



OUTDOOR

POWER EQUIPMENT

OPERATION

GENERAL ELECTRIC COMPANY, CORPORATIONS PARK, BUILDING 702,
SCHENECTADY, NEW YORK 12305, Phone (518) 374-2211

SUBJECT: SERVICE TRAINING MANUAL - E12s & E15

ELEC-TRAK Dealers

The enclosed E12s and E15 Service Training Manual will assist your service personnel in becoming familiar with the electric tractor and in trouble shooting. The service manual points out all of the important items on the ELEC-TRAK tractor and gives details of its operation. It is very important that your service personnel understand how the ELEC-TRAK tractor operates. Knowing this makes trouble shooting very easy. Be sure your service personnel review this manual.

This Service Training Manual is sent to you at no charge. Additional copies of this manual are available at \$2.95 each, less 25%. To order additional copies for your shop personnel or customers, address correspondence to Advertising and Sales Promotion.

In the near future a similar section on the E20 will be added and you will receive this as soon as it is available.

Very truly yours,

J. L. Armstrong
Manager - Dealer Training

JLA:bk
Enc.

cc: E. L. Re
Home Office Marketing





SERVICE TRAINING MANUAL



GENERAL ELECTRIC

E-12S AND E-15

ELEC-TRAK TRACTOR

SERVICE

TRAINING MANUAL

OUTDOOR POWER EQUIPMENT OPERATION

Schenectady, New York 12305

THIS ELEC-TRAK TRAINING MANUAL WILL HELP FAMILIARIZE
NEW ELEC-TRAK DEALERS WITH THE ELEC-TRAK TRACTOR COMPO-
NENTS AND OPERATION.

FOR DETAILS ON SERVICING, TROUBLE SHOOTING AND PARTS
INFORMATION, REFER TO THE ELEC-TRAK PRODUCT SERVICE MANUAL.

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FRONT LIFT, LIGHTS AND P.T.O.

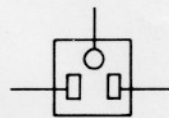
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CONTROL SUMMARY

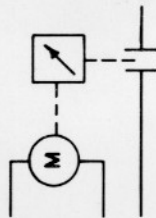
- Control Operation 58
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SCHEMATIC DRAWING SYMBOLS

The following symbols will be encountered in using ELEC-TRAK schematics. All service personnel involved with the ELEC-TRAK should become familiar with each symbol and the function performed by the device it represents.



Grounded AC line plug.



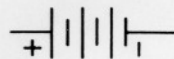
Timer -

A motor-driven device that shuts off a power source as well as itself after a preset time.

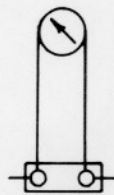


Transformer -

Changes AC voltage from one voltage to another. May step up or step down voltage level.

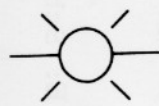


Battery-Power pack - Produces electrical energy by a chemical process.



Shunt and Meter -

A method of reading high current values. The current is passed through the shunt. The meter reads the voltage drop.



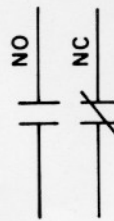
Light or lamp.



Manual switch or disconnect. (Shown in open position)



Cam-operated switch. (Shown in closed position)



Relay or solenoid-operated contacts. NO - normally open, NC - normally closed.



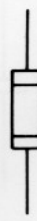
Actuating coil of relay or solenoid.



Thermal overload protector (circuit breaker) - Automatic reset protective device, senses current and/or temperature combinations. Provides a closed circuit until overloaded.



Thermal overload protector - manual reset.



Fuse - A throw-away protective device in a circuit.



Plug-in Disconnect- Eases removal of electrical assemblies.



Motor Armature - The rotating center member of an electric motor.

Motor Field -



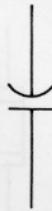
The fixed outside member of a motor produces an electromagnetic field. (This field is produced by magnetic materials in permanent magnet motors.)

Resistor -



Device to resist the flow of current measured in ohms.

Capacitor -



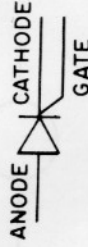
Two electrodes separated by an insulator or dielectric. This device can be charged and discharged at a controlled rate; also can store energy for short periods of time. Sizes considered in μf . (Microfarads)

Diode -



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

SCR -



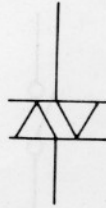
Solid state semiconductor switch which closes when current is directed into the anode and gate. The SCR opens when anode current is cut off.

Unijunction Transistor -



A variable resistance voltage divider. When used with a capacitor and resistor, controlled time delays can be had.

Varistor -



An energy absorbing device used to protect semiconductors.

NOTE: Schematic symbols have not been completely standardized.

MECHANICAL

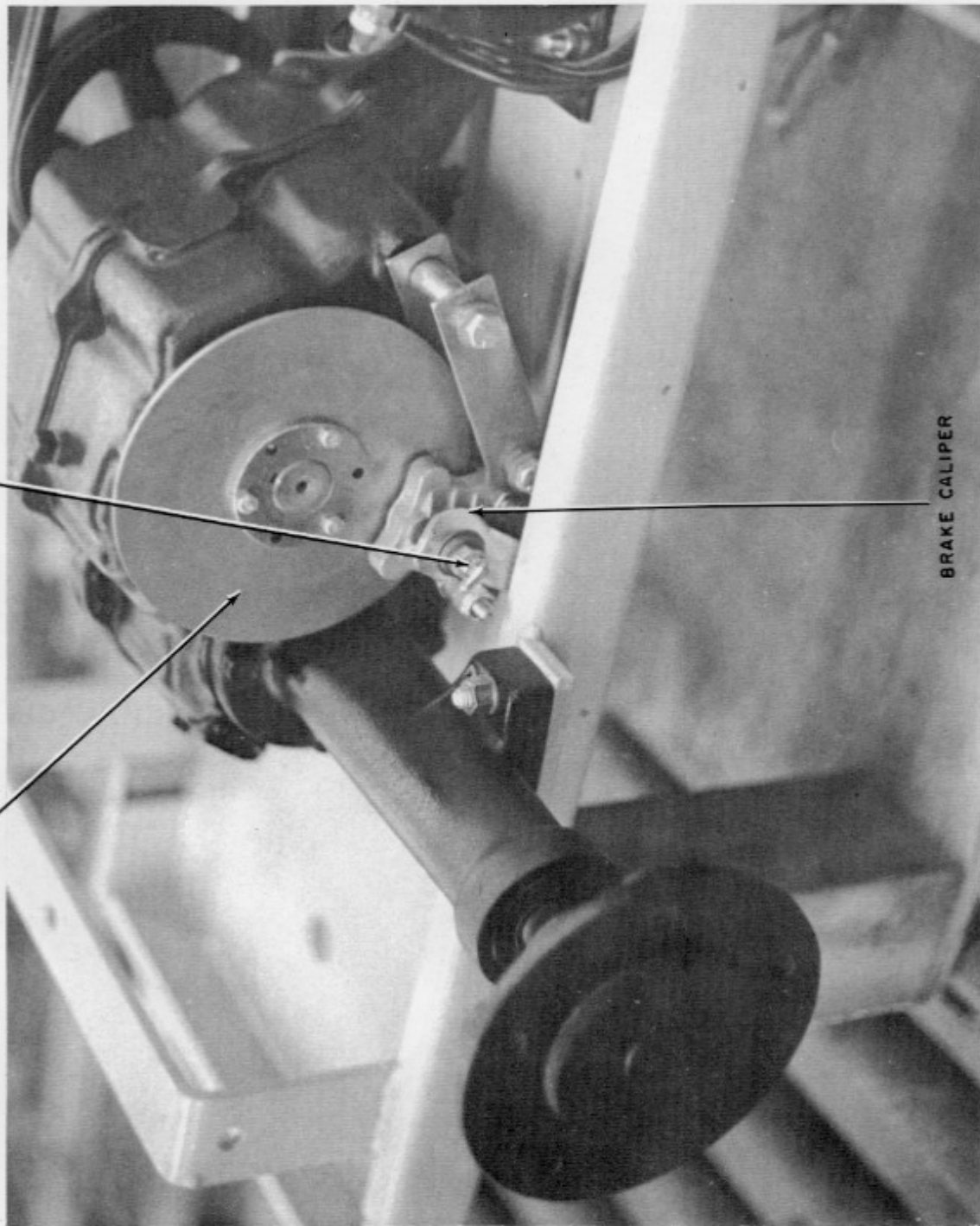
SECTION

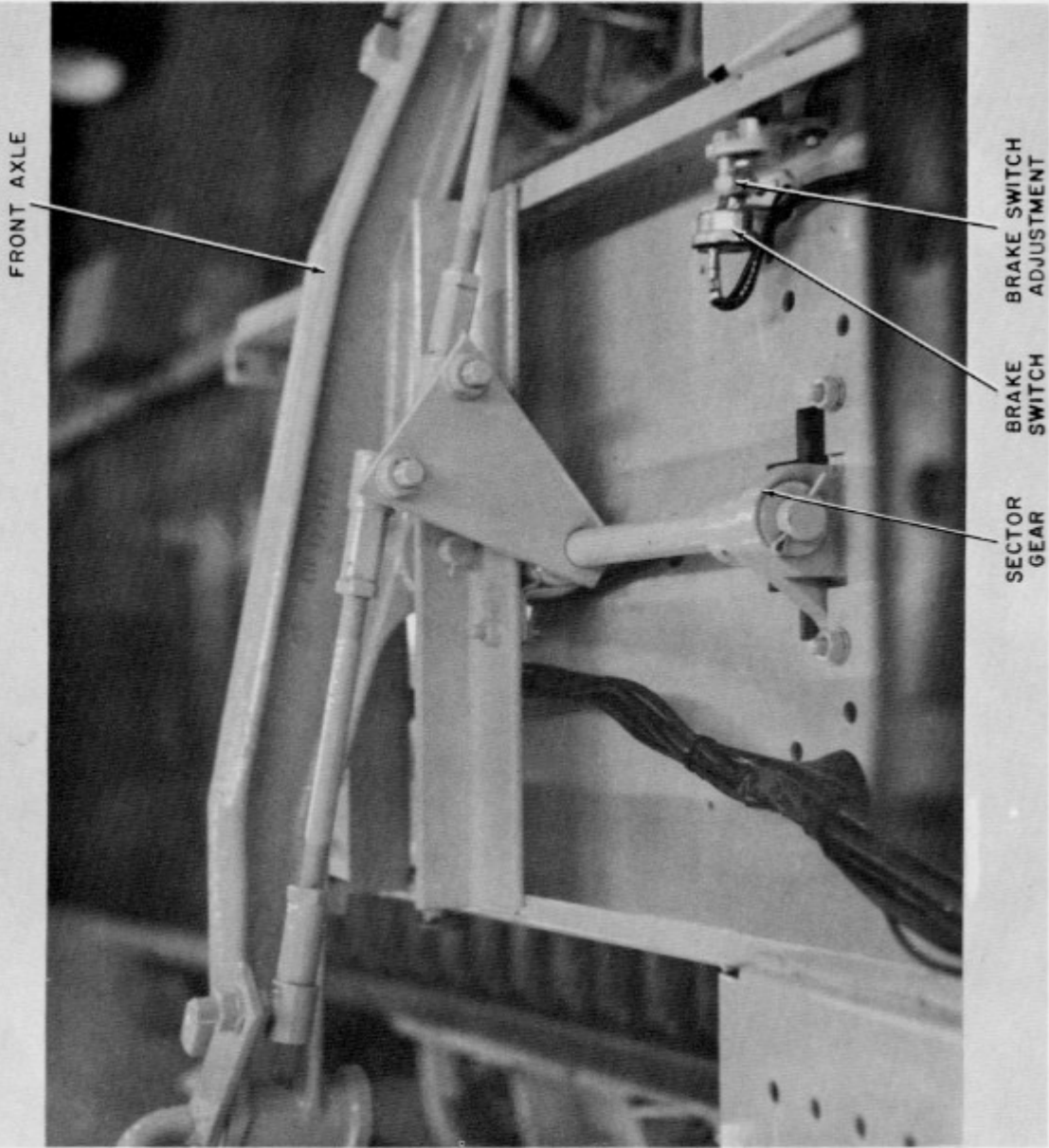
BRAKE ASSEMBLY

BRAKE ADJUSTMENT NUT

BRAKE DISC

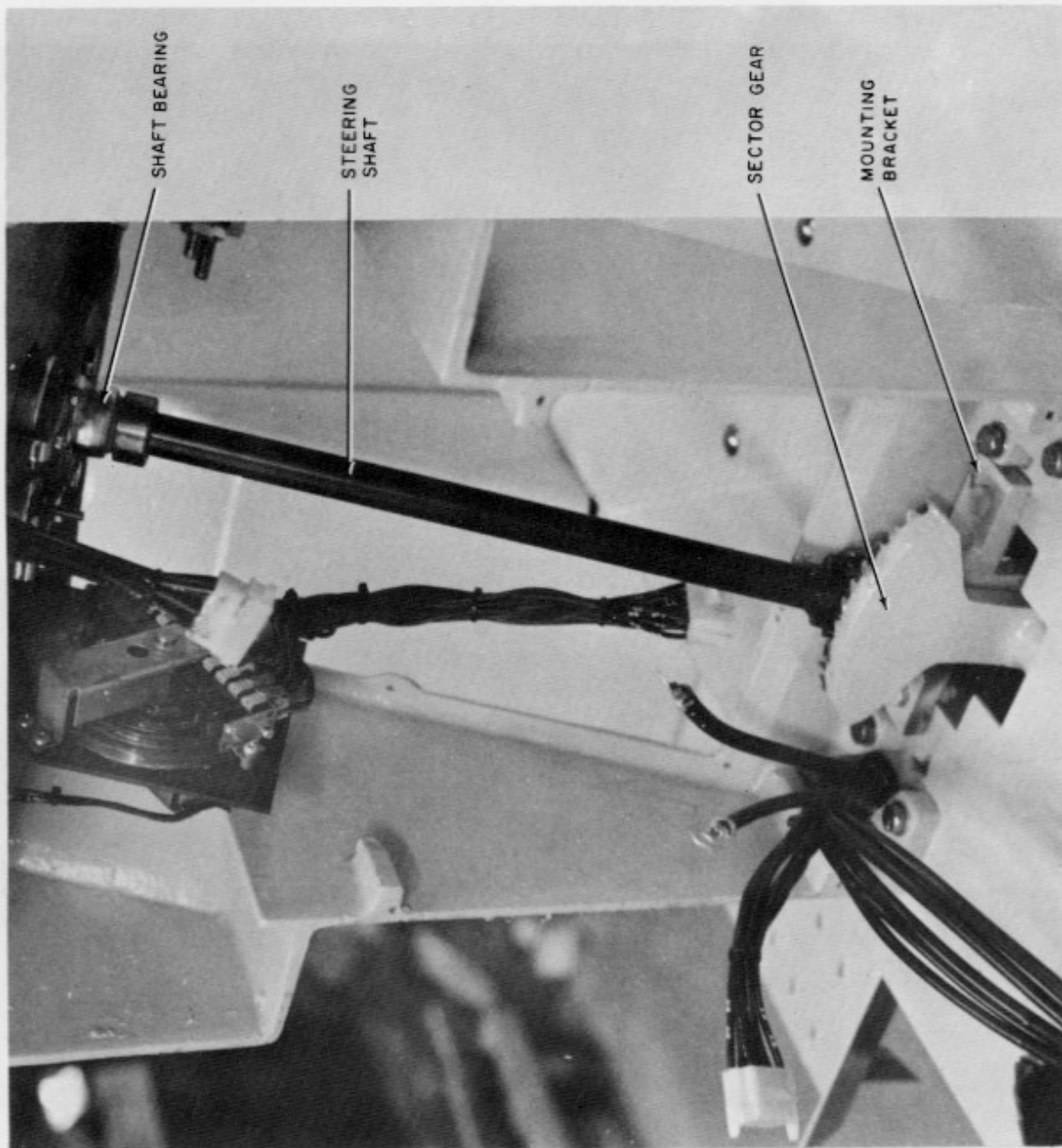
BRAKE CALIPER

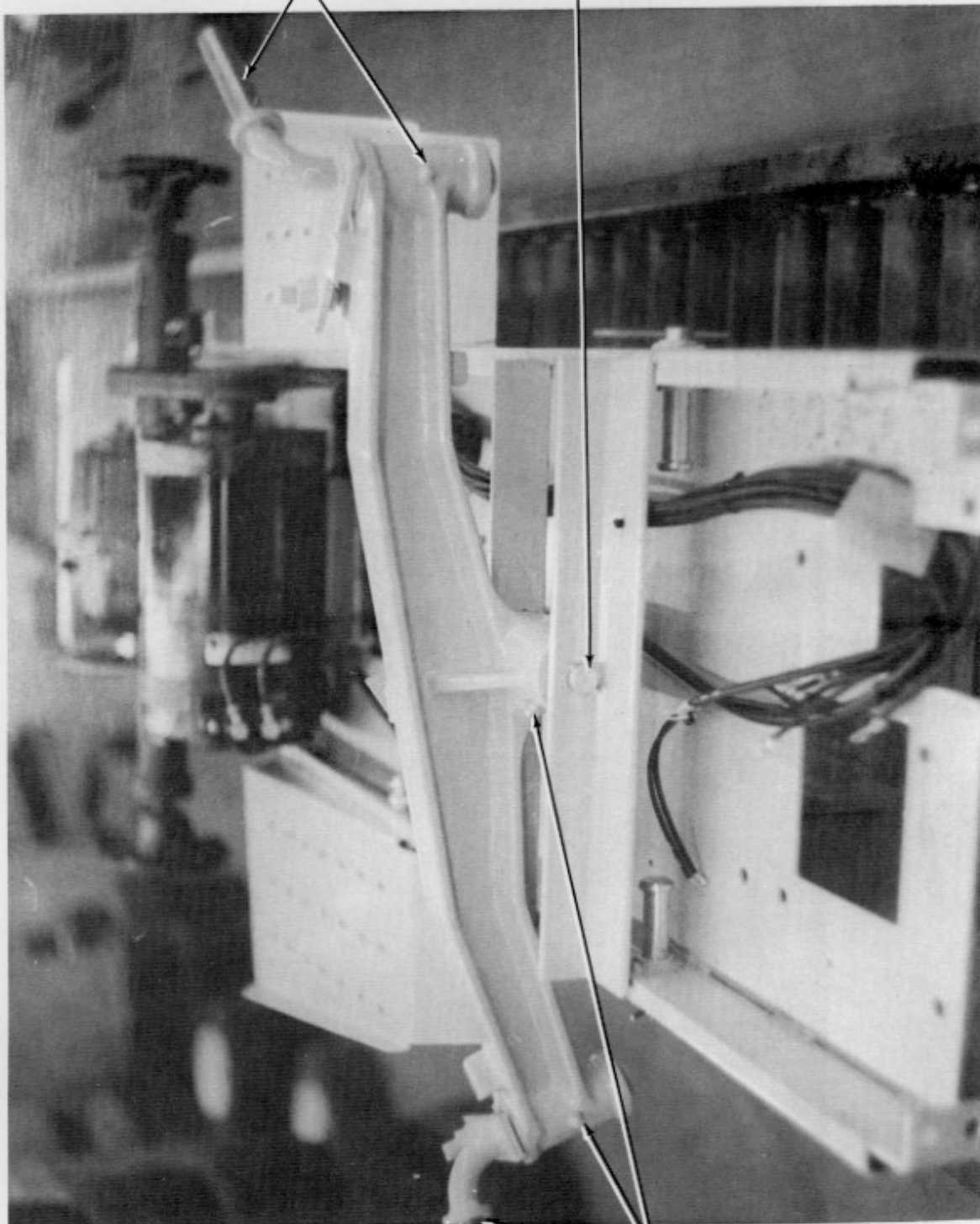




STEERING ASSEMBLY
AND
BRAKE SWITCH

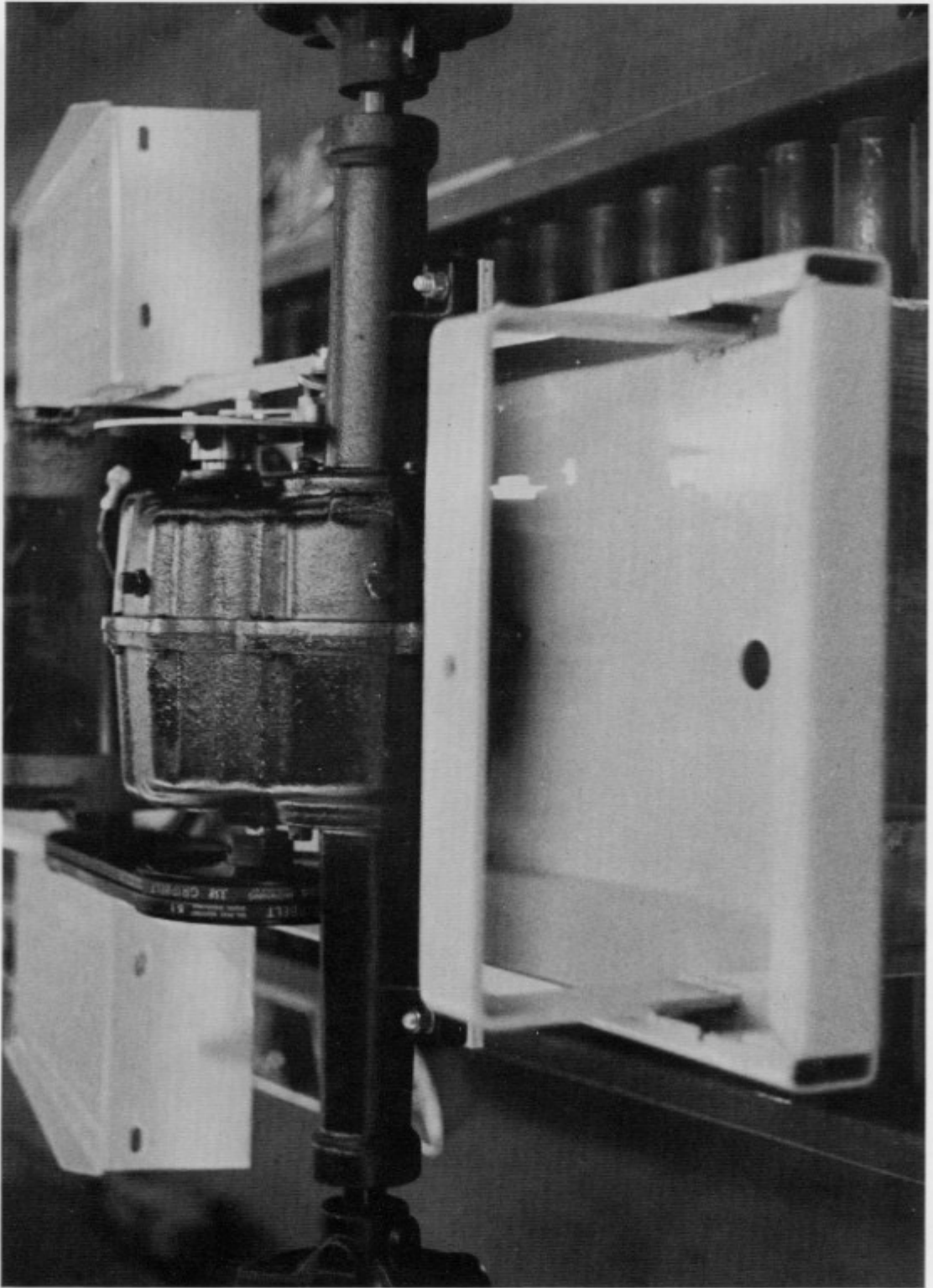
STEERING





FRONT AXLE

TRANSAXLE
(Peerless 2300 Series)



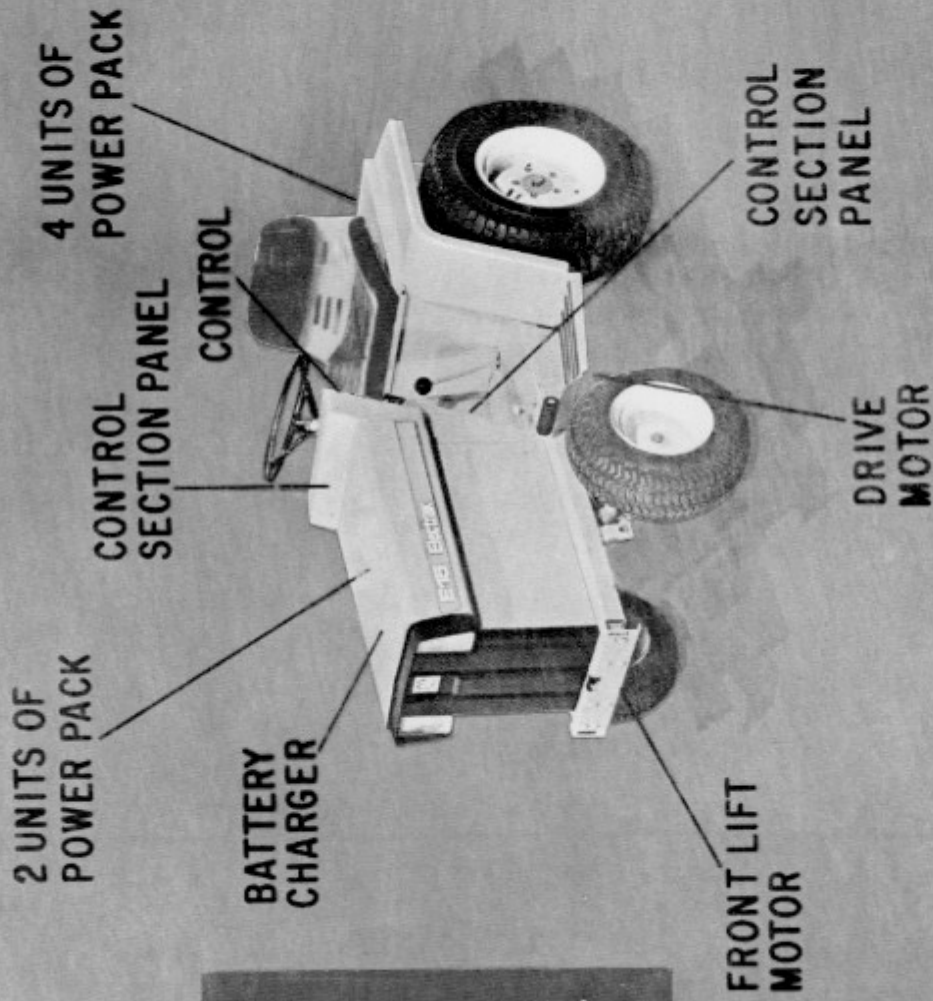
ELECTRICAL

COMPONENTS

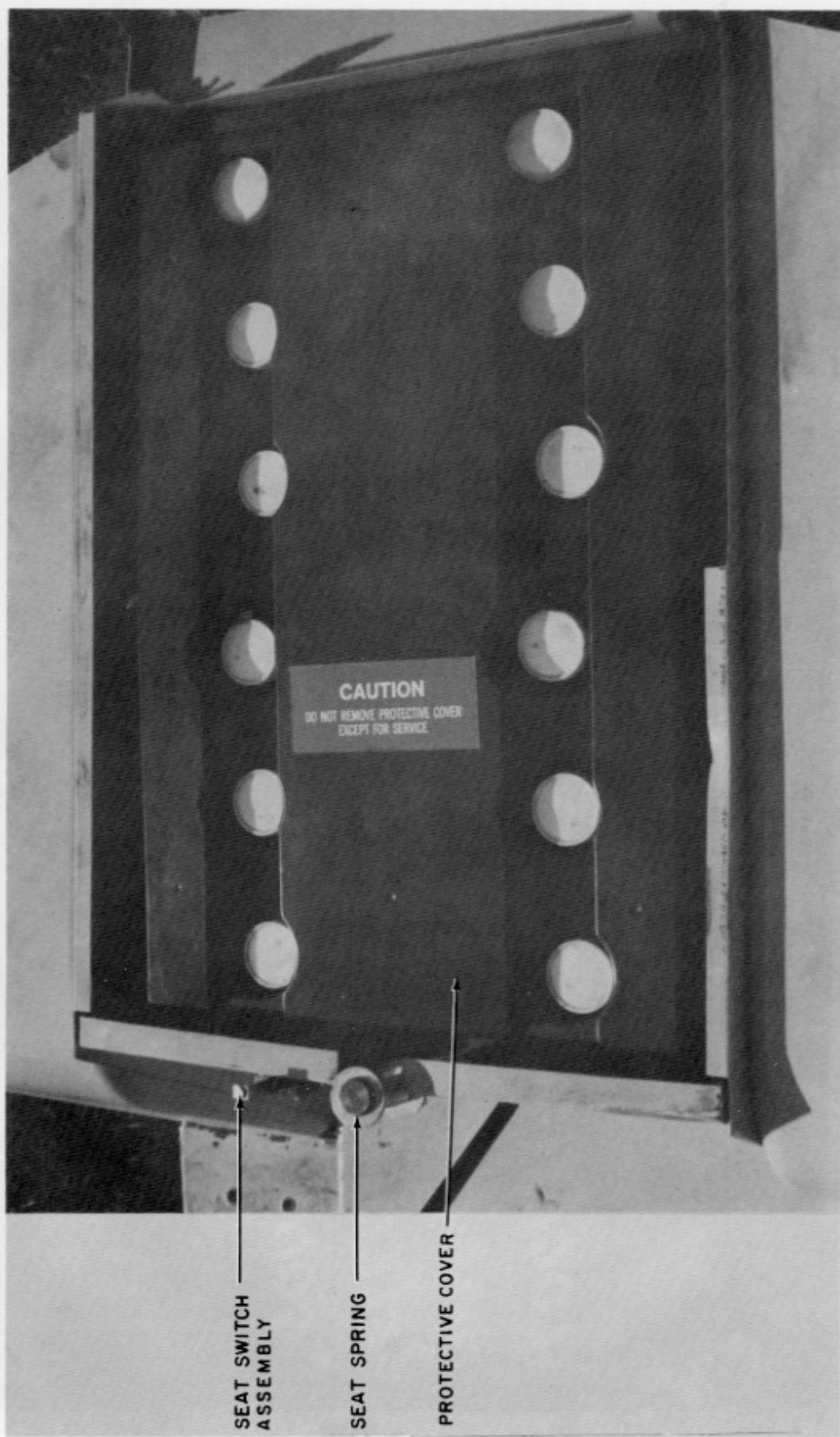
MAJOR COMPONENTS

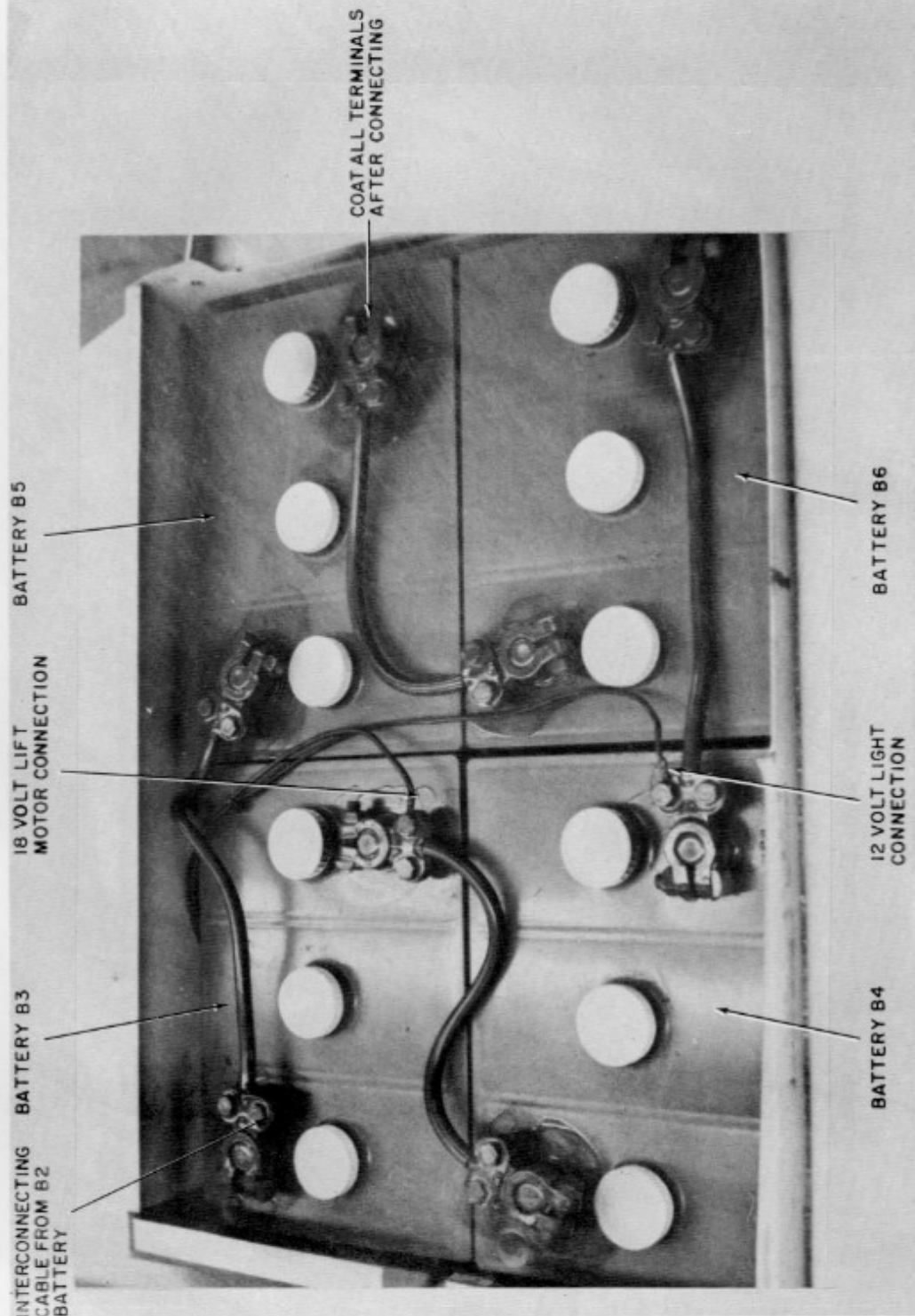
- Power Pack - Six 6-Volt Batteries
- Battery Charger - 120 Volts A.C. to 40 Volts D.C.
- Electric Lift - 18 Volts D.C.
- Drive Motor - 36 Volts D.C.
- Control Panels - 36 Volts D.C.
- Speed Control - 36 Volts D.C.

LOCATION OF MAJOR ELECTRICAL COMPONENTS



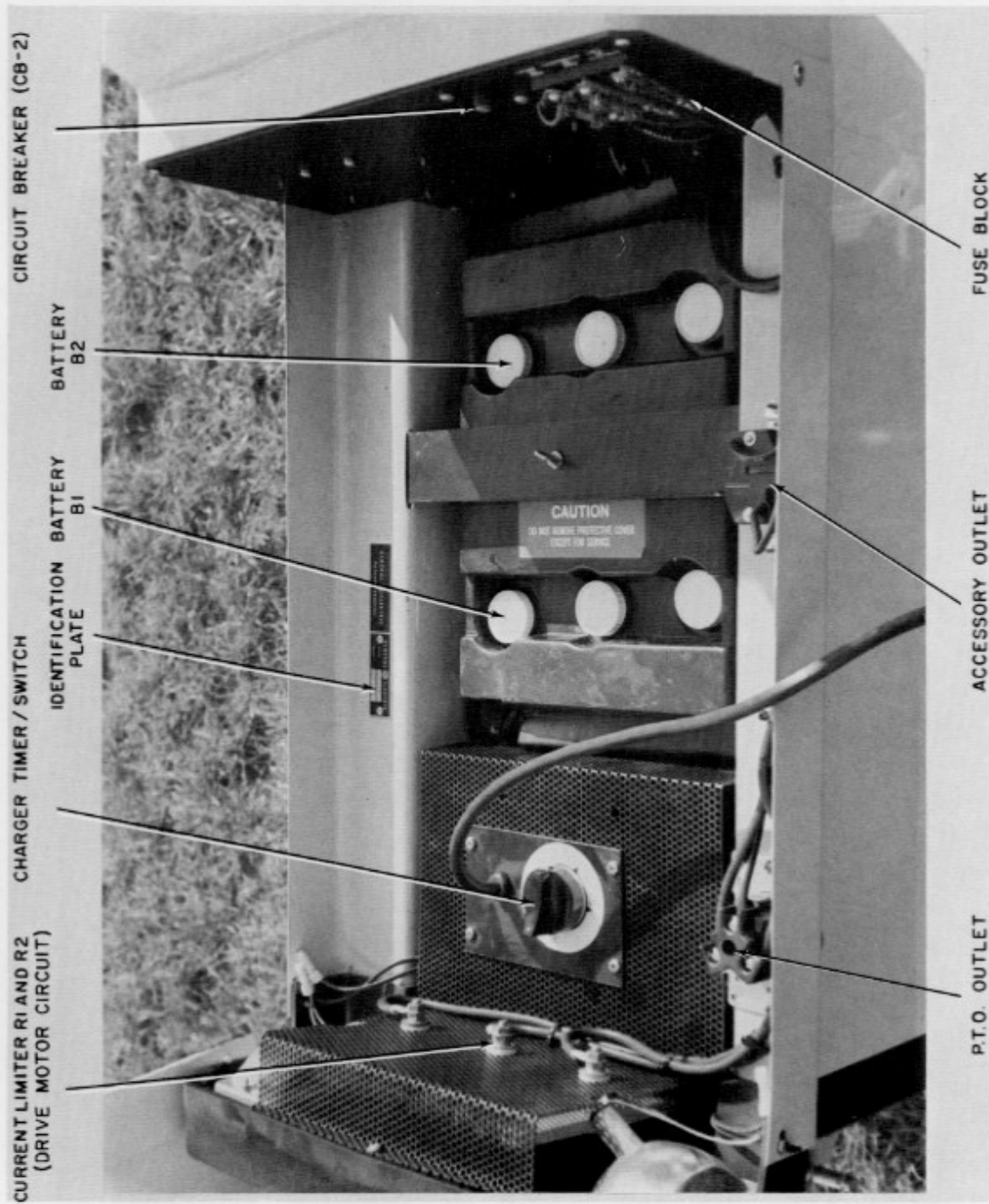
REAR POWER PACK SECTION

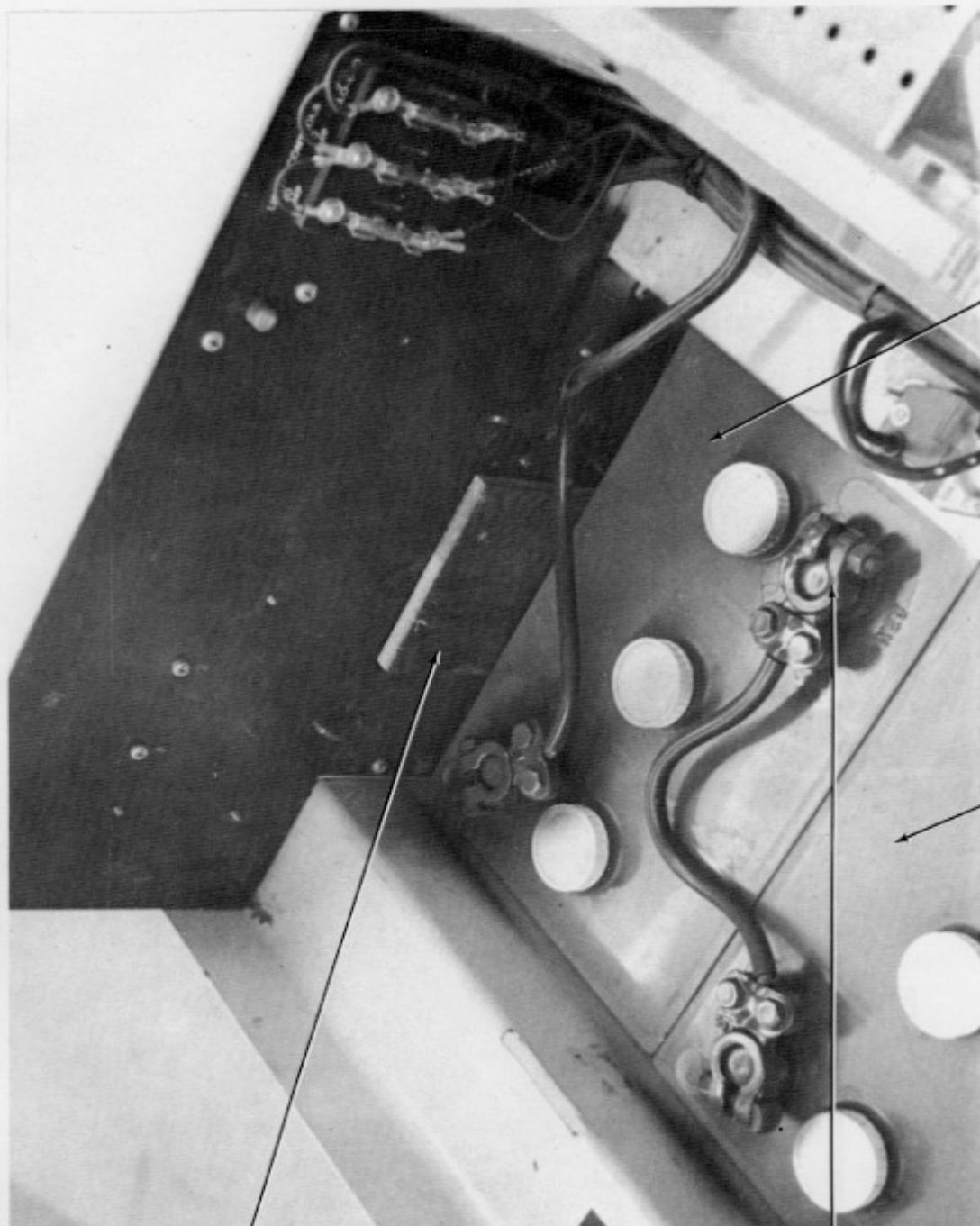




REAR POWER PACK SECTION
(Cover Removed)

FRONT POWER PACK SECTION





SPACER

(TOP GOES FLUSH OR
BELOW TOP OF BATTERY
PREVENTS BATTERY CASE
ABRASION)

COAT ALL TERMINALS
AFTER CONNECTING

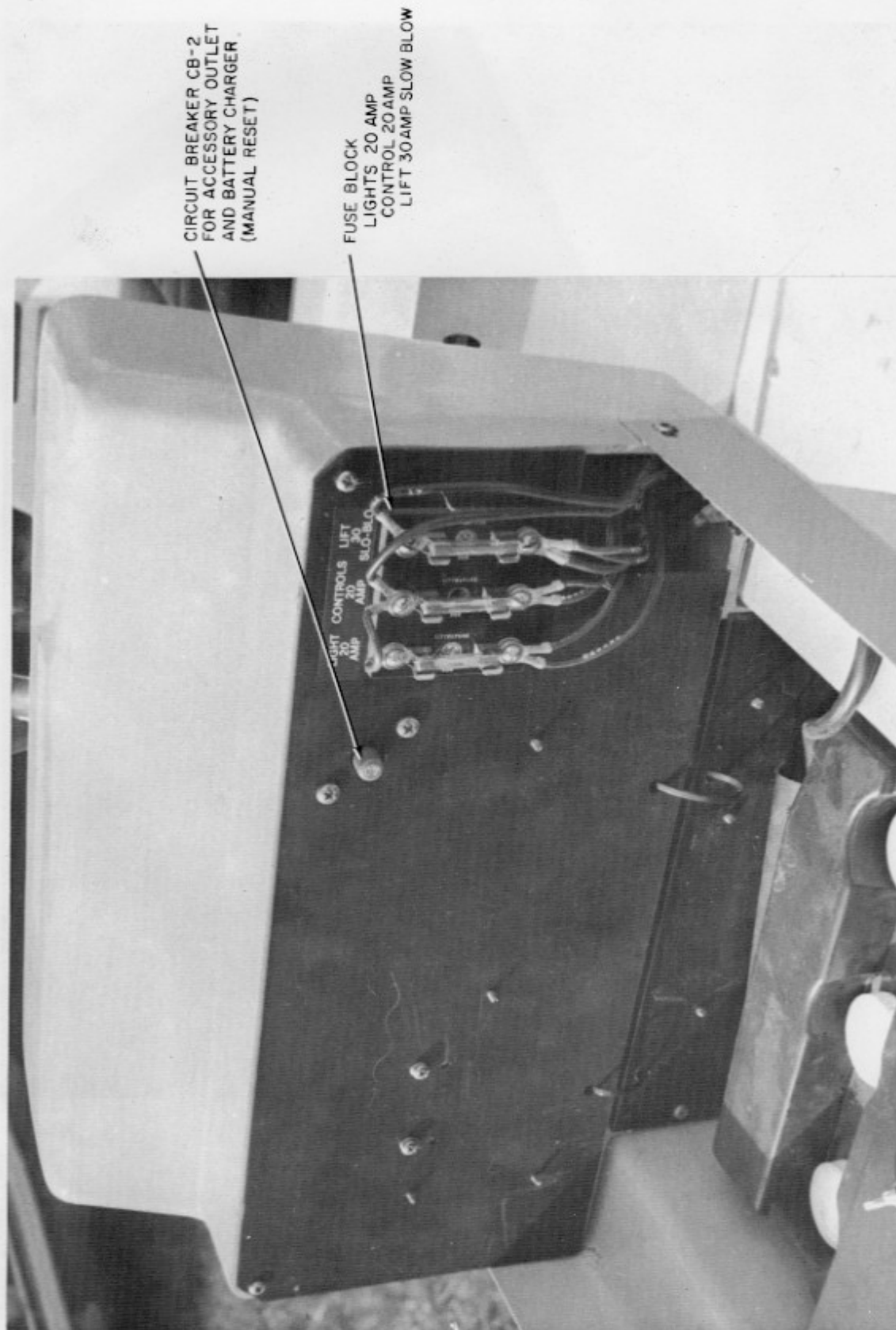
BATTERY B2

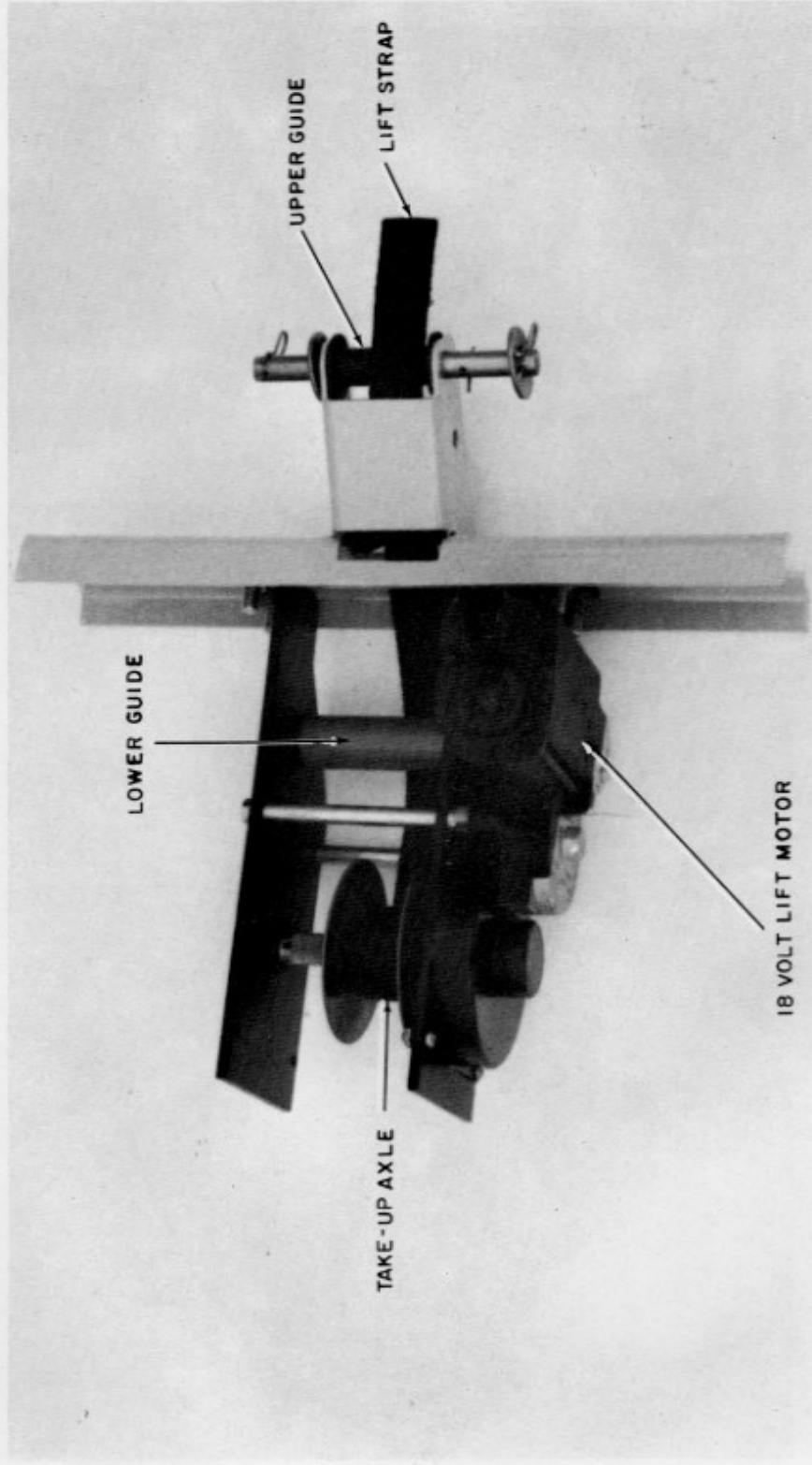
BATTERY B1

FRONT BATTERY SECTION

(Cover Removed)

UPPER CONTROL PANEL - FRONT SIDE





FRONT LIFT ASSEMBLY
(Top View)

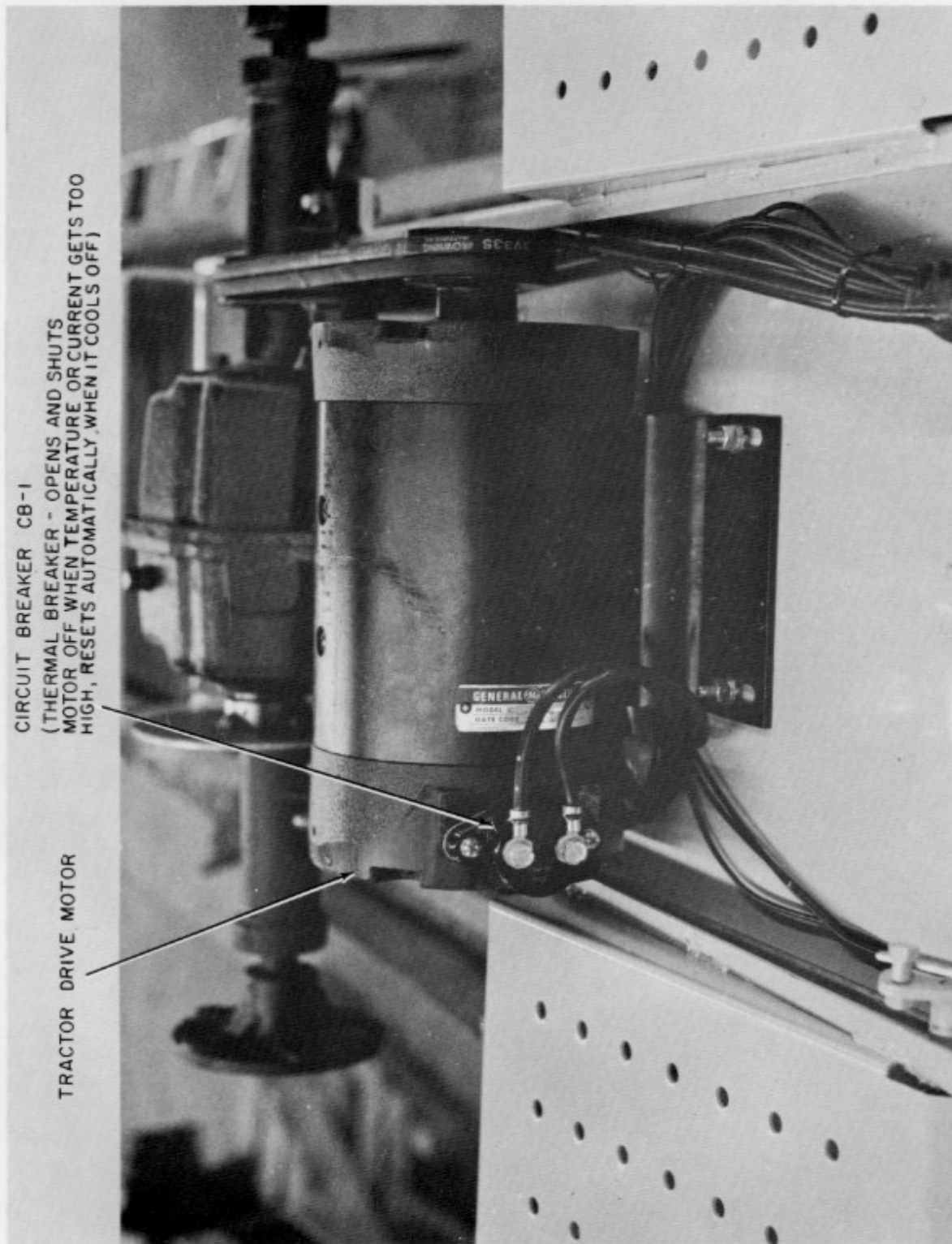
DRIVE MOTOR

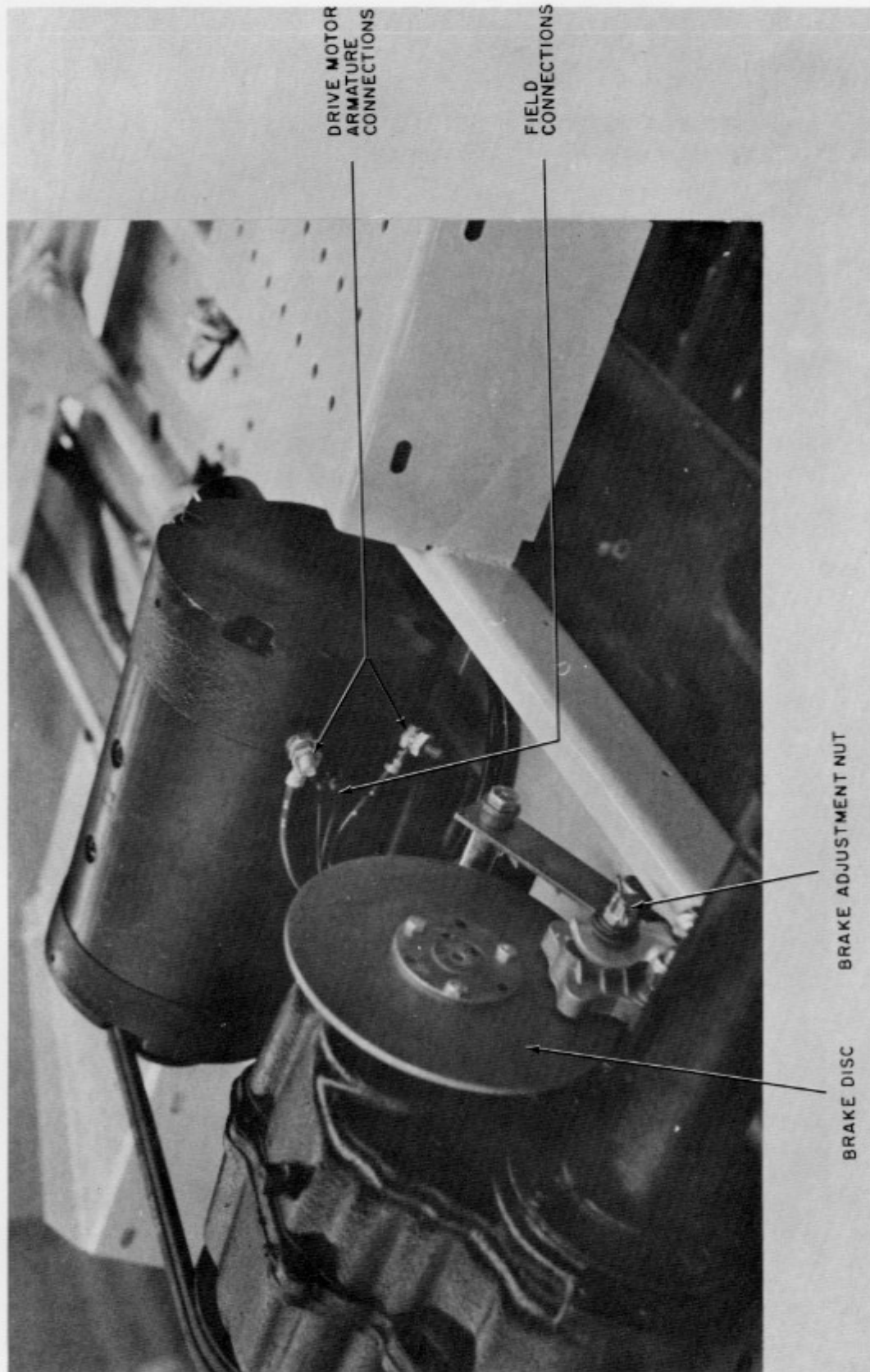
(Underside of Tractor)

CIRCUIT BREAKER CB-1

(THERMAL BREAKER - OPENS AND SHUTS
MOTOR OFF WHEN TEMPERATURE OR CURRENT GETS TOO
HIGH, RESETS AUTOMATICALLY WHEN IT COOLS OFF)

TRACTOR DRIVE MOTOR

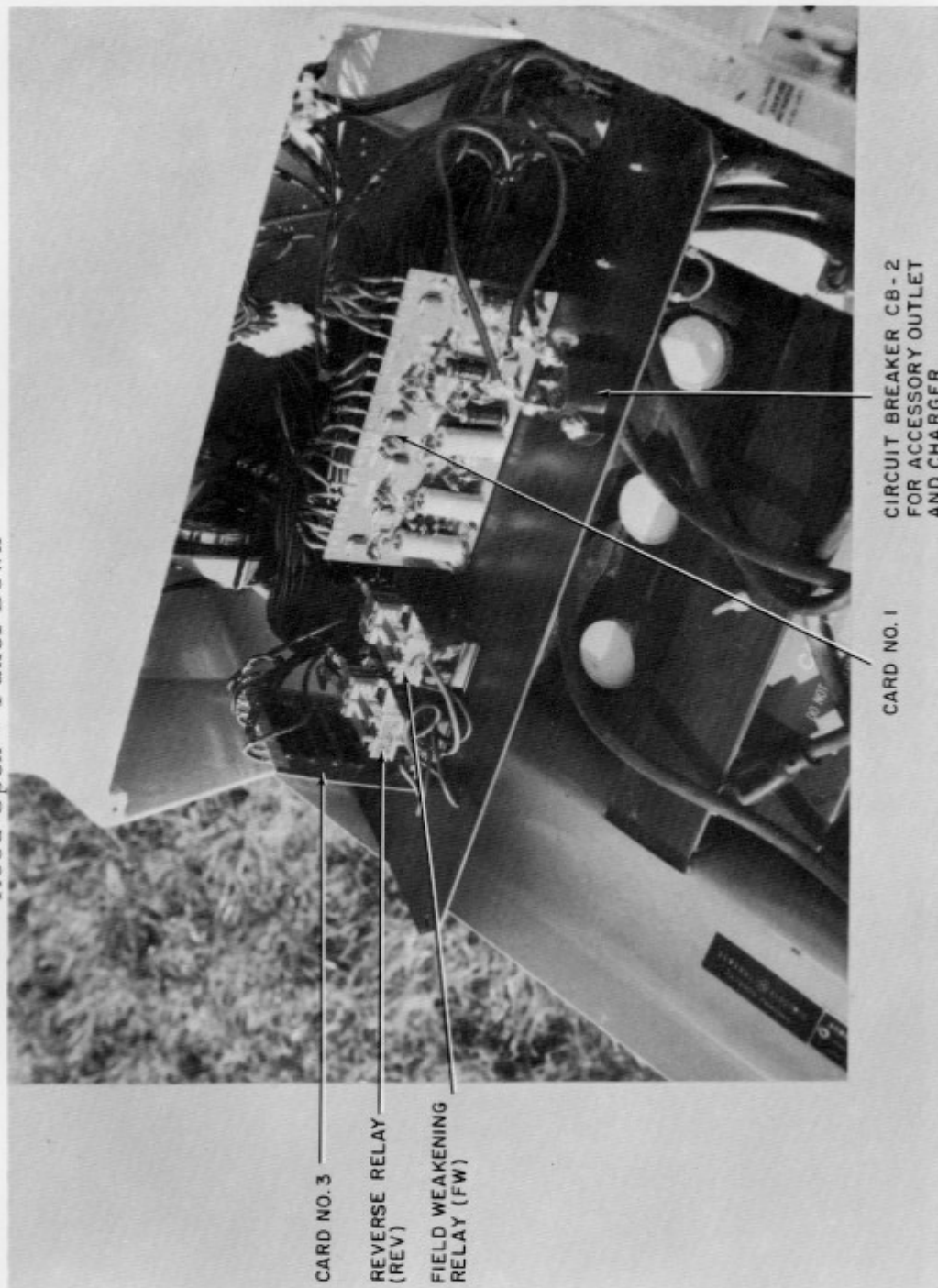




DRIVE MOTOR AND BRAKE ASSEMBLY

UPPER CONTROL PANEL E-15

(Rear Side)
Hood Open - Panel Down



E-12S

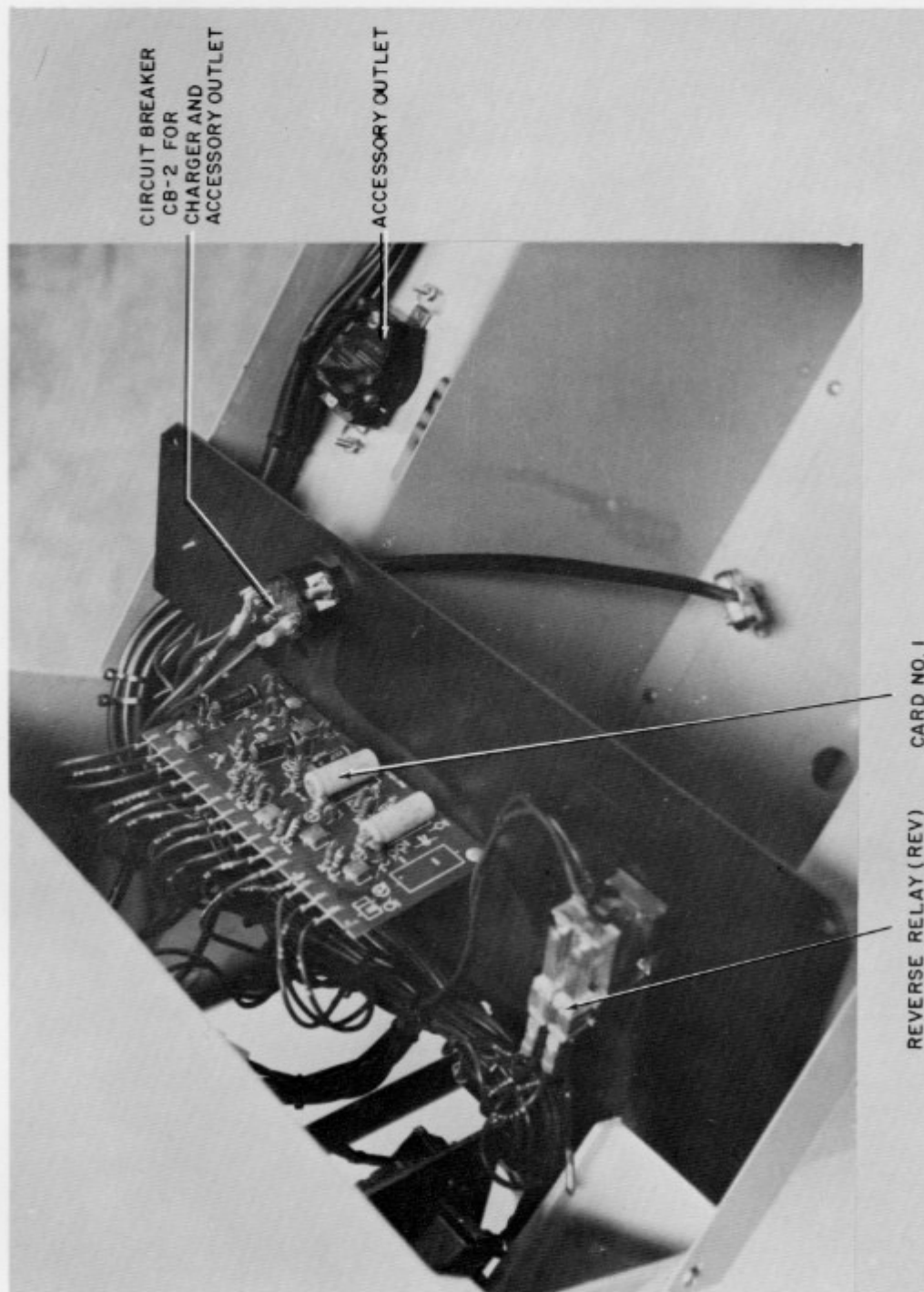
THE E-12S CONTROL IS LIKE THE E-15 EXCEPT THE

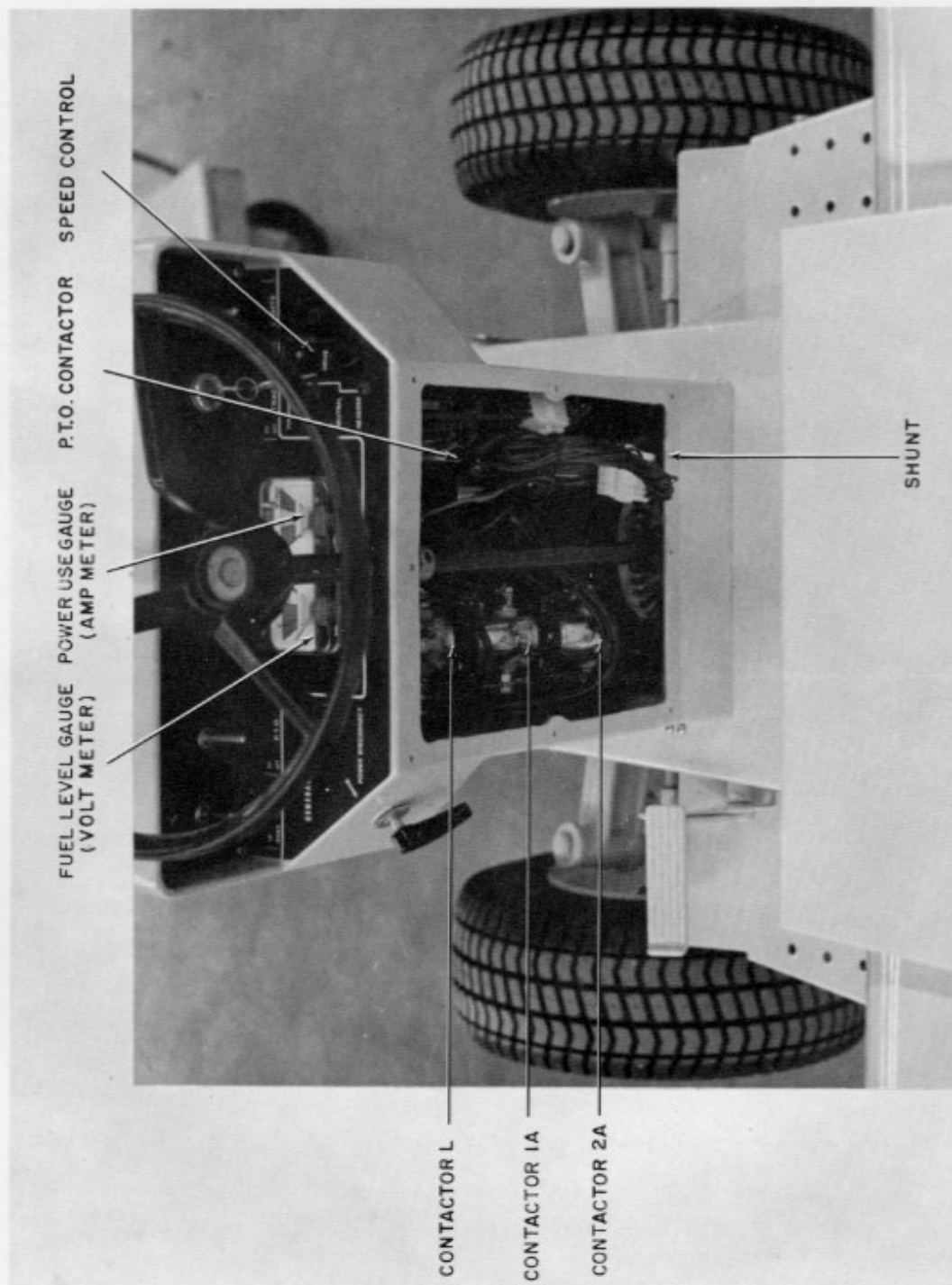
E-12S DOES NOT HAVE A FIELD WEAKENING RELAY

(FW) OR CARD #3.

UPPER CONTROL PANEL E-12S
(Rear Side)

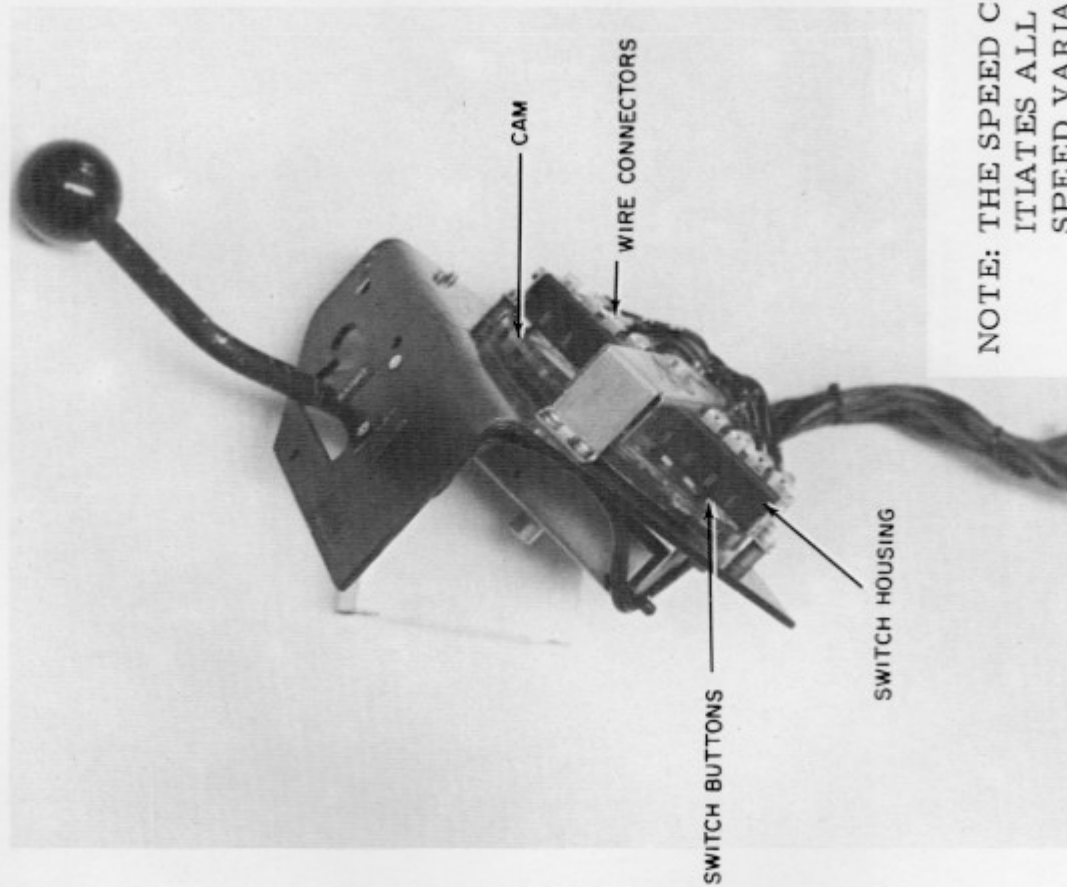
Hood Open - Panel Down



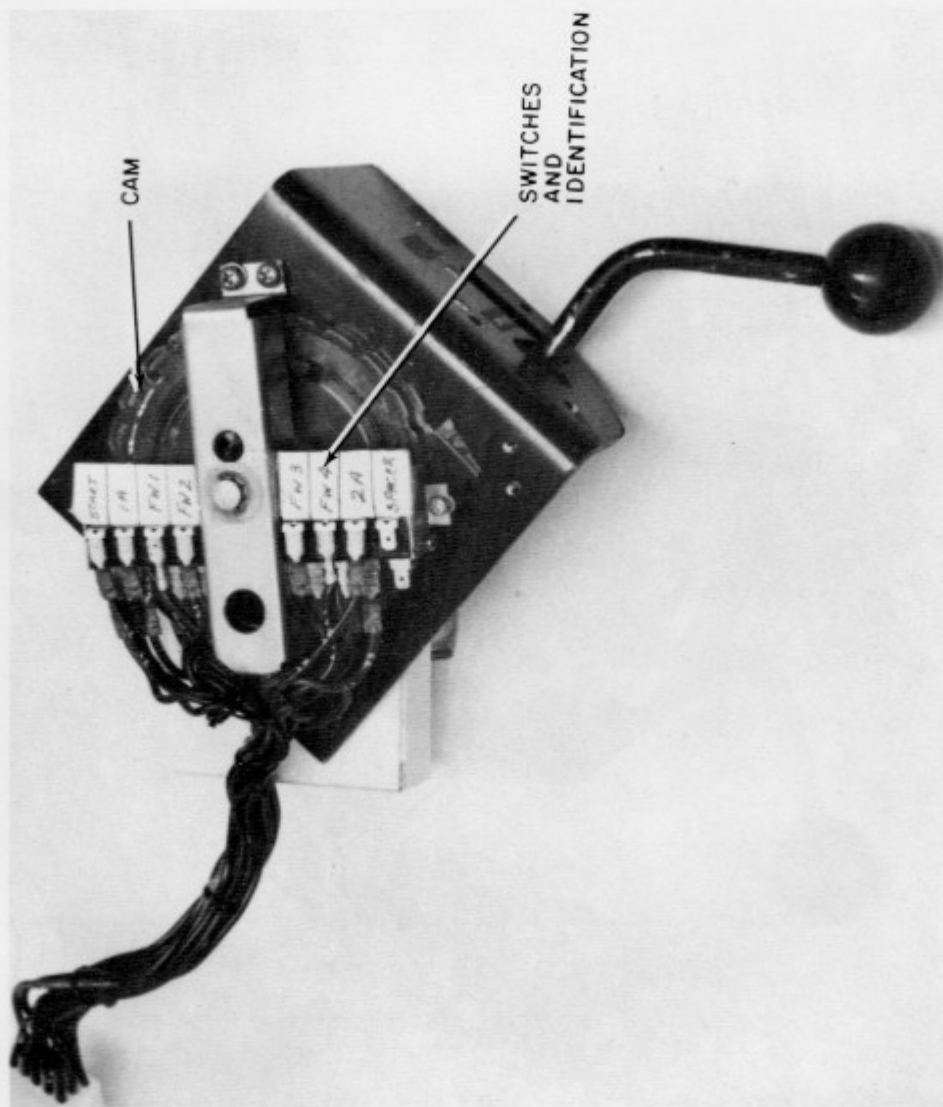


DASH AND LOWER CONTROL PANEL

SPEED CONTROL



NOTE: THE SPEED CONTROL INITIATES ALL ELECTRICAL SPEED VARIATIONS, FORWARD AND REVERSE.

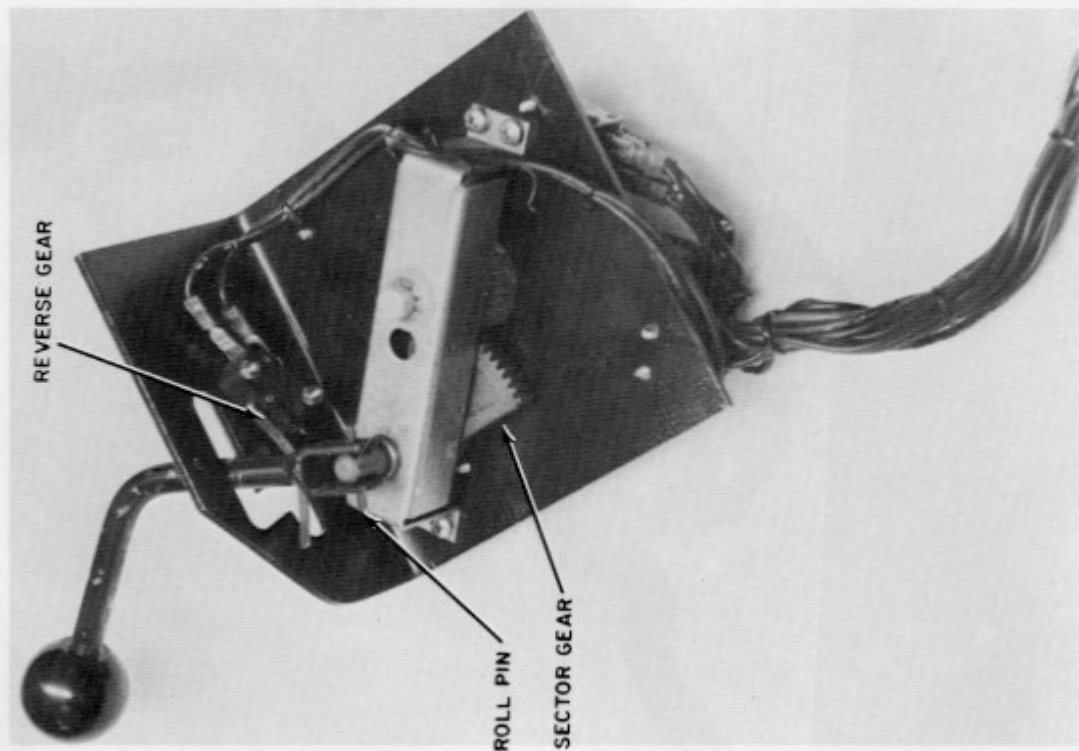


SPEED CONTROL

(Side View)

SPEED CONTROL

(Right Side)



ELECTRICAL
OPERATION

110 VOLT A.C.
HOUSE VOLTAGE

CHARGER

36 + VOLT D.C.

POWER
PACK

AUTOMATIC
CONTROL

MANUAL
SWITCHING

SMALL
ACCESSORY
OUTLET

DRIVE
MOTOR

LARGE PTO
OUTLET

LIGHTS

LIFT

ELEC-TRAK BLOCK DIAGRAM

CONTROL SECTION COMPONENTS

		<u>Speeds Forward</u>	<u>Speeds Reverse</u>
- Speed Control	E-12	3	3
	E-15	7	3
- Contactors - L, 1A, 2A			
- Relays - Field Weakening* (FW); Reverse (Rev)			
- Circuit Cards #1 and #3*			
- Current Limiters - R1 and R2			

*Does not apply to E-12S

SPEED CONTROL SEQUENCE

Lever Position

<u>Forward</u>	<u>Contactor/Switch</u>	<u>Results</u>
1	Start "L"	Power to drive motor, R ₁ & R ₂ in circuit
2	1A	Bypass R ₁ current limiter, R ₂ in circuit
3 (maximum field - max. torque)	2A	Bypass R ₂ current limiter, FW* relay picks up, (FW contacts open)
4*	FW ₁	Field Limiter 4 in field
5*	FW ₂	Field Limiter 5 in field
6*	FW ₃	Field Limiter 6 in field
7*	FW ₄	Field Limiter 7 in field
		ON CARD #3
<u>Reverse</u>		
Left-hand Neutral	Reverse Switch, reverses motor field polarity	
1	Start "L"	Power to drive motor, R ₁ & R ₂ in circuit
2	1A	Bypass R ₁ current limiter, R ₂ in circuit
3 (max. field - max. torque)	2A	Bypass R ₂ current limiter (FW* will pick up)

*Does not apply to E-12S

MEMORANDUM FOR THE RECORD
SUBJECT: [illegible]
DATE: [illegible]

MEMORANDUM FOR THE RECORD
SUBJECT: [illegible]
DATE: [illegible]

1

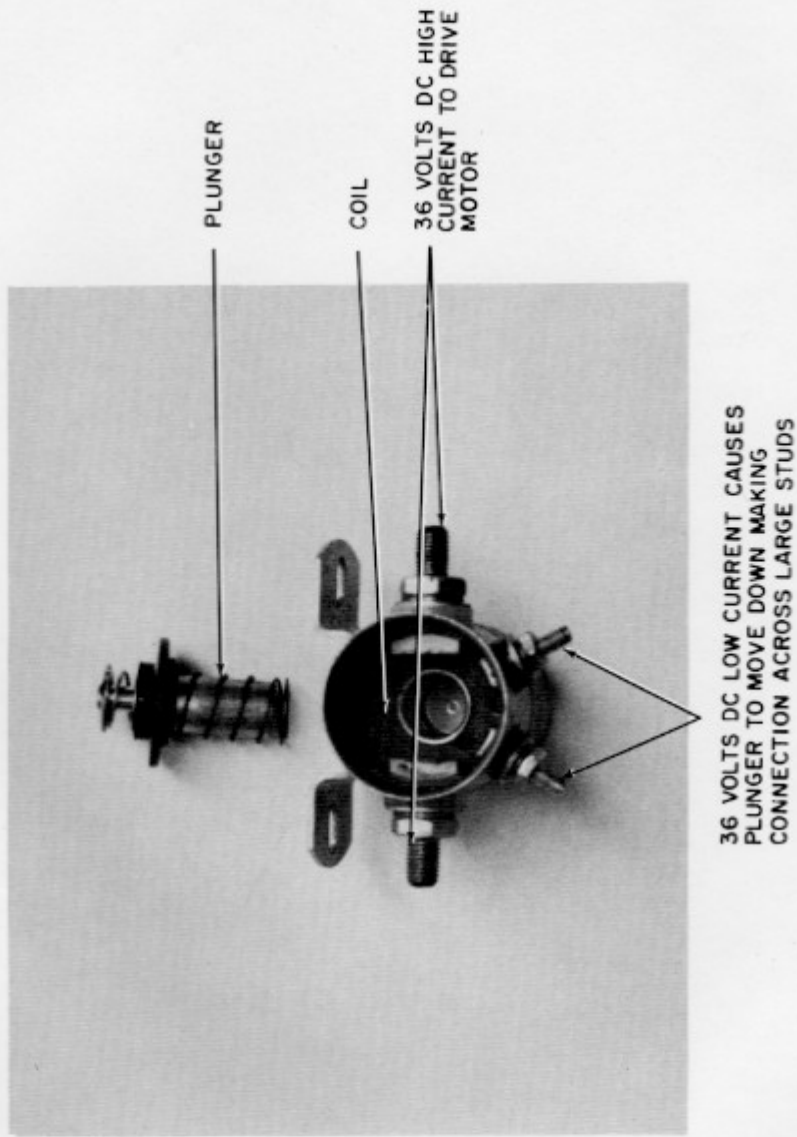
2

3

4

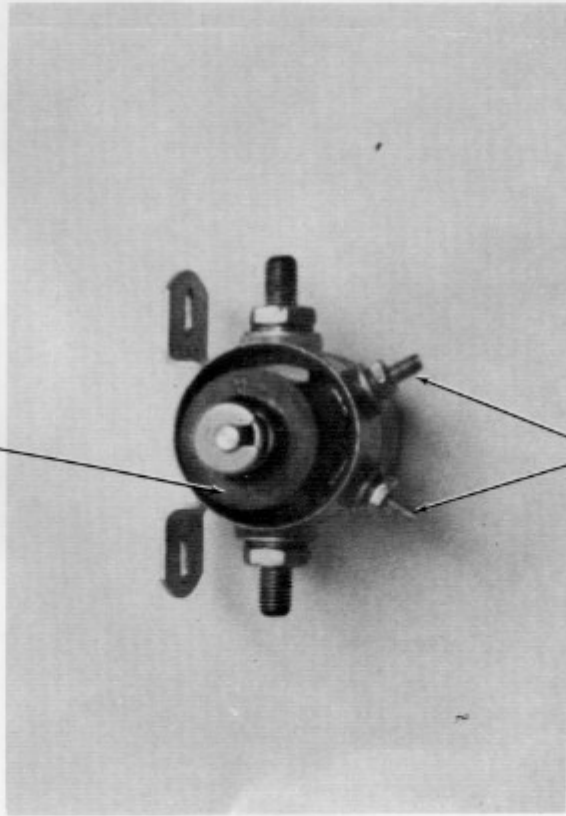
DISASSEMBLED CONTACTOR

(Used for "L", 1A & 2A)



No Voltage Applied

PLUNGER IS RAISED
NO ELECTRICAL CONNECTION
ACROSS LARGE STUDS

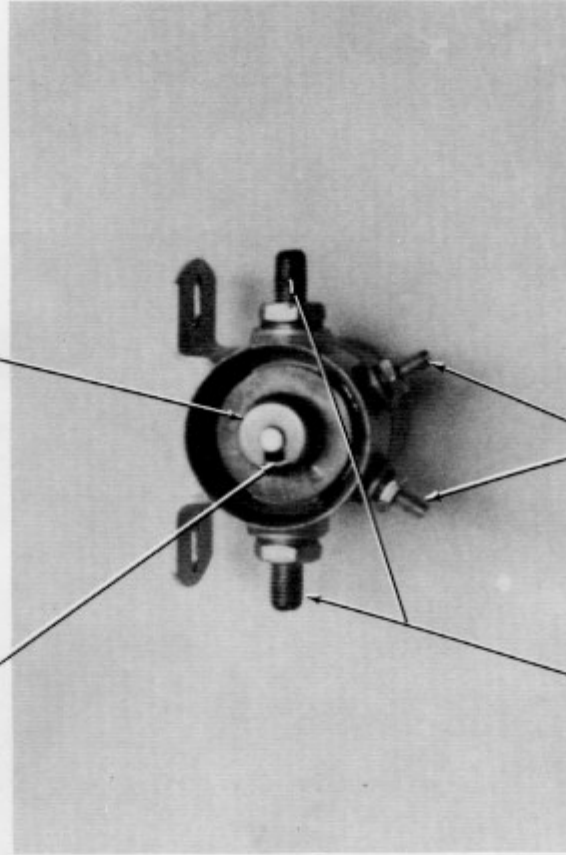


NO VOLTAGE APPLIED

Voltage Applied

COPPER WASHER MAKES
CONTACT ACROSS LARGE
STUDS

PLUNGER IS PULLED DOWN
BY MAGNETIC COIL



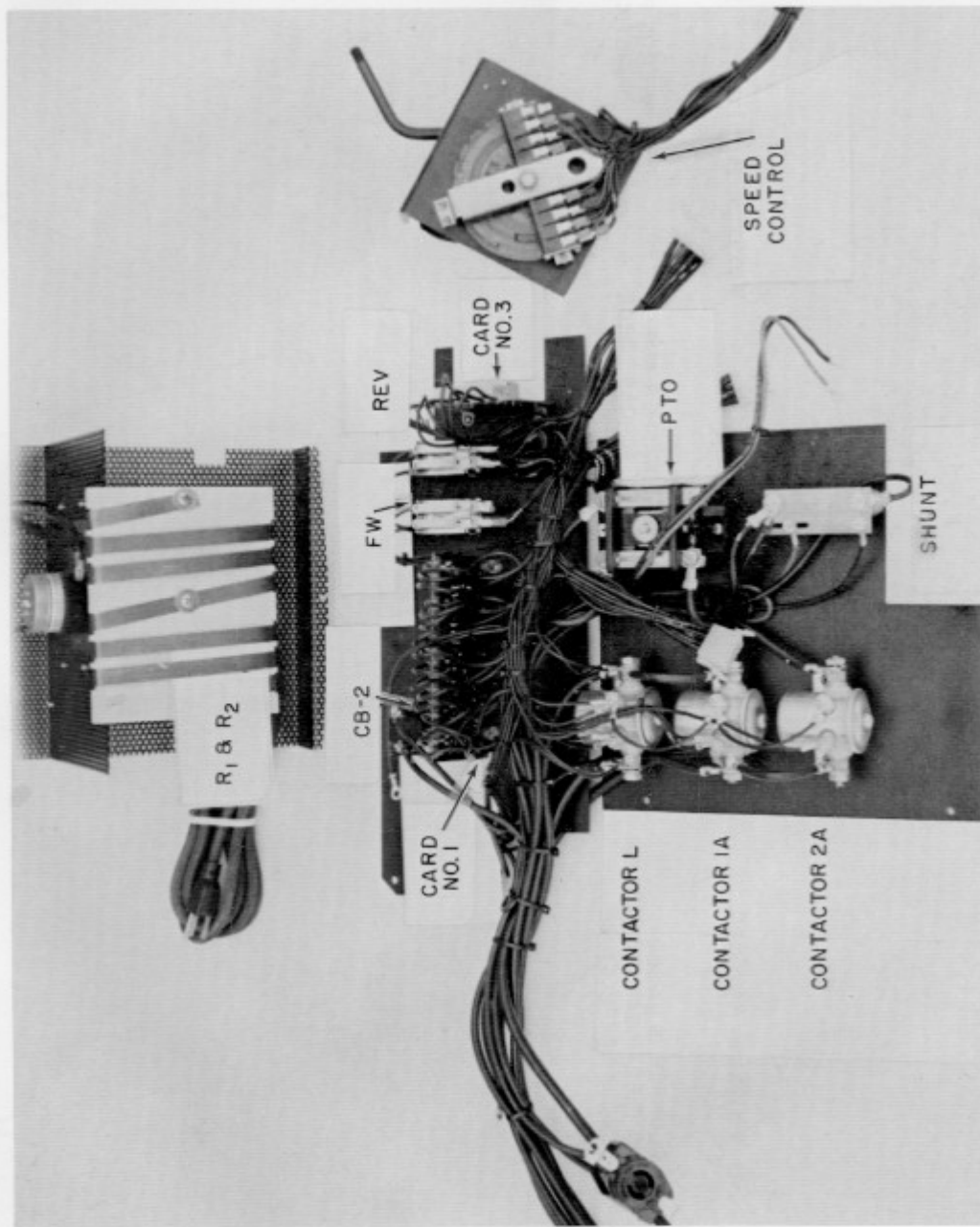
LARGE STUDS
POWER TO MOTOR

36 VOLTS DC APPLIED
ENERGIZING COIL

CONTACTOR
(L, 1A & 2A)

E-15 CONTROLS WITH WIRING

- P.T.O. Contactor is Energized When P.T.O. Switch Is Turned ON.
- Shunt is Required to Connect Power-Use Meter (Amp Meter)



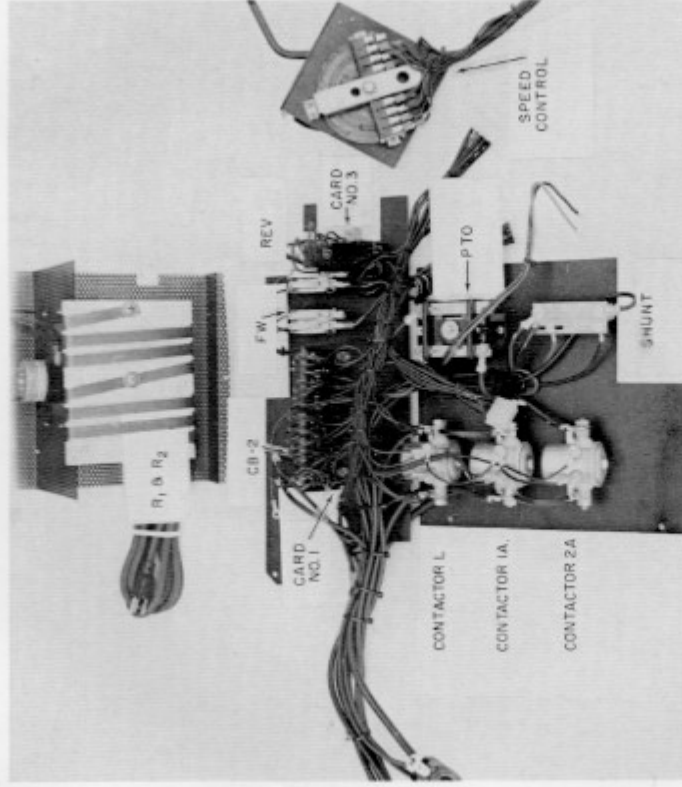
DRIVE MOTOR

OPERATION

Release page 1 of 1
COLLECTOR OBSERVATION

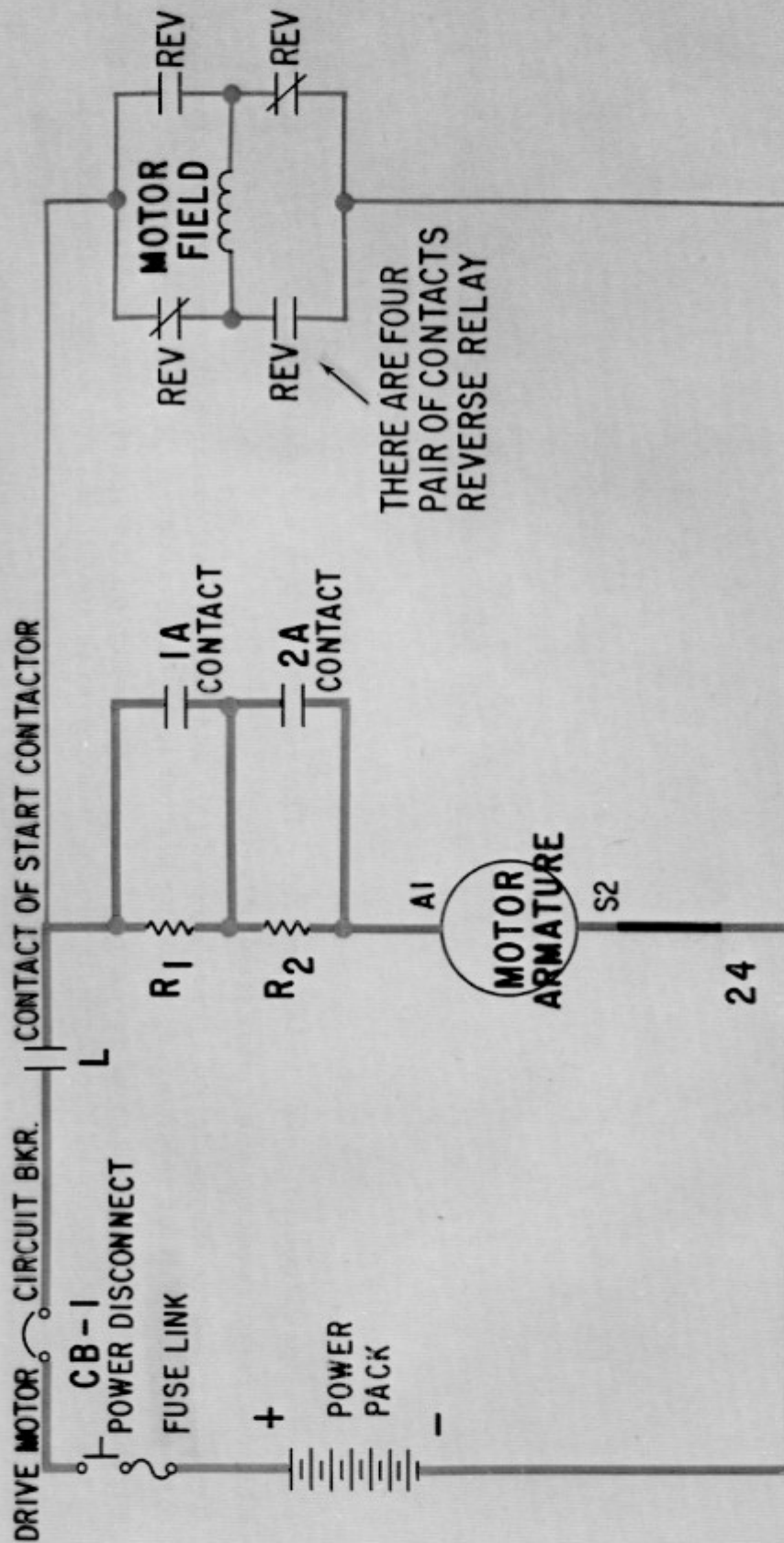
CONTROL OPERATION

Forward Speeds 1, 2 & 3

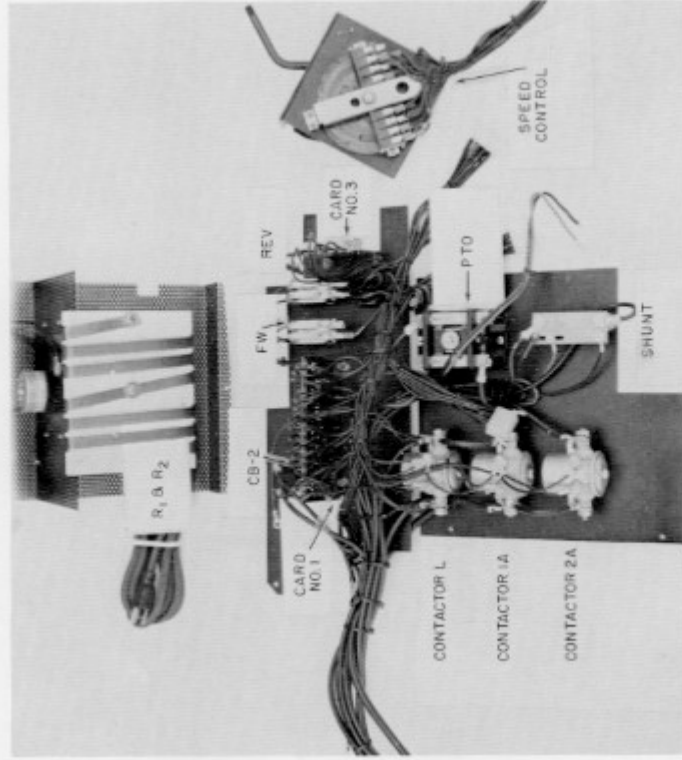


- Power disconnect engaged
- Key on, on seat, and brake off
- First speed control position L (Start) switch on the speed control closes, supplying power to the L contactor coil and the L contacts close- the tractor starts, R₁ and R₂ in motor circuit.
- Second speed control position, 1A switch on the speed control closes, supplying power to the 1A contactor coil and the 1A contacts close - R₁ current limiter bypassed.
- Third speed control position (Drive), the 2A switch on the speed control closes, supplying power to the 2A contactor and 2A contacts close- R₂ current limiter bypassed. The field weakening relay (FW) picks up.
- Once any of the above contactors is energized, its contacts stay closed until the speed control lever is moved back toward neutral, removing power from its coil.

ELEC-TRAK DRIVE MOTOR CIRCUIT

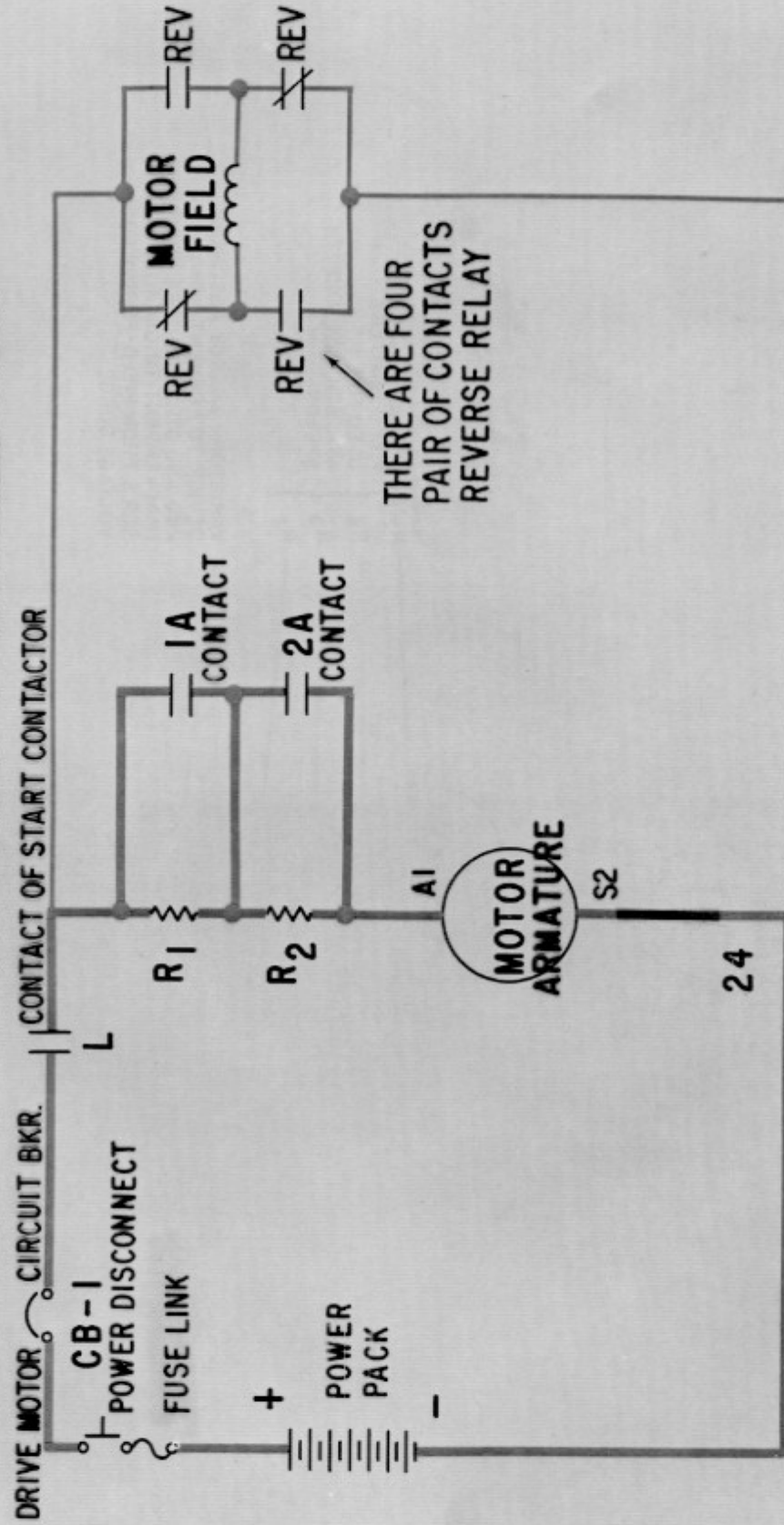


REVERSE OPERATION



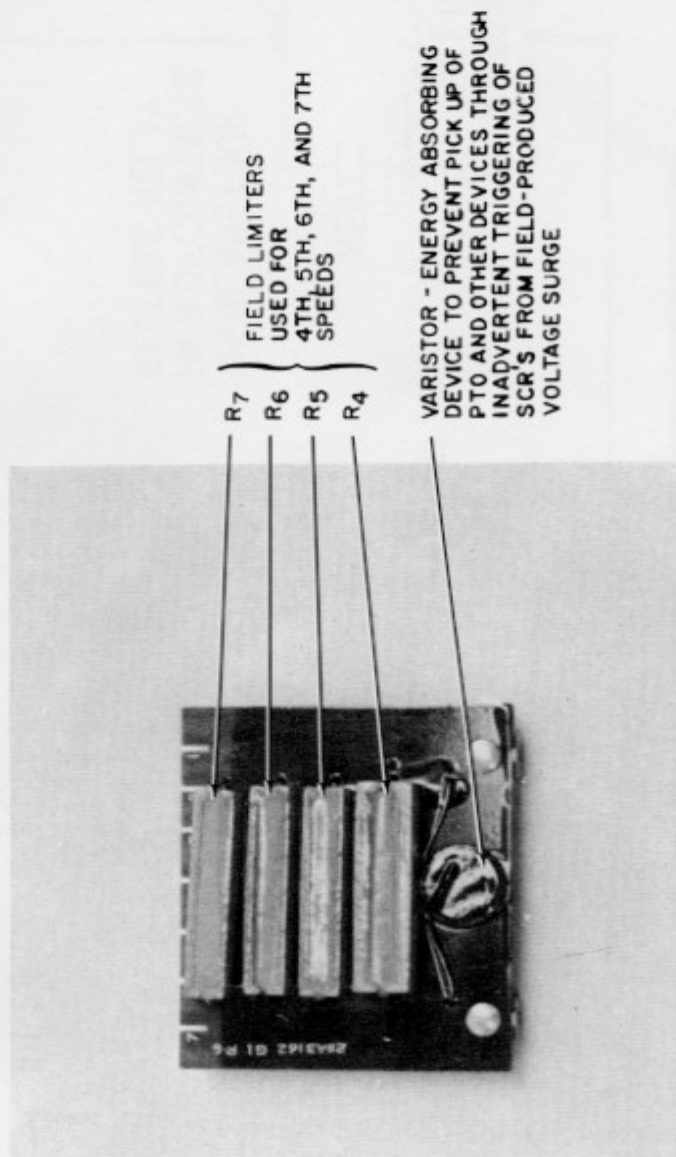
- Move the speed/control lever to left neutral. The reverse switch energizes the (REV) reverse relay.
- Reverse relay reverses the motor field polarity.
- Reverse contacts shown closed (#) are opened (=), and the reverse contacts shown open are closed. Tractor motor now rotates in reverse, allowing tractor to go backwards.
- First speed/control position in reverse- the L (Start) switch on the speed/control closes, supplying 36 volts to the L contactor coil and the contacts close- first reverse speed. R₁ and R₂ in motor circuit.
- Second speed/control position in reverse- the 1A switch on the speed/control closes, supplying 36 volts to the 1A contactor coil and the contacts close- second reverse speed. R₁ is bypassed.
- Third speed/control position in reverse- the 2A switch on the speed/control closes, supplying 36 volts to the 2A contactor coil and the contacts close- third reverse speed. R₂ is bypassed.
- The three speeds in reverse use the same switches and contactors as the first three forward speeds except the field polarity is reversed by the reverse relay.

ELEC-TRAK DRIVE MOTOR CIRCUIT



CARD #3

Used for E-15 Only



TRACTOR SPEEDS

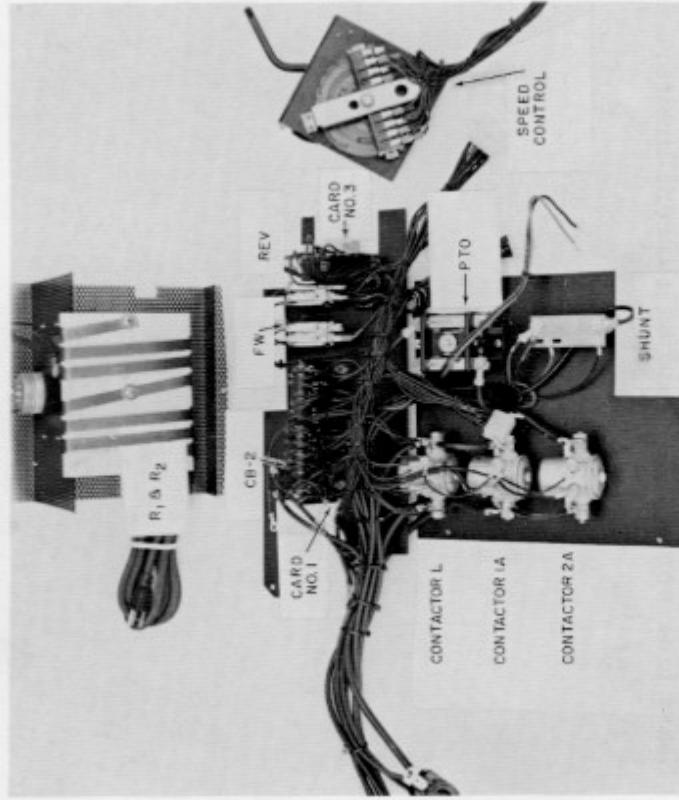
E-12S - Three Forward and three Reverse speeds, using L, 1A and 2A contactors and switches

E-15 - Has seven Forward speeds

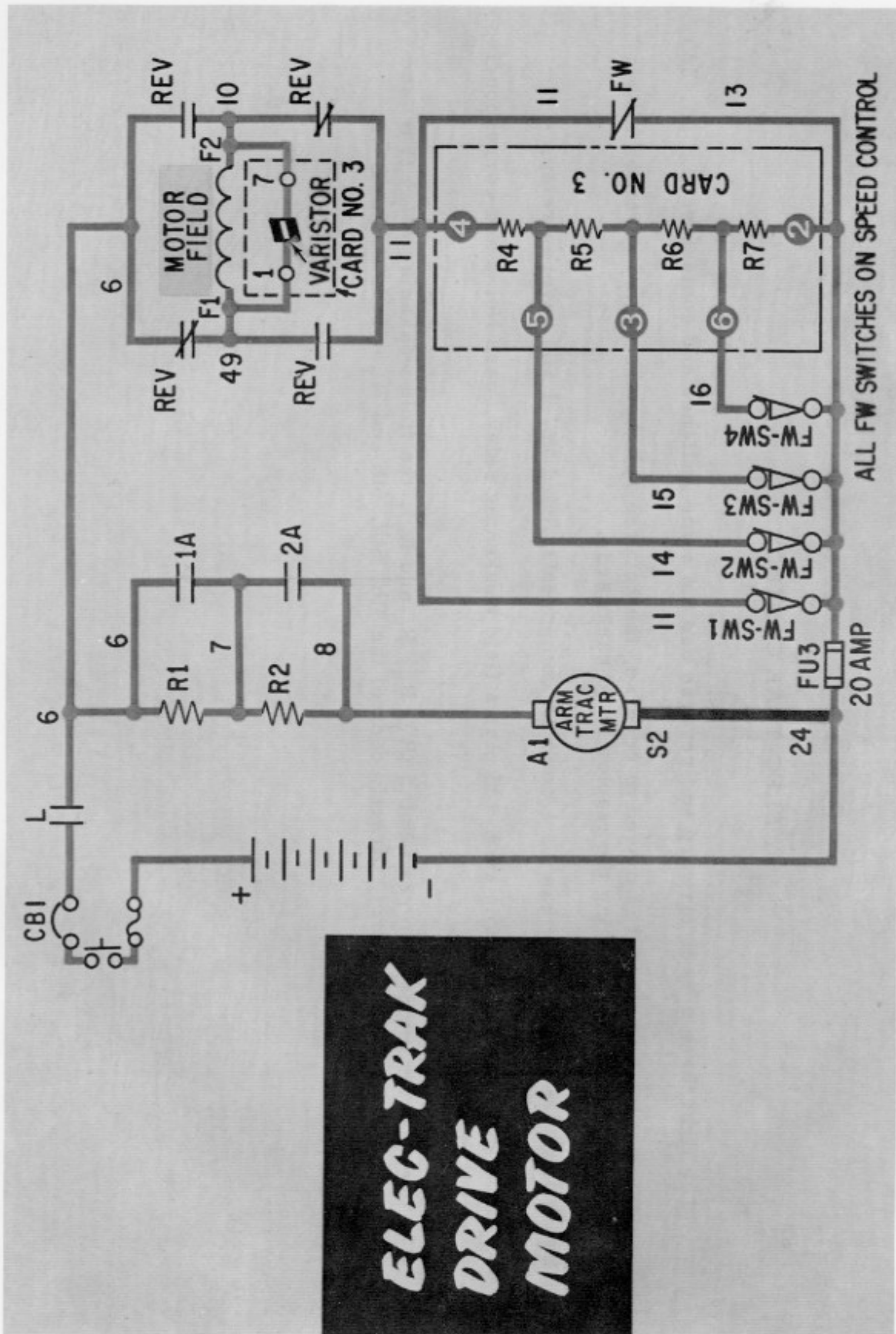
- First three use L, 1A and 2A
- Last four speeds - by adding current limiters in motor field - R₄, R₅, R₆, and R₇ on Card #3

E-15

Forward Speeds 4, 5, 6 & 7



- The field weakening (FW) relay is energized in the 3rd speed control position, opening the FW contacts.
- Speed control in 4th position- the FW₁ switch opens on the speed control, which puts current limiter R₄ on card #3 in the drive motor field.
- Speed control in 5th position- the FW₂ switch opens on the speed control, which puts current limiter R₅ on card #3 in series with R₄ in the drive motor field.
- Speed control in 6th position- the FW₃ switch opens on the speed control, which puts current limiter R₆ on card #3 in series with R₄ and R₅.
- Speed control in 7th position- the FW₄ switch opens on the speed control, which puts current limiter R₇ on card #3 in series with R₄, R₅ and R₆ in the motor field.
- Each time one of the above current limiters is added, the field voltage is reduced and the motor speed increases.

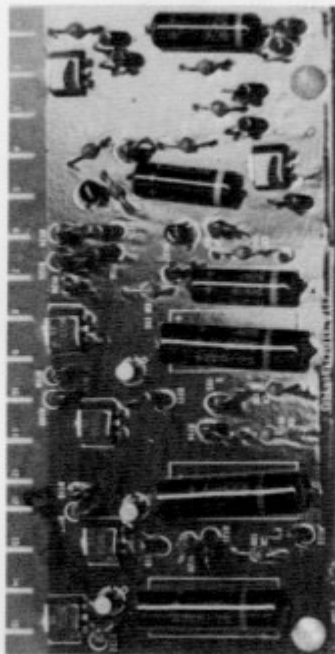


ELEC-TRAK CONTROL

- The first three speeds forward and reverse use the same switches and contactors (L, 1A, 2A)
- When the speed control is moved to reverse, the reverse relay picks up and reverses the motor field polarity, causing the tractor to go backwards.
- The E-12S control only has L, 1A and 2A components, card No. 1 and reverse relay.
- The E-15 has same items as E-12S plus a field weakening relay, card No. 3 and corresponding switches.
- The current limiters on card No. 3 (R_4 , R_5 , R_6 and R_7), the field weakening relay (FW) and FW switches on speed control, directly control the 4th, 5th, 6th and 7th speeds on the E-15.

CARD #1

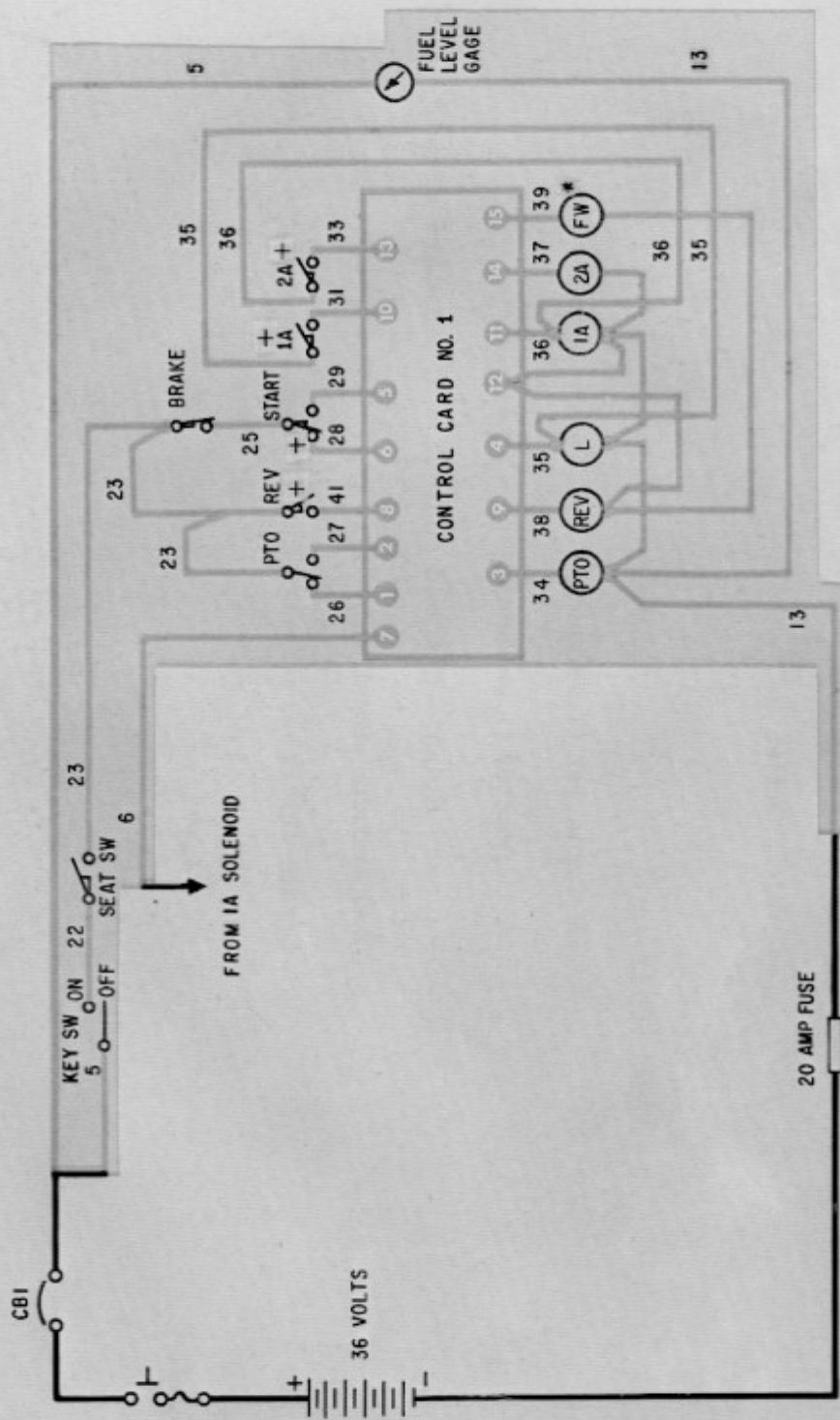
All "Return to Neutral" and Time Delay Circuits Are on Card #1



- Return to neutral - Operator must return the speed/control to neutral if in the speed position when he leaves the seat, opens the brake switch or turns the key off. If the P. T. O. switch is on when getting off the seat or turning key off, the P. T. O. switch must be turned "off" and back to the "On" position.
- After the 1A and 2A switches are closed, there is a time delay before the respective contactors are energized.

CARD NO. 1

- The input for the P. T. O. and the L contactor coils goes through card No. 1 to supply the "return to neutral" function.
- The input for the 1A and 2A contactor coils control input goes through card No. 1 to supply the time delay for these contactors. The 1A contactor energizes about 1 second after the 1A switch is closed. The 2A contactor energizes about 1 second after the 2A switch is closed.
- The FW coil is automatically energized a moment after the 2A contactor is energized.
- The (REVERSE) coil input goes through card No. 1 to prevent rapid speed/control movement from forward to reverse. If the speed control is moved too fast from forward (above 3rd speed) to reverse, the reverse Relay coil (REV) and L contactor coil will not energize. The operator must return speed control lever to neutral and then to reverse to move the tractor backwards.



+ Switches on speed control
 * Does not apply to E-12S

CARD #1

Return to Neutral and Time Delay

TWO BASIC CIRCUITS ON CARD #1

Return to Neutral

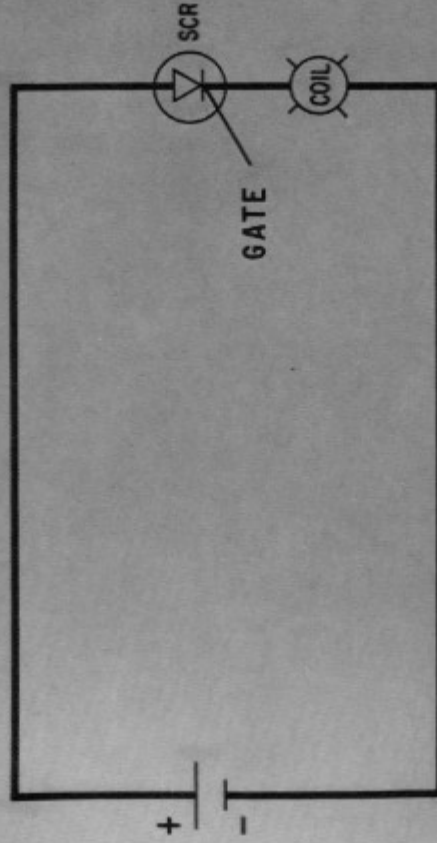
- Speed/Control
- P.T.O. Outlet

Time Delay

- 1A Contactor (1 second)
- 2A Contactor (1 second)
- Reverse Relay - if speed control is above third speed, (2A) and the speed/control is moved too fast into reverse, the reverse relay and L contactor will not pick up.

BASIC COMPONENT ON CARD #1

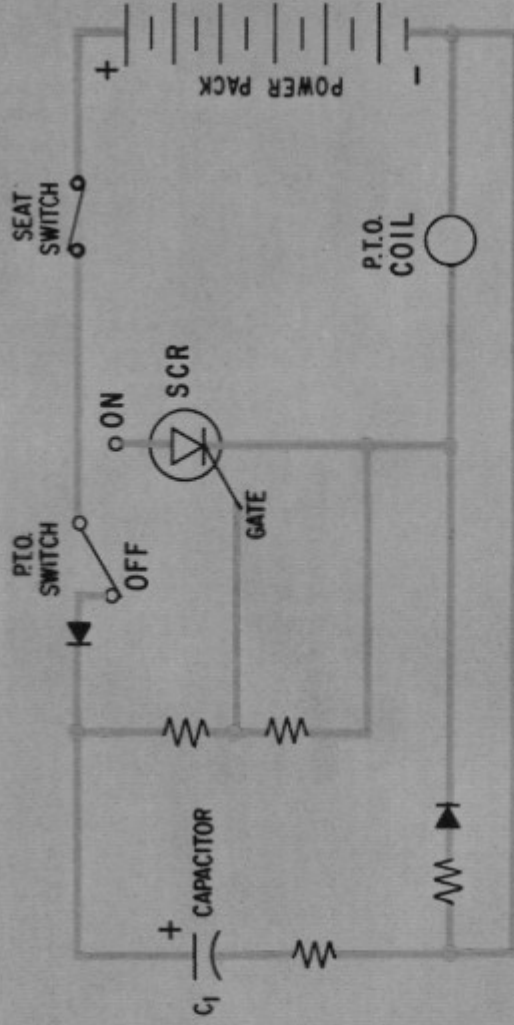
SEMICONDUCTOR SWITCH-SCR



- The SCR will not conduct until the gate is pulsed with current.
- Once the coil current is interrupted, it will not conduct until gate is again pulsed.

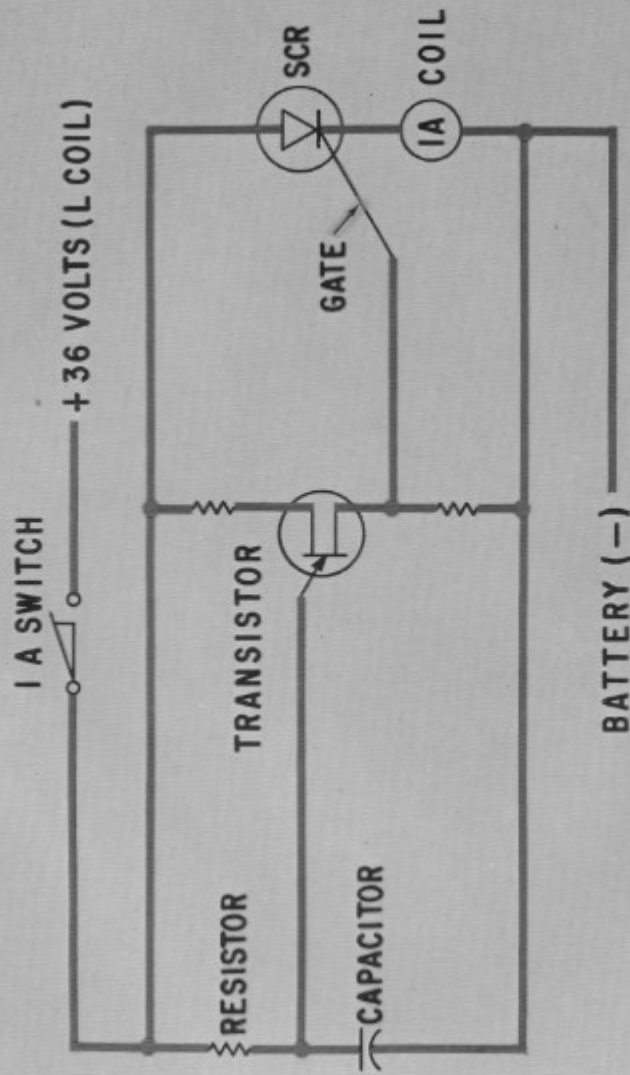
BASIC CIRCUIT ON CARD NO. 1

RETURN TO NEUTRAL CIRCUIT



- With the PTO switch off, capacitor C_1 is charged by the 36-volt power pack.
- When the PTO switch is on, the capacitor discharges through the resistors and fires the SCR gate.
- The SCR conducts and the PTO coil is energized.
- When the operator gets off the seat, the circuit is broken, and the PTO is de-energized.
- When the operator gets back on the seat, nothing happens until the PTO switch is turned to "Off" and back "On".
- When the PTO switch is turned off, the capacitor charges. Turn on switch fires the gate - PTO coil energizes.
- Similar circuit is used for the speed/control return to neutral function.

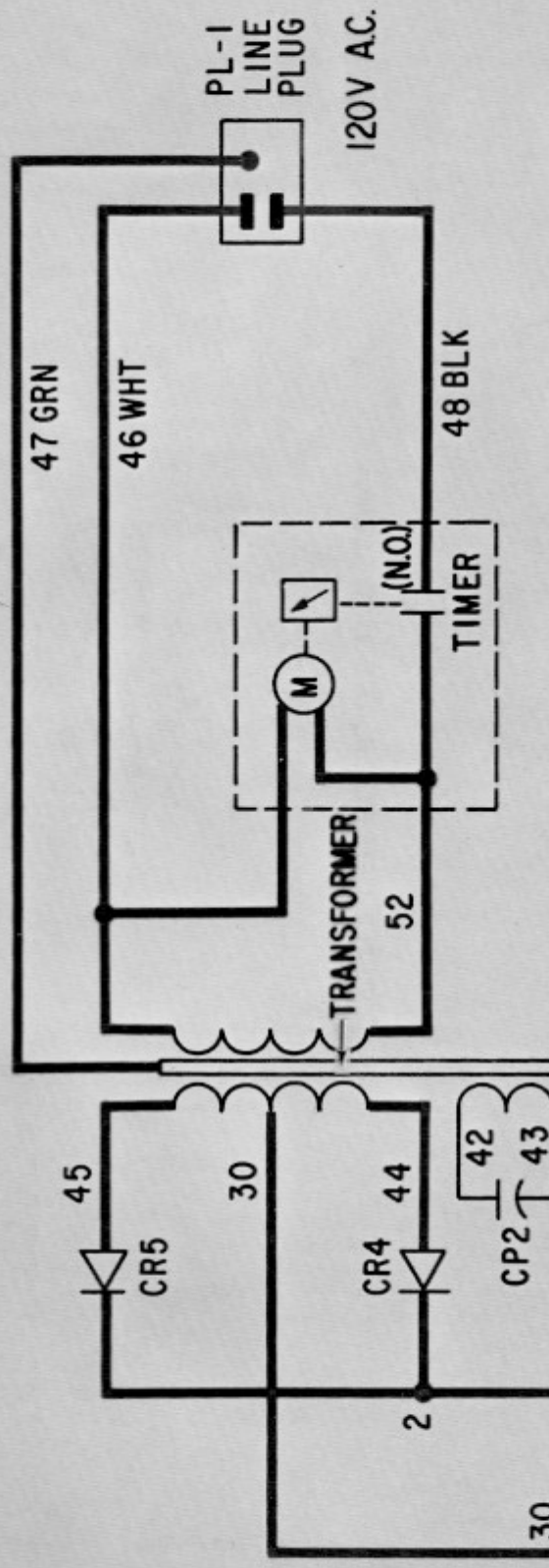
TIME DELAY CIRCUIT



- Uses the SCR but delays firing of the gate.
- Firing of the gate is delayed by using transistor with resistor network.
- Time delay can be varied, depending on value of capacitor and resistor in series.

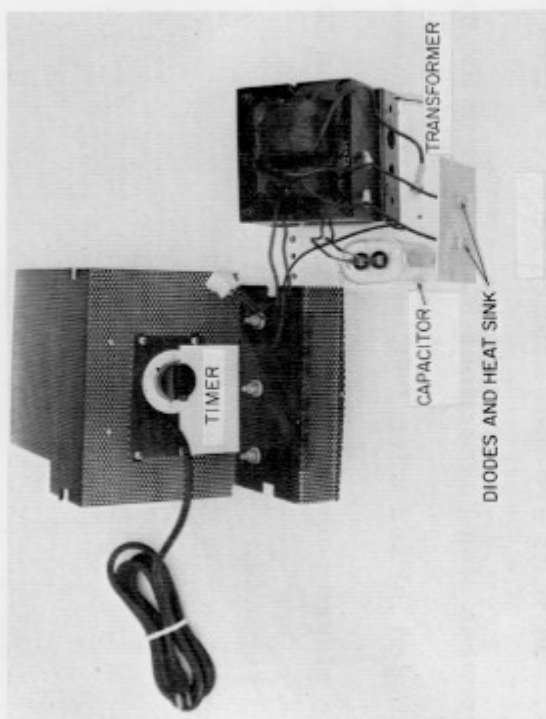
BATTERY CHARGER, FRONT LIFT,
LIGHTS, AND P.T.O.

BATTERY CHARGER



- CR₄ and CR₅ are diodes
- CP₂ is the capacitor
- Wires #30 to 44 or 30 to 45 will measure about 40 volts AC when charger is on
- Wires #44 to 45 will measure about 80 volts AC when charger is on
- Wires #2 to 30 will measure about 40 volts DC when charger is on

TO DISCONNECT
TO CIRCUIT BREAKER NO. 2

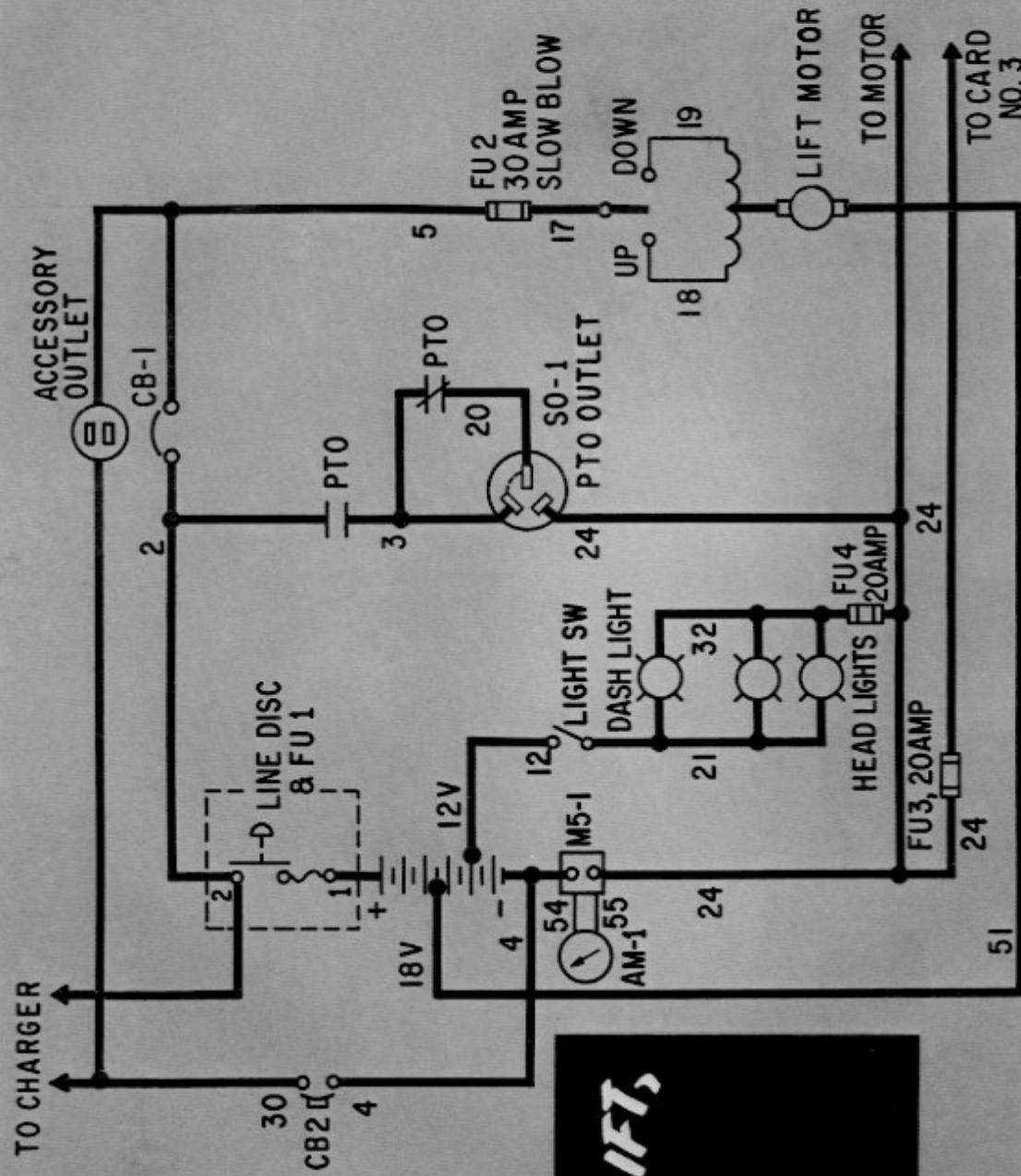


Charger Description

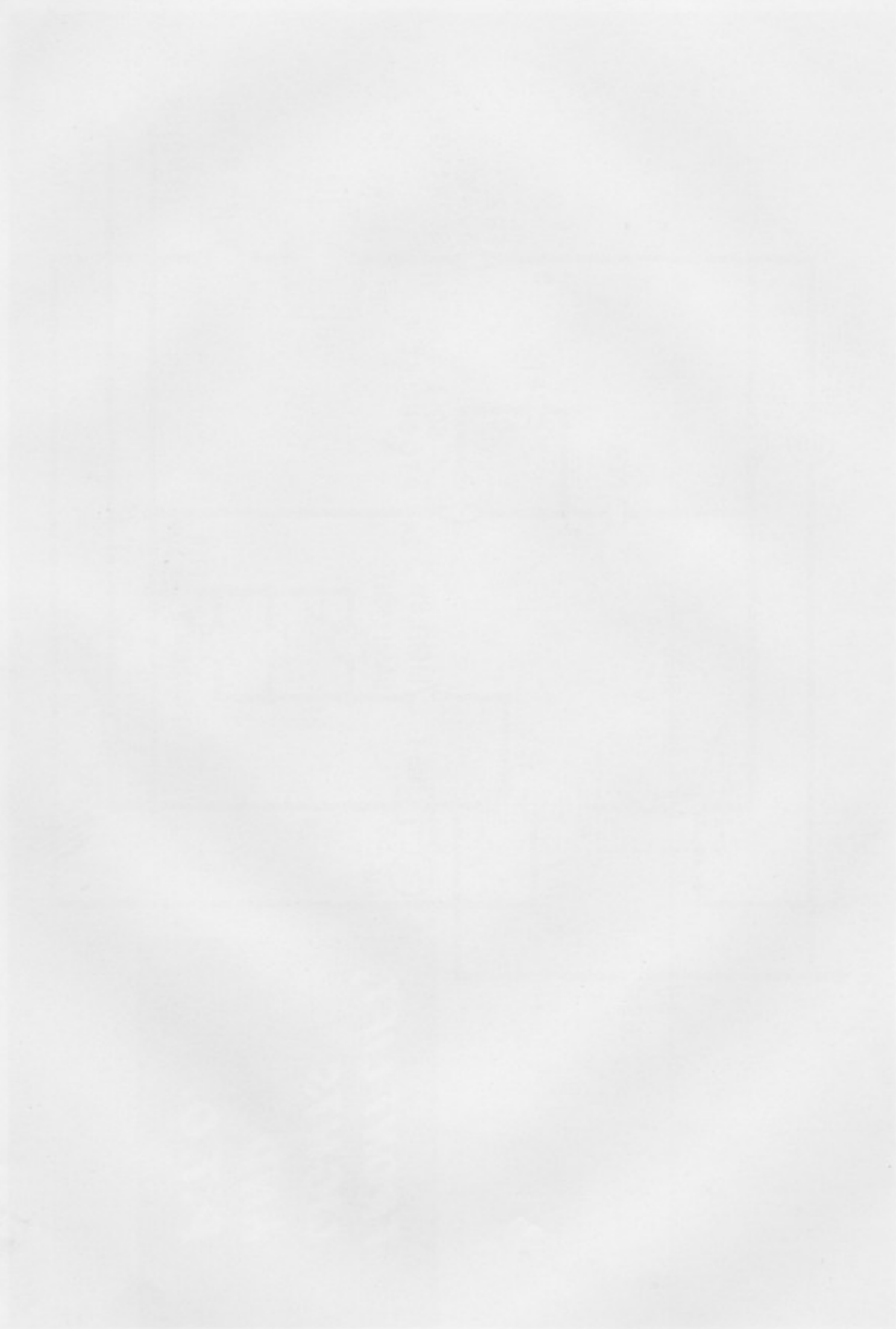
- 120 Volt, 15 Amp AC input for Charger
- Transformer reduces 120 volts AC to 80/40 volts AC
- Diodes convert 40 volts AC to 40 volts DC
- Capacitor regulates charging rate
- Maximum draw on 120 volts AC is approximately 14 amps
- Timer when set to 1 - 2 years runs about 18 hours before it shuts off
- Power disconnect must be engaged

ELECTRIC LIFT, LIGHTS & PTO CIRCUITS

- Electric lift circuit is 18 volts.
- Lights are a 12-volt system - does not connect to disconnect.
- PTO contacts are shown in power-off condition. When PTO coil is energized (see page 45), the PTO contact shown open, closes, and PTO contact shown closed, opens. 36 volts are then applied between wires #3 and #24. The dotted connection between plug connections 3 and 20 is in the mower housing (when mower is plugged in) and when PTO shuts off, the mower motor acts as a generator via closed connection between wires 24 and 20, and stops the motor in less than 3 seconds.

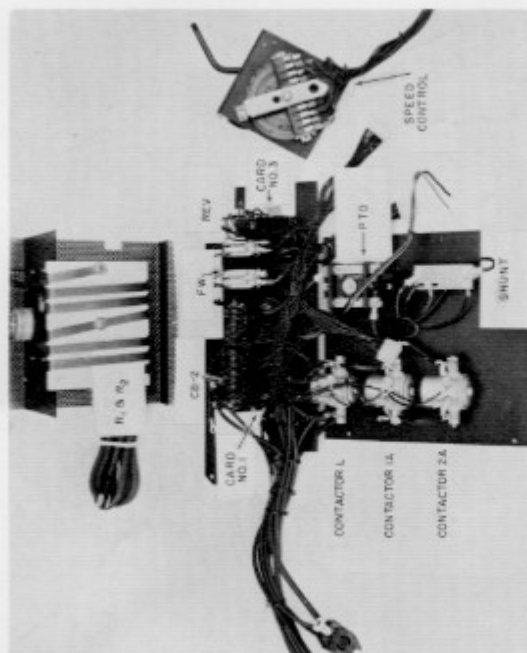


FRONT LIFT, LIGHTS AND P.T.O.



CONTROL SUMMARY

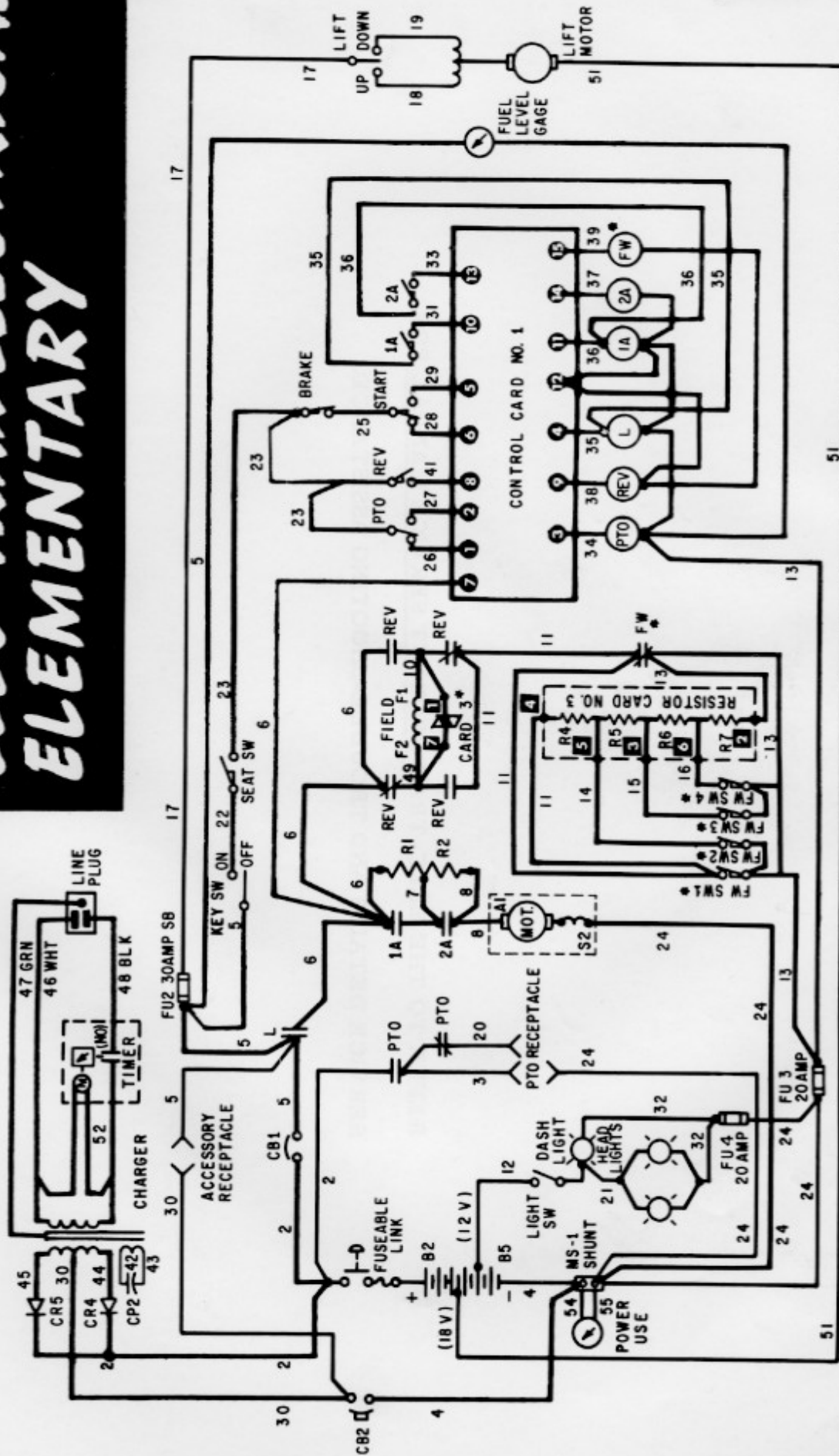
SPEED CONTROL SEQUENCE



Lever Position	Contactor/Switch	Results
<u>Forward</u>	Start "L"	Power to drive motor, R ₁ & R ₂ in circuit
1	1A	Bypass R ₁ current limiter
2	2A	Bypass R ₂ current limiter, FW* relay opens
3	FW ₁ *	* Limiter 4 in field)
4*	FW ₂ *	* Limiter 5 in field)
5*	FW ₃ *	* Limiter 6 in field)
6*	FW ₄ *	* Limiter 7 in field)
7*		ON CARD #3
<u>Reverse</u>		
Left-hand neutral	Reverse Switch	Reverses motor field polarity
1	Start "L"	Power to drive motor, R ₁ and R ₂ in circuit
2	1A	Bypass R ₁ current limiter
3	2A	Bypass R ₂ current limiter

*Does not apply to E-12S

ELEC-TRAK ELECTRICAL ELEMENTARY



* DOES NOT APPLY TO E-12S

REFER TO THE ELEC-TRAK PRODUCT SERVICE MANUAL FOR
SERVICE DETAILS AND TROUBLE-SHOOTING ASSISTANCE.

General Electric Company
Outdoor Power Equipment Operation
Corporations Park, Bldg. 702
Schenectady, N. Y. 12305

GENERAL  ELECTRIC