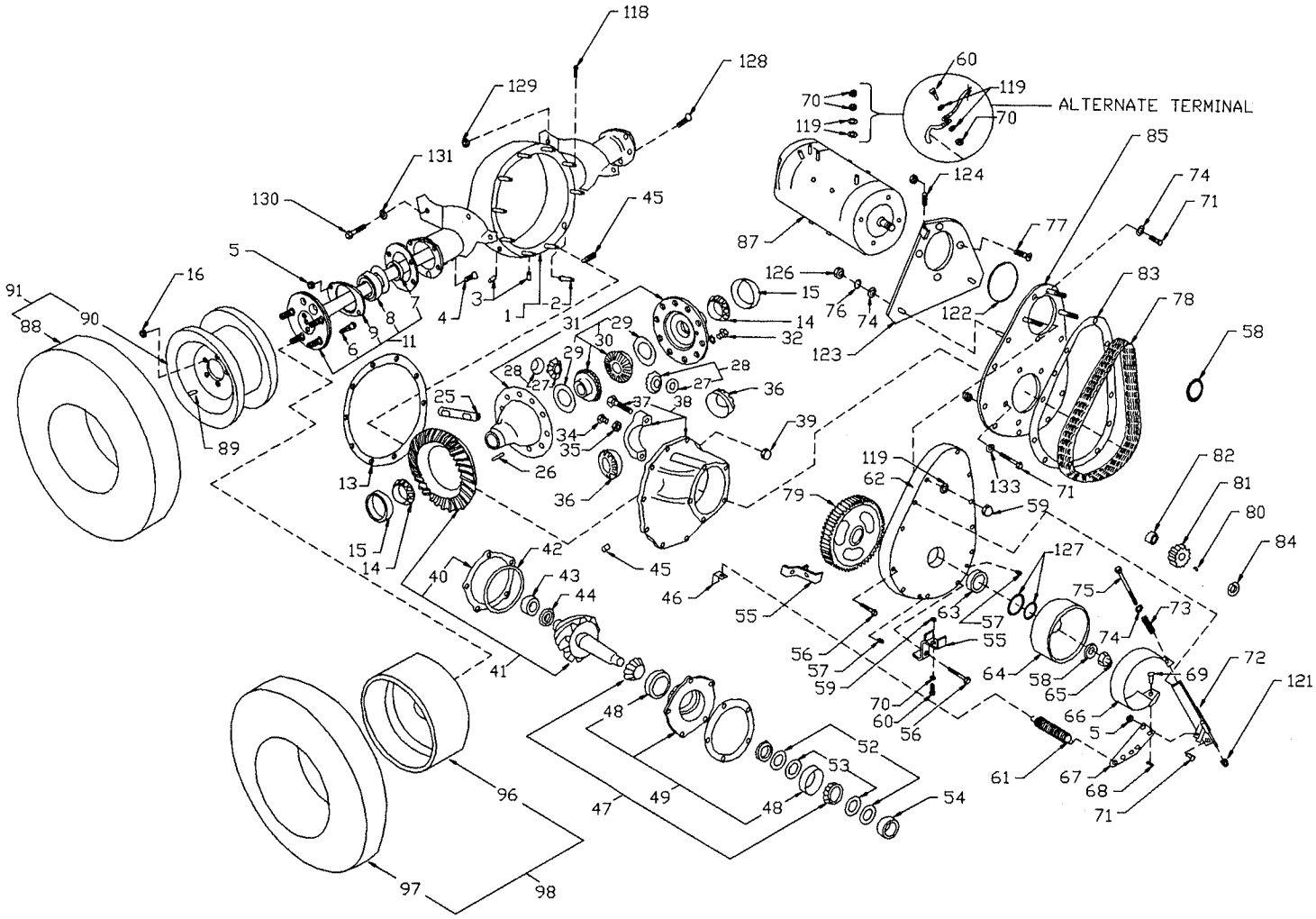
NOTE: BRUSH MEASUREMENT HOLES (2) WITH NEW BRUSHES A 1/16" DIAMETER ROD CAN BE INSERTED APPROXIMATELY .780" INTO THE BRUSH MEASUREMENT HOLES. BRUSHES SHOULD BE REPLACED WHEN ROD CAN BE INSERTED 1.560" INTO HOLE. THIS LEAVES APPROXIMATELY 1/8" WEAR REMAINING.

Replacement parts for G. E. Motor 5BC48JB754 (4.5 / 6.0 H.P. Motor) Taylor-Dunn part number 70-049-00

FIG. I.D.	T-D PART NO.	DESCRIPTION	QTY.
1.	70-205-00	FIELD COIL SET	1
2.	80-200-00	BALL BEARING, COMMUTATOR END	1
3.	80-504-00	BALL BEARING, PULLEY END	1
5.	70-172-00	BRUSH HOLDER ASSEMBLY WITHOUT BRUSHES	1
6.	70-104-00	BRUSH ASSEMBLY	2
7.	85-412-00	SPRING, BRUSH EXTENSION	4
8.	70-250-00	GASKET, TERMINAL	4
9.	45-506-00	OIL SEAL	1
10.	70-210-62	INSULATOR KIT, MOTOR TERMS	1

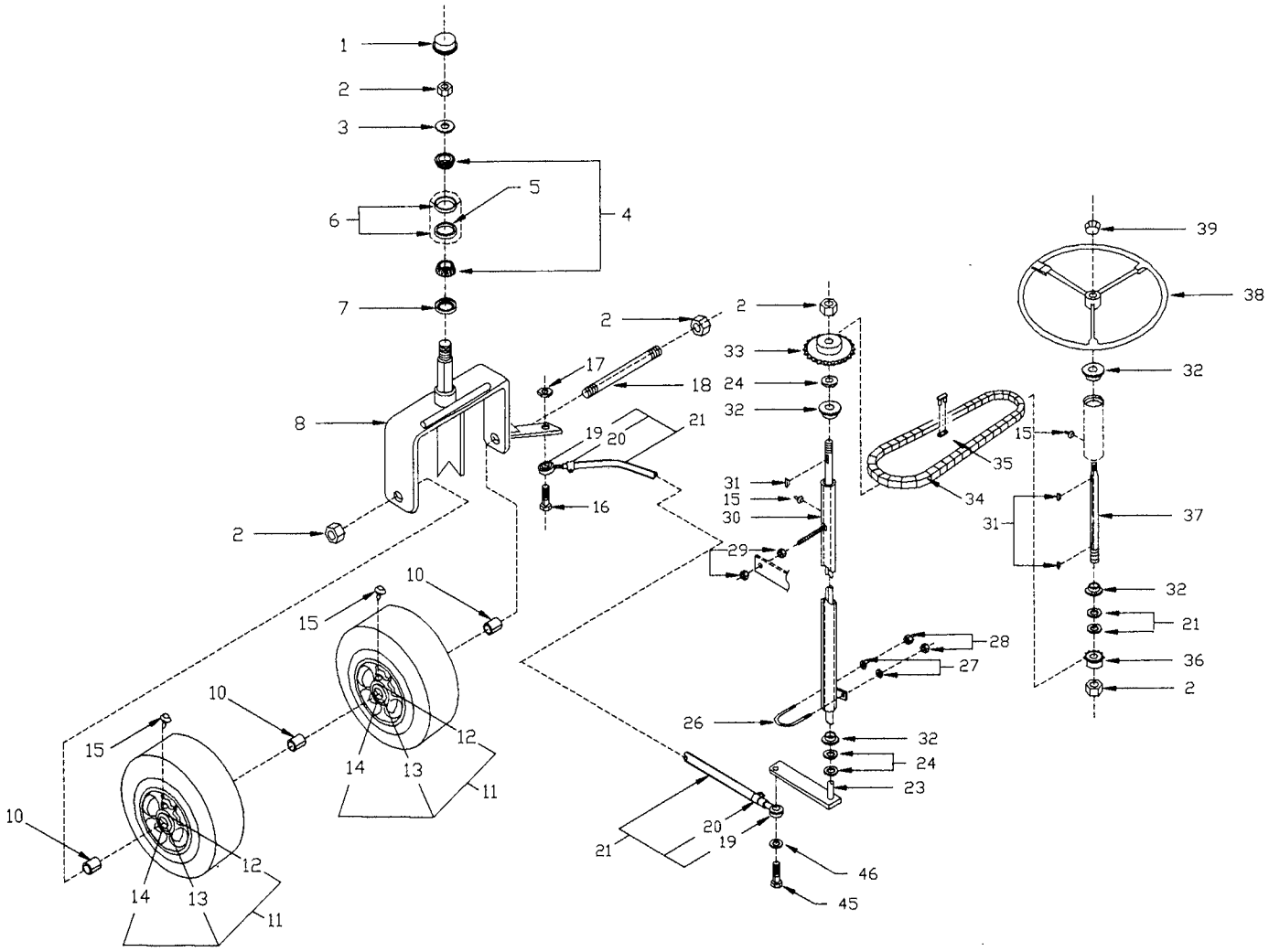
SECTION 11
Page 13

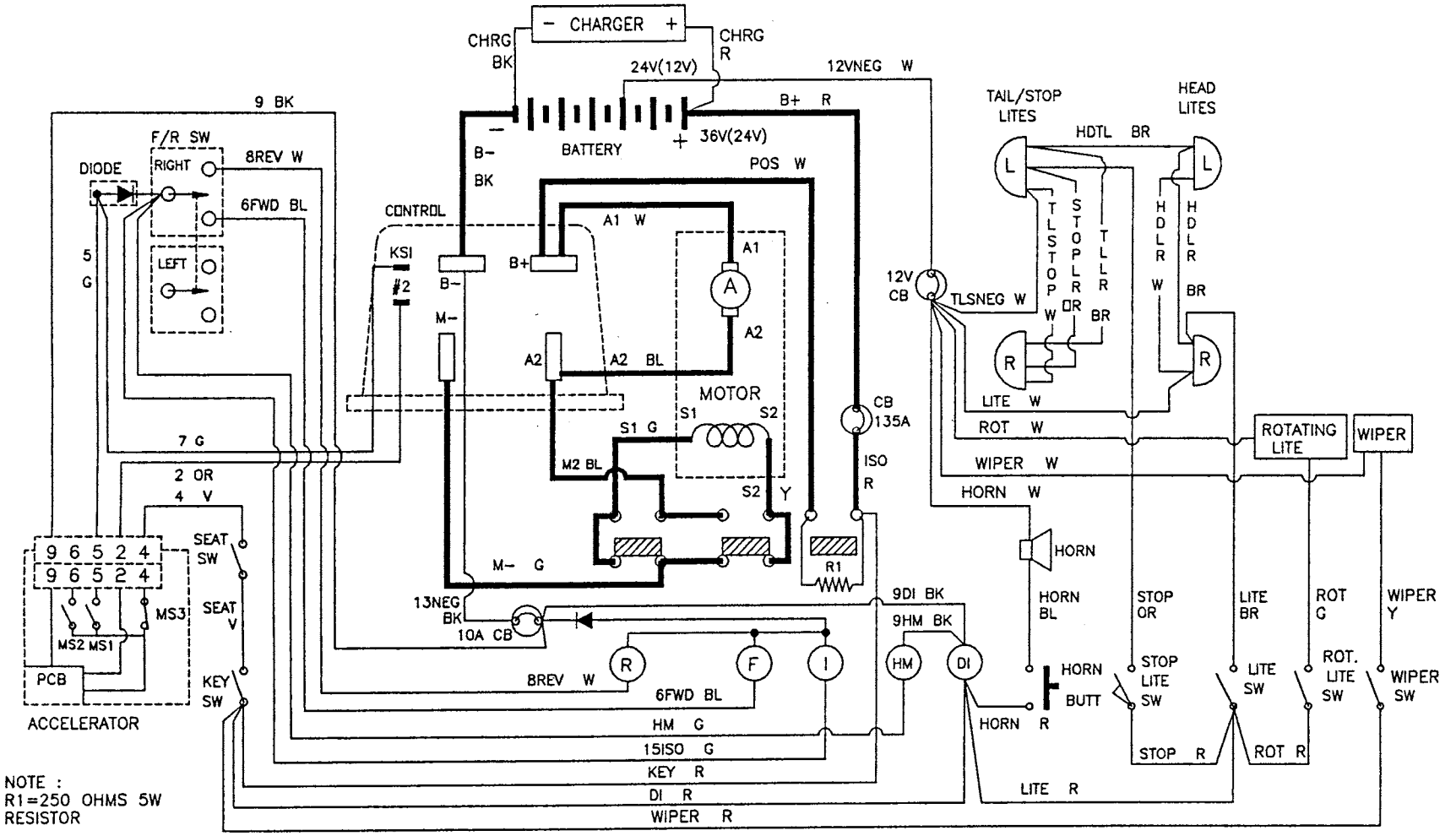
POWER TRACTION REAR AXLE, MOTOR AND BRAKES
FIGURE NO. 5



SECTION 10
Page 5

FRONT FORK AND STEERING DIAGRAM
FIGURE NO. 3





SECTION 7
Page 1

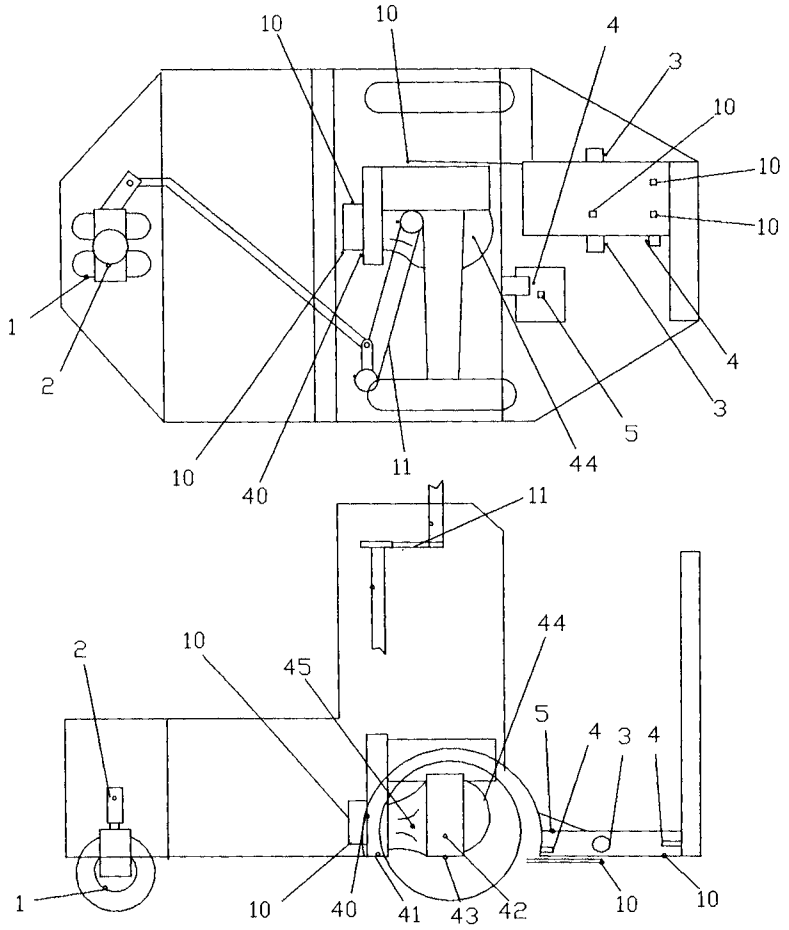
TAYLOR-DUNN
2114 WEST BALL ROAD
ANAHEIM, CALIFORNIA
92804

SCHEMATIC

BK = BLACK
BL = BLUE
BR = BROWN
G = GREEN
HM = HR.METER
R = RED
V = VIOLET
W = WHITE
Y = YELLOW
OR = ORANGE
I = ISOLATOR
F = FORWARD
R = REVERSE
CB = CIRCUIT BREAKER
DI = DISCHARGE INDICATOR
HDLR = HEADLITE LEFT TO RIGHT
HDTL = HEADLITE TO TAIL LITE
TLLR = TAIL LITE LEFT TO RIGHT
STOPLR = STOP LITE LEFT TO RIGHT
TLSNEG = TAIL/STOP LITE NEGATIVE
TLSTOP = TAIL LITE TO STOP LITE

SECTION 5
Page 1

LUBRICATION DIAGRAM



A. SUPER LITHIUM GREASE

1. FRONT WHEEL HUB
2. FRONT WHEEL SPINDLE
3. TREADLE PIVOT
4. BRAKE LEVER
5. BRAKE LOCK PIN (LUBE BY HAND)

NOTE: 45 NOT USED IN THIS CONFIGURATION

NOTE: PLUG 40 ADDED FOR EASE IN REFILLING GEAR CASE TO PROPER LEVEL. GEAR CASE OIL LEVEL IS MAINTAINED BY RECIRCULATION FROM DIFFERENTIAL DURING OPERATION.

B. LIGHT OIL

10. CLEVIS PINS-MECHANICAL LINKAGE
11. CHAIN

C. "POWER TRACTION"
USE SAE 30 OIL
PROPER OIL LEVEL CHECK AT PLUG 42

TO CHANGE OIL-USE 2 QTS

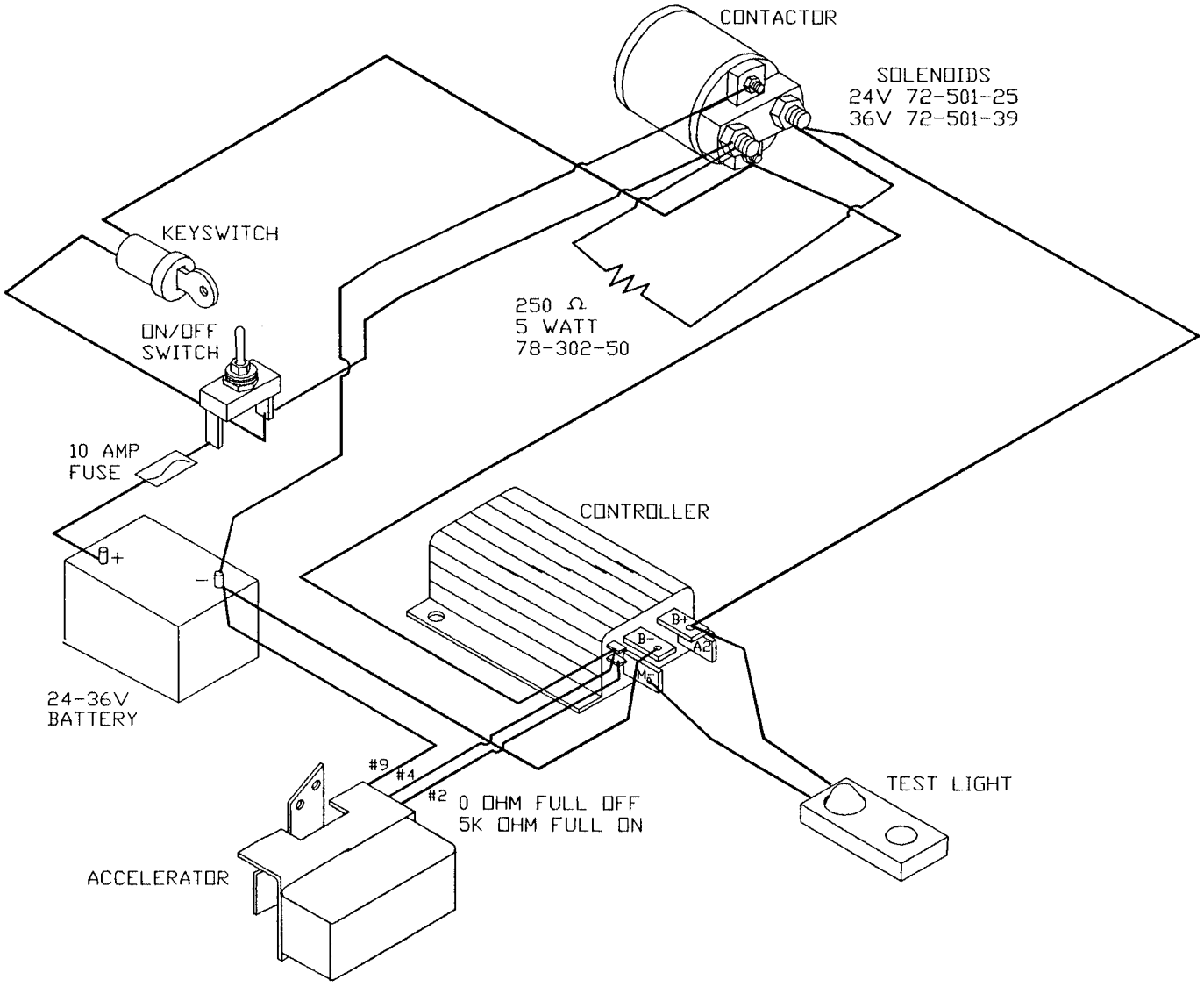
a. REMOVE DRAIN PLUGS 41 & 43
b. REMOVE LEVEL PLUGS 40 & 42 AND FILL PLUG 44
c. DRAIN OIL & REPLACE 41 & 43
d. ADD OIL BY 44 TO LEVEL OF 42
e. ADD OIL BY 40 TO LEVEL OF 40
f. REPLACE PLUGS

SECTION 14
Page 11

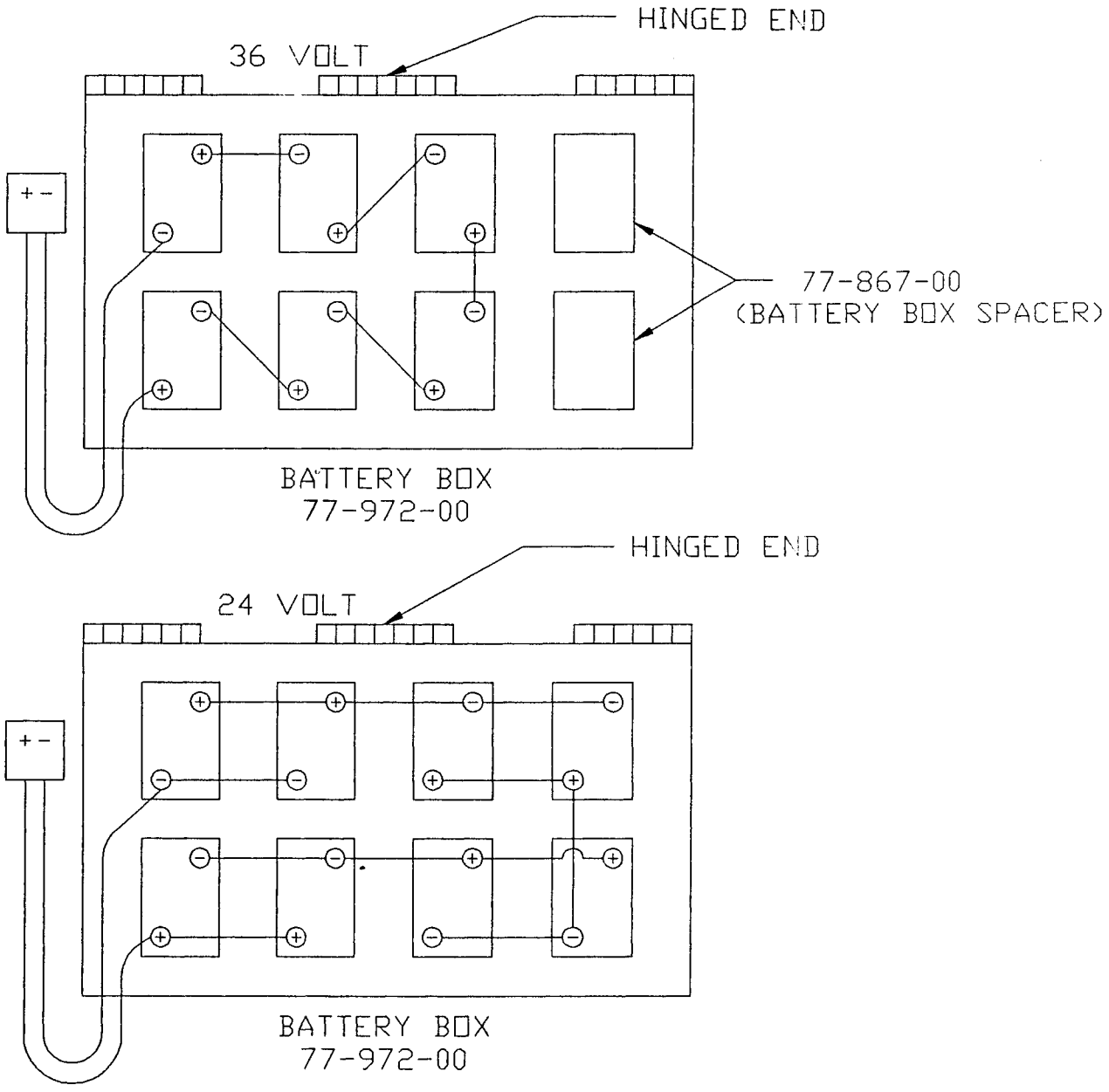
BENCH TESTING

7. Test the controller's high pedal disable function:
   a. Turn toggle switch off
   b. Depress accelerator until test light comes on full.
   c. Turn switch back on. Verify test light does not come on until the accelerator arm is depressed most of the way down, then turn back up.

BENCHTOP CHECKOUT SETUP



SECTION 16
Page 6



SECTION 16
Page 8

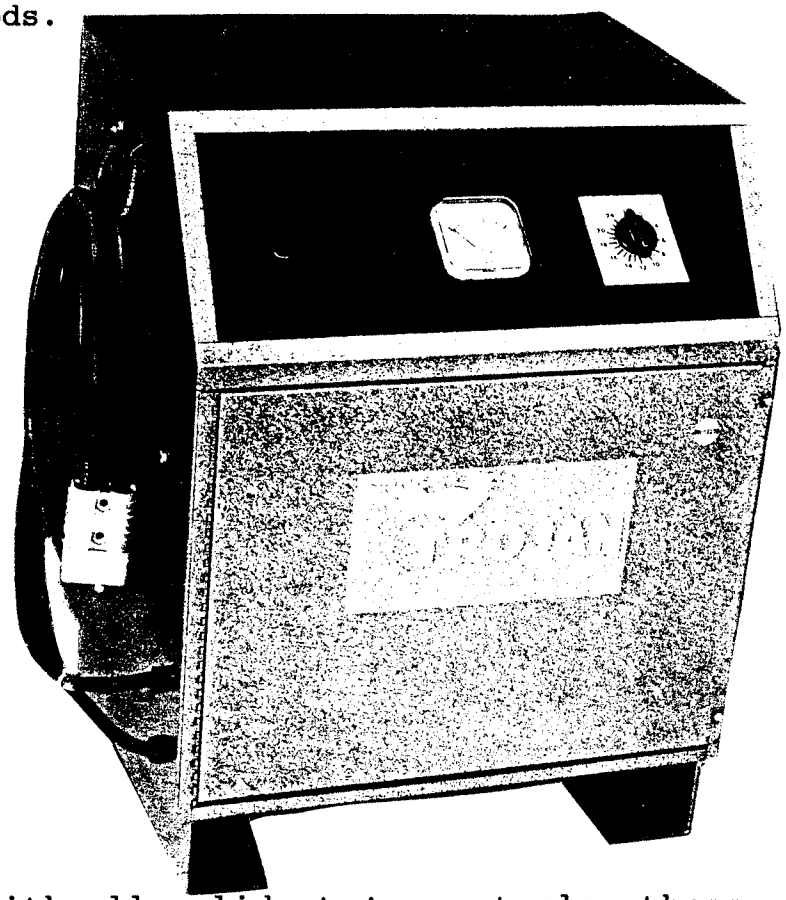
BATTERIES AND CHARGER

SERVICE AND ADJUSTMENTS

When testing battery charge condition with hydrometer, always return electrolyte solution to the same cell from which it was removed. DO NOT MIX electrolyte from one cell to another.

Refer to charger section for additional information on battery testing and charging methods.

CHARGERS



Equipped with all solid state controls, these units automatically monitor the charge rate, protecting your batteries from undercharge or overcharge, thus allowing your batteries to achieve their maximum life while always operating at peak efficiency.

All units are constructed of the finest materials and carry a written guarantee.

SECTION 17
Page 1

BODY AND TRIM PARTS