CLARK EQUIPMENT

INDUSTRIAL TRUCK DIVISION

CLARK EQUIPMENT

OPERATORS MANUAL

FOR

EC 30B-40B
EC 30C-40C
ECS 50C

HYDRAULICALLY ACTUATED CARBON PILE (with Dual Field Drive Motor)
THE all-new SOLID STATE CONTROL

5th REVISION
0-172

CLARK EQUIPMENT COMPANY

PUBLISHED BY

TECHNICAL SERVICE DEPARTMENT,
BATTLE CREEK, MICHIGAN, U.S.A.

INDUSTRIAL TRUCK DIVISION

PLEASE NOTE

INSTRUCTIONS ON USE OF MANUAL

This Operator's Manual is published as a service reference guide and includes Specifications, Operating Instructions, Lubrication and Preventive Maintenance Instructions, and Trouble Shooting Guide.

The TABLE OF CONTENTS for this manual is printed on green paper and is placed at the front for easy reference. A separate INDEX (also printed on green paper) is placed in front of the Lubrication and Preventive Maintenance Section.

Lubrication and Preventive Maintenance Instructions are listed under the TIME INTERVALS that they should be performed.

The TIME INTERVAL is part of the page number and code number.

Example: 8H 002-0; 8H is the TIME INTERVAL (8 operating hours), 002 is the PAGE NUMBER, and -0 is a CODE NUMBER that you as a customer should disregard. The dash number or code number is for the benefit of the publisher only.

The INDEX is set up under the TIME INTERVALS that the Lubrication and Preventive Maintenance should be performed.

Example: (8 Hours)	Time Interval (H=Hours)	&	Page Number (000-)
Hydraulic Sump Tank, level check...	8H		503
Brake Pedal Free Travel, check.....	8H		373

The above states to check the sump tank fluid level every 8 operating hours and refer to page 503 for fluid recommendations etc. Also, to check brake pedal free travel at this interval and turn to page 373 for instructions.

Turn to the eight (8) hour section (8H) and then to the page listed — 503 or 373 etc. The instructions covered therein will pertain only to the checks or adjustments that should be performed at this TIME INTERVAL.

If, for instance, the Brake Pedal Free Travel is incorrect, you would then refer to the INDEX for "Brake Pedal Free Travel, adjust" which would be listed in the TIME INTERVALS following the 8 hour section.

Example: (100 Hours)	Time Interval (H=Hours)	&	Page Number (000-)
Brake Pedal Free Travel, adjust....	100H		302

Turn to the one hundred hour section (100H) and then to

INSTRUCTIONS ON USE OF MANUAL

page 302. Complete instructions as to the importance of pedal free travel, the method to check and adjust for correct free travel with illustrations are included therein.

NOTE

YOU WILL NOTE THAT AT THE BEGINNING OF EVERY SECTION A LUBRICATION AND PREVENTIVE MAINTENANCE ILLUSTRATION IS SHOWN GIVING THE LOCATION OF THE COMPONENTS TO BE SERVICED.

It is impossible to cover all types of machine operations in one manual. Operating conditions should determine the lubrication and maintenance intervals. Common sense and a close observance can best determine the frequency with which you should service your machine.

The care you give your machine will greatly determine the satisfaction and service life that you will obtain from it. A difinite maintenance program should be set up and followed. Haphazard maintenance will only lead to faulty performance and short life.

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TABLE OF CONTENTS

TROUBLE SHOOTING GUIDE

SAFETY INSTRUCTIONS FOR MAINTAINING INDUSTRIAL TRUCKS

Powered industrial trucks may become hazardous if adequate maintenance is neglected. Therefore, adequate maintenance facilities, personnel and procedures should be provided.

Maintenance and inspection of all powered industrial trucks should be performed in conformance with the recommendation in this manual and the following practices.

1. A scheduled preventive maintenance, lubrication, and inspection system should be followed.

2. Only qualified and authorized personnel should be permitted to maintain, repair, adjust, and inspect industrial trucks.

3. Before Leaving The Truck:

   A. Stop truck.

   B. Fully lower the load engaging means.

   C. Place directional controls in neutral.

   D. Apply the parking brake.

   E. Stop the engine or turn off power.

   F. Lock the control or ignition circuit.

   G. Block the wheels if truck is on a ramp, or being worked on.

4. Before Working On Truck:

   A. Raise wheels free of floor or disconnect power source.

   B. Use chocks or other positive truck positioning devices.

   C. Block load engaging means, innermast(s), or chassis before working under them.

   Before working on engine fuel system of gasoline powered trucks with gravity feed fuel systems, be sure fuel shutoff valve is closed.

   Before working on engine fuel system of LP gas powered trucks, close LP gas cylinder valve and run engine until fuel in system is depleted and engine stops running.

   Operation to check performance of the truck or attachments should be conducted in an authorized, safe clearance area.

5. Before Starting To Operate The Truck:

   A. Be in operating position.

   B. Depress clutch (or brake pedal on automatic transmission and electric trucks).

   C. Place directional controls in neutral.

   D. Start engine or turn on power.

   E. Before operating truck, check functioning of lift and tilt systems, directional and speed controls, steering, warning devices, brakes, and any attachment. (If used)

   F. Release parking brake.

- continued -

SAFETY INSTRUCTIONS FOR MAINTAINING INDUSTRIAL TRUCKS

6. Avoid fire hazards and have fire protection equipment present. Do not use an open flame to check level, or for leakage, of fuel, electrolyte or coolant. Do not use open pans of fuel or flammable cleaning fluids for cleaning parts.

7. Properly ventilate work area, vent exhaust fumes and keep shop clean and floor dry.

8. Handle LP gas cylinders with care. Do not drop, dent, or damage in any way.

9. Brakes, steering mechanisms, control mechanisms, warning devices, lights, governors, lift overload devices, guards and safety devices should be inspected regularly and maintained in a safe operating condition.

10. All parts of lift and tilt mechanisms and frame members should be carefully and regularly inspected and maintained in a safe operating condition.

11. Special trucks or devices designed and approved for hazardous area operation should receive special attention to ensure that maintenance preserves the original, approved safe operating features.

12. Fuel systems should be checked for leaks and condition of parts. Extra special consideration should be given in the case of a leak in the fuel system. Action should be taken to prevent the use of the truck until the leak has been corrected.

13. All hydraulic systems should be regularly inspected and maintained in conformance with good practice. Tilt cylinders, valves, and other similar parts should be checked to assure that "drift" has not developed to the extent that it would create a hazard.

14. Capacity, operation and maintenance instructions plates, tags, or decals should be maintained in legible condition.

15. Batteries, motors, controllers, limit switches, protective devices, electrical conductors and connections should be inspected and maintained in conformance with good practice. Special attention should be paid to the condition of electrical insulation.

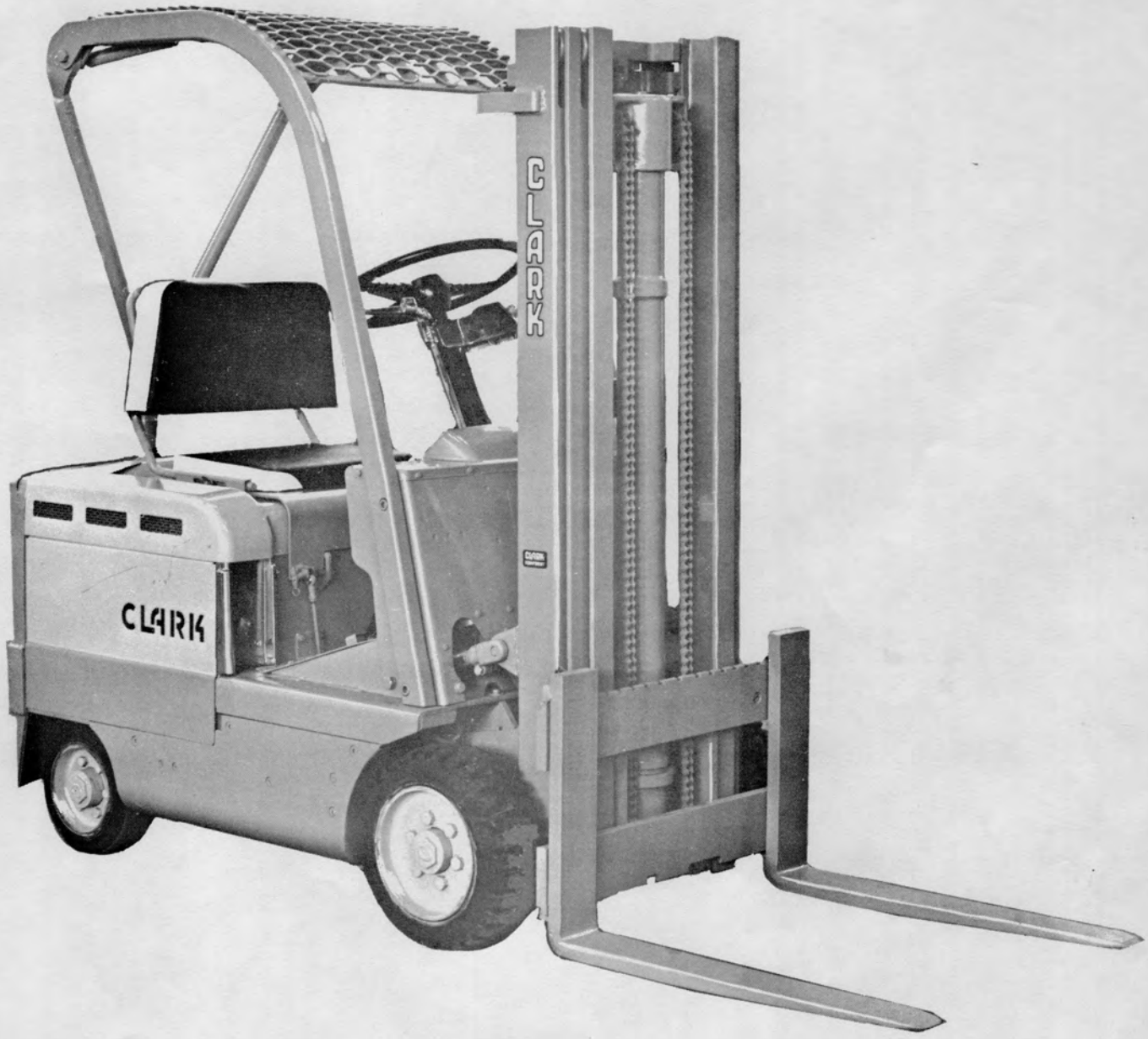
16. Industrial trucks should be kept in a clean condition to minimize fire hazards and facilitate detection of loose or defective parts.

17. Modifications and additions which affect capacity and safe truck operation should not be performed by the customer or user without manufacturers prior written approval. Capacity, operation and maintenance instruction plates, tags or decals should be changed accordingly.

18. Care should be taken to assure that all replacement parts are interchangeable with the original parts and of a quality equal to that provided in the original equipment.

INDUSTRIAL TRUCK DIVISION

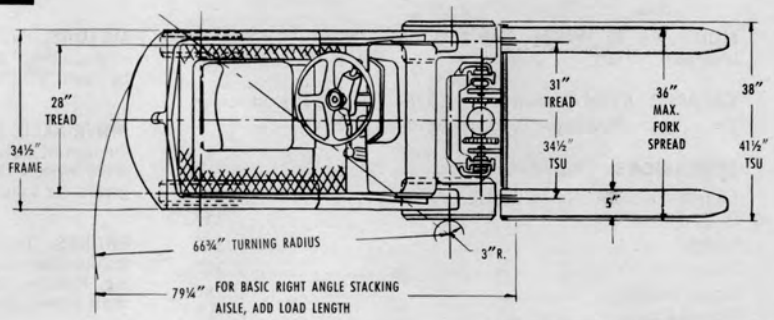
LUBRICATION AND PREVENTIVE MAINTENANCE



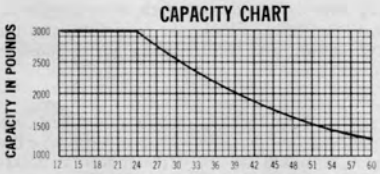
DIMENSIONAL SPECIFICATIONS

CLARKLIFT® EC-30

3,000 pounds capacity, 24 inch load center



CAPACITY CHART



LOAD CENTER IN INCHES FROM FRONT FACE OF FORKS—RATED CAPACITIES SHOWN ABOVE ARE COMPUTED WITH UPRIGHTS IN VERTICAL POSITION. THEY APPLY ONLY ON MAXIMUM FORK HEIGHTS UP TO AND INCLUDING 154".

UPRIGHT DIMENSION TABLE

MFH		Overall Height Lowered	Free Lift		
Std. Hi-Lo	Std. & FFL TSU		Std.	Hi-Lo & FFL TSU**	TSU
70	——	53	17¼	——	——
76	——	56	17¼	——	——
82	——	59	17¼	——	——
88	——	62	17¼	——	——
94	135	65	17¼	45½	13
100	144	68	17¼	48½	13
*106	*153	71	17¼	51½	13
112	162	74	17¼	54½	13
118	171	77	17¼	57½	13
124	180	80	17¼	60½	13
*130	*189	83	17¼	63½	13
136	198	86	17¼	66½	13
142	207	89	17¼	69½	13
148	216	93	17¼	72½	13
*154	*225	96	17¼	75½	13
160	——	99	17¼	79½	——
166	——	102	17¼	82½	——
172	——	106	17¼	86½	——
*178	——	109	17¼	89½	——

INTERMEDIATE HEIGHTS AVAILABLE IN INCREMENTS OF 3" MFH.

FOR OVERALL HEIGHT RAISED — ADD 48" TO MFH.

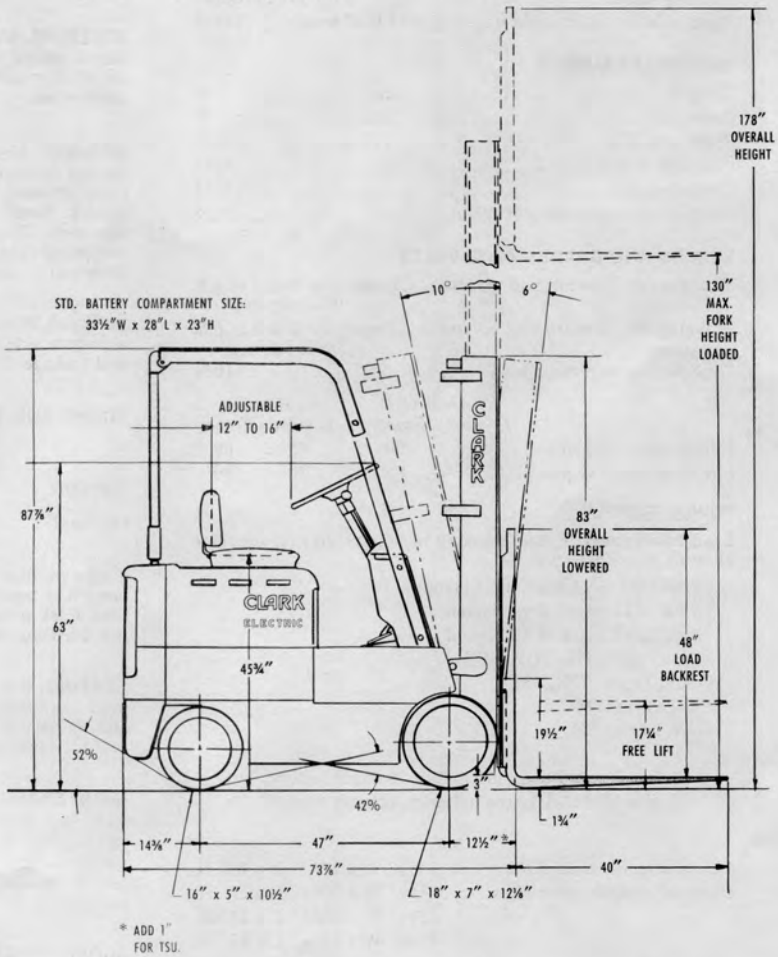
*INDICATES PREFERRED STANDARD SIZES.

**LESS LOAD BACKREST

CERTIFIED BY CLARK ENGINEERING DEPT.

On all CLARK literature, dimensional and performance specifications are checked for accuracy by the engineering department.

NOTE: Clark products and specifications are subject to improvements and changes without notice.



* ADD 1" FOR TSU.

ENGINEERING SPECIFICATIONS

CLARKLIFT® EC-30

3,000 pounds capacity, 24 inch load center

MODEL EC-30 Weight with lead acid battery

	Standard	Hi.Lo
	7,120 lbs.	7,160 lbs.

CAPACITY Rated Capacity.....3,000 lbs. at 24″ load center
(See capacity chart for other ratings)

DIMENSIONS

Length (to front face of forks)	73⅞″
Wheelbase	47″
Width	38″
Tread (drive)	31″
Tread (steer)	28″
Turning radius	66¾″
Basic aisle for right angle stacking (add load length)	79¼″

UNDERCLEARANCES

Upright	3″
Drive axle	3″
Steer axle	3½″
Center of frame	4½″
Counterweight	4¾″
Grade clearance at counterweight	52%

SPEEDS AND GRADES AT 36 VOLTS

Travel speed, forward and reverse....Loaded up to 6.4 m.p.h. (563.2 f.p.m.)

Travel speed, forward and reverse....Empty up to 6.7 m.p.h. (589.6 f.p.m.)

Gradeability with rated load.....10%

	STANDARD		*HI-LO*	
	Loaded	*Empty*	*Loaded*	*Empty*
Lifting speed (f.p.m.)	60	90	45	69
Lowering speed (f.p.m.)	70	85	70	80

POWER SUPPLY

Lead acid battery in steel trays 30 to 36 volt, having adequate kilowatt hours capacity.

15 cells, 21 to 23 plate, 3 x 5 layout
16 cells, 19 plate, 4 x 4 layout
18 cells, 17 plate, 4 x 5 layout
Exide Types: TG, TGP, TSC
Gould Types: 72X, 85T
C & D Types: HC
K-W Types: FH

For Ready Power installation, contact factory.
For Nickel-Alkaline batteries, contact factory.

Standard compartment size.....33½″ W x 28″ L x 23″ H.
Optional compartment sizes.....33½″ W x 30¾″ L x 23″ H.
33½″ W x 32¾″ L x 23″ H.
33½″ W x 34¾″ L x 23″ H.

BATTERY CONNECTOR. Anderson type SB, 175 ampere continuous rating with ample capacity for overloads. Both halves are identical and interchangeable.

MOTORS. Drive motor is dual wound. Pump motor is series wound. Both motors are fan cooled, ventilated and protected by class "F" insulation.

DRIVE AXLE. Heavy-duty drive axle by Clark, with double reduction of bevel and spur gears. Final gear reduction is at the drive wheels through pinion and internal ring gear; sealed in grease for longer life.

BRAKES. Two systems: Foot brake, torque multiplied, hydraulic internal expanding double shoe with bonded brake lining. Parking brake is mounted on the drive motor armature shaft and applies when operator leaves the seat.

STEERING. Vanadium steel steer axle is mounted on two torsional rubber bushing assemblies, with inclined king pins. Recirculating ball type steering gear with 18″ diameter steering hand wheel.

UPRIGHT. Nested roller type telescopic upright. I-beam inner section of chrome alloy steel is nested within the 1045 steel outer channel. Carriage has lateral thrust rollers mounted on outside. Latch assures completion of free lift before inner section rises. Dual tilt cylinders have chrome plated rods. Anticavitating control valve prevents drifting. Tilting range is 10° back and 6° forward.

LIFT CYLINDER. Piston type, with free-floating mounting to eliminate side strains. Oil drain line to sump prevents external seal leakage. Flow regulator controls lowering speed.

FORKS AND FORK CARRIAGE

	Length	*Width*	*Thickness*
Standard	40″	5″	1¾″
Optional	Contact Factory		

Forks are heat treated and upset forged from SAE 1045 steel; bottom is tapered from chisel tip 30 inches to specified thickness. Fork spread from 0″ inside to 36″ outside width. Carriage is welded construction from SAE 1045 steel.

SEATING. Rubber mounted wide seat and back rest are Polyurethane foam, covered with vinyl plastic. Backrest is curved, and swivels to fit driver. Automotive type latch releases the seat for horizontal adjustment up to 4 inches.

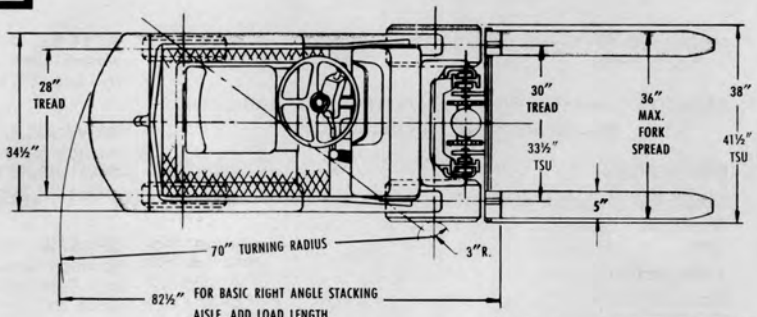
MAINTENANCE. Removable hood and side plates provide top and side removal of battery. Pump, pump motor, control panel, carbon pile unit and SCR panel quickly exposed for inspection and maintenance. Pressure gun fittings at all lubrication points.

ADDED ADVANTAGES. The following are all standard equipment: Driver's overhead guard and load back rest, electric horn, shock mounted direct reading hour meter and battery discharge indicator. All exposed surfaces are shot blasted and prime painted with weather resistant paint. Standard color is two tone silver-grey and red; optional colors with grey are orange, yellow, green or blue.

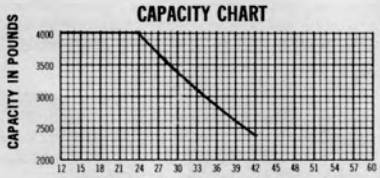
DIMENSIONAL SPECIFICATIONS

CLARKLIFT® EC-40

4,000 pounds capacity, 24 inch load center



CAPACITY CHART



LOAD CENTER IN INCHES FROM FRONT FACE OF FORKS—RATED CAPACITIES SHOWN ABOVE ARE COMPUTED WITH UPRIGHTS IN VERTICAL POSITION. THEY APPLY ONLY ON MAXIMUM FORK HEIGHTS UP TO AND INCLUDING 154".

UPRIGHT DIMENSION TABLE

MFH		Overall Height Lowered	Free Lift		
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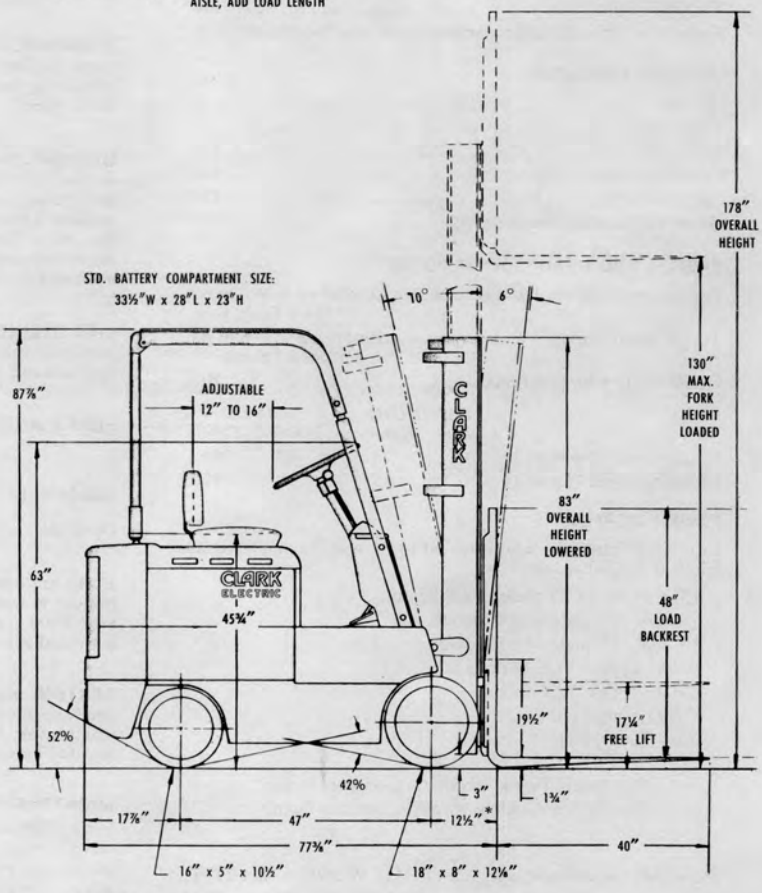
*106	*153	71	17¼	51½	13
112	162	74	17¼	54½	13
118	171	77	17¼	57½	13
124	180	80	17¼	60½	13
*130	*189	83	17¼	63½	13
136	198	86	17¼	66½	13
142	207	89	17¼	69½	13
148	216	93	17¼	72½	13
*154	*225	96	17¼	75½	13
160	—	99	17¼	79½	—
166	—	102	17¼	82½	—
172	—	106	17¼	86½	—
*178	—	109	17¼	89½	—

INTERMEDIATE HEIGHTS AVAILABLE IN INCREMENTS OF 3" MFH.

FOR OVERALL HEIGHT RAISED — ADD 48" TO MFH.
*INDICATES PREFERRED STANDARD SIZES.
**LESS LOAD BACKREST



* ADD 1" FOR TSU.

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On all CLARK literature, dimensional and performance specifications are checked for accuracy by the engineering department.

NOTE: Clark products and specifications are subject to improvements and changes without notice.

ENGINEERING SPECIFICATIONS

CLARKLIFT® EC-40

4,000 pounds capacity, 24 inch load center

MODEL EC-40 Weight with lead acid battery — Standard: 7,990 lbs. Hi.Lo: 8,030 lbs.

CAPACITY Rated Capacity.....4,000 lbs. at 24″ load center
(See capacity chart for other ratings)

DIMENSIONS

Length (to front face of forks)	77⅜″
Wheelbase	47″
Width	38″
Tread (drive)	30″
Tread (steer)	28″
Turning radius	70″
Basic aisle for right angle stacking (add load length)	82½″

UNDERCLEARANCES

Upright	3″
Drive axle	3″
Steer axle	3½″
Center of frame	4¼″
Counterweight	4¾″
Grade clearance at counterweight	52%

SPEEDS AND GRADES AT 36 VOLTS

Travel speed, forward and reverse....Loaded up to 6.3 m.p.h. (554.4 f.p.m.)

Travel speed, forward and reverse....Empty up to 6.6 m.p.h. (580.8 f.p.m.)

Gradeability with rated load.....10%

	STANDARD		*HI-LO*	
	Loaded	*Empty*	*Loaded*	*Empty*
Lifting speed (f.p.m.)	50	90	40	69
Lowering speed (f.p.m.)	70	85	70	80

POWER SUPPLY

Lead acid battery in steel trays 30 to 36 volt, having adequate kilowatt hours capacity.

15 cells, 21 to 23 plate, 3 x 5 layout
16 cells, 19 plate, 4 x 4 layout
18 cells, 17 plate, 4 x 5 layout
Exide Types: TG, TGP, TSC
Gould Types: 72X, 85T
C & D Types: HC
K-W Types: FH

For Ready Power installation, contact factory.
For Nichel-Alkaline batteries, contact factory.

Standard compartment size.....33½″ W x 28″ L x 23″ H.
Optional compartment sizes.....33½″ W x 30¾″ L x 23″ H.
33½″ W x 32¾″ L x 23″ H.
33½″ W x 34¾″ L x 23″ H.

BATTERY CONNECTOR. Anderson type SB, 175 ampere continuous rating with ample capacity for overloads. Both halves are identical and interchangeable.

MOTORS. Drive motor is dual wound. Pump motor is series wound. Both motors are fan cooled, ventilated and protected by class "F" insulation.

DRIVE AXLE. Heavy-duty drive axle by Clark, with double reduction of bevel and spur gears. Final gear reduction is at the drive wheels through pinion and internal ring gear; sealed in grease for longer life.

BRAKES. Two systems: Foot brake, torque multiplied, hydraulic internal expanding double shoe with bonded brake lining. Parking brake is mounted on the drive motor armature shaft and applies when operator leaves the seat.

STEERING. Vanadium steel steer axle is mounted on two torsional rubber bushing assemblies, with inclined king pins. Recirculating ball type steering gear with 18″ diameter steering hand wheel.

UPRIGHT. Nested roller type telescopic upright. I-beam inner section of chrome alloy steel is nested within the 1045 steel outer channel. Carriage has lateral thrust rollers mounted on outside. Latch assures completion of free lift before inner section rises. Dual tilt cylinders have chrome plated rods. Anti-cavitating control valve prevents drifting. Tilting range is 10° back and 6° forward.

LIFT CYLINDER. Piston type, with free-floating mounting to eliminate side strains. Oil drain line to sump prevents external seal leakage. Flow regulator controls lowering speed.

FORKS AND FORK CARRIAGE

	Length	*Width*	*Thickness*
Standard	40″	5″	1¾″
Optional	Contact Factory		

Forks are heat treated and upset forged from SAE 1045 steel; bottom is tapered from chisel tip 30 inches to specified thickness. Fork spread from 0″ inside to 36″ outside width. Carriage is welded construction from SAE 1045 steel.

SEATING. Rubber mounted wide seat and back rest are Polyurethane foam, covered with vinyl plastic. Backrest is curved, and swivels to fit driver. Automotive type latch releases the seat for horizontal adjustment up to 4 inches.

MAINTENANCE. Removable hood and side plates provide top and side removal of battery. Pump, pump motor, control panel, carbon pile unit and SCR panel quickly exposed for inspection and maintenance. Pressure gun fittings at all lubrication points.

ADDED ADVANTAGES. The following are all standard equipment: Driver's overhead guard and load back rest, electric horn, shock mounted direct reading hour meter and battery discharge indicator. All exposed surfaces are shot blasted and prime painted with weather resistant paint. Standard color is two tone silver-grey and red; optional colors with grey are orange, yellow, green or blue.

INDUSTRIAL TRUCK DIVISION

SPECIFICATIONS

NOTE

The following specifications apply to BOTH the EC 30 & 40 B unless otherwise specified.

GENERAL

Basic aisle for right angle stacking (add length of load)
EC 30 B.....79¼ inches
EC 40 B.....82½ inches

Battery Connector.....Type SB, 175 Amperes

TRANSMISSION

Gear Ratio:
Axle adapter & differential-3.33 to 1

STEER AXLE

Left-hand turning radius angle:

Left wheel.....77 deg 35 min.
Right wheel.....54 deg 20 min.

Right-hand turning radius angle:

Left wheel.....54 deg 20 min.
Right wheel.....77 deg 35 min.

DRIVE AXLE

Ratio (axle ends).....4.4 to 1
Capacity:
Differential.....5 Pints
Axle ends (each).....1¼ pounds

TIRES

Front: EC30B.....18X7X12 1/8
EC40B.....18X8X12 1/8
Rear:.....16X5X10 1/2

HYDRAULIC SYSTEM

Sump tank capacity.....3.09 gal
Sump tank filter (replaceable)25-40 micron
Sump tank breather (replaceable)..5 micron
Main pump type.....Gear-dual
Capacity.....2.7 and 10.9 GPM
Hydraulic valve pressure relief valve setting.....1750-1800 PSI

BRAKE SYSTEM

Type (service): Hydraulic internal expanding double shoe mounted in drive axle housing.

Brake pedal free travel.....½"

Parking brake: Two shoe, external compressing, spring applied-mechanically released, mounted on drive motor.

DRIVE MOTOR

Horsepower.....8.35, 5.5
Speed.....1110,1380
Voltage.....36, 36
Amperes.....220, 145
Winding.....Series, Series
Direction of rotation.....Reversible
Bearings: Double row 308 convergent race type on drive end and 306 cartridge type on front end.
Brush spring tension:
Initial.....63-60 ounces
Final.....42-40 ounces

PUMP MOTORS
CLARK PART #1615378 & 1627786

Horsepower.....10.86 hp
Motor speed.....2620 rpm @ 12 ft. lbs.
Voltage.....26
Amperes.....290
Winding.....Series
Direction of Rotation.....
.....CW as viewed from front end
Spring Tension...50 oz (new), 33 oz (worn)
Bearings...Single row double shielded type

CLARK PART #1627785 & 328193

Horsepower.....11.5 hp
Motor speed.....2015 rep
Voltage.....36
Amperes.....294
Winding.....Series

BRUSH SPRING TENSION

Initial.....50-47½ oz
Final.....35-33 oz

CONTACTOR POINT SPRING TENSIONS (AC) Norm. open

Forward & reverse coil.....2½-3 lbs.
1-A coil.....2½-3 lbs.
Pump coil.....2½-3 lbs.

CONTACTOR POWER POINT AIR GAPS (AC-norm. open)

Forward & reverse coils 13/32"+ or -1/32"
1-A coils.....3/16"+ or -1/32
Pump coils.....5/32"+ or -1/32"

PUMP MOTOR AMPERAGE DRAW (for every 100 lbs. of pump pressure + or - 10%)

EC30B (3,000 lb. vehicle)
Lift (no load)
Standard.....148 amps at 91 FPM
HI-LO.....145 amps at 69 FPM
Triple.....145 amps at 74 FPM
Lift (3000 lb load)
Standard.....260 amps at 61 FPM
HI-LO.....260 amps at 47 FPM
Triple.....260 amps at 51 FPM

Full tilt fore (no load).....116 amps-3.4 sec
Full tilt fore (3000 lb load...100 amps 3.3 sec
Full tilt aft (no load).....112 amps-3 sec
Full tilt aft (3000 lb load)...140 amps-3.7 sec

EC40B (4000 lb vehicle)
Lift (no load)
Standard.....148 amps at 91 FPM
HI-LO.....145 amps at 69 FPM
Triple.....145 amps at 74 FPM
Lift-4000 lb load
Standard.....304 amps at 53 FPM
HI-LO.....286 amps at 43 FPM
Triple.....286 amps at 46 FPM
Full tilt fore (no load).....116 amps 3.4 sec
Full tilt fore (4000 lb load)..100 amps 3.3 sec
Full tilt aft (no load).....112 amps 3 sec
Full tilt aft (4000 lb load).....144 amps 4 sec

DRIVE MOTOR AMPERAGE DRAW (for each mile per hour @ certain creep speed)

EC30B (3000 lb vehicle)
No Load: 60 amps@4.7 MPH (Max Carbon Pile)
75 amps@6.7 MPH (Hi-speed)

3000 lb. 70 amps@4.3 MPH (Max Carbon Pile)
Load: 80 amps@6.4 MPH (Hi-speed)
NOTE: Reverse the same as forward.

EC40B (4000 lb. Vehicle)
No Load: 60 amps@4.7 MPH (Max Carbon Pile)
77 amps@6.6 MPH (Hi-speed)

4000 lb. 75 amps@4.1 MPH (Max Carbon Pile)
Load: 85 amps@6.3 MPH (Hi-speed)
NOTE: Reverse the same as forward.

TORQUE SPECIFICATIONS

Axle Mounting Ring Bolts:
Body Fit.....950-1000 ft-lb
Tapered Head.....650-700 ft-lb

Steering Hondwheel to Shaft Nut;35-40 ft-lb
Pump motor mounting nuts.....300-350 ft-lb
Counterweight mounting bolts:175-200 ft-lb
Axle end to adapter bolt.....75-85 ft-lb
Axle end to adapter stud.....75-85 ft-lb
Axle end to adapter stud nut...90-95 ft-lb
Silent block to axle bolts...150-175 ft-lb

Split Rim Wheels: (dry thread)
Drive wheel.....85-95 ft-lb
Steer wheel.....100-120 ft-lb

Steering gear pitman arm lock nut torque...
.....100-125 ft-lb

ENGINEERING SPECIFICATIONS

CLARKLIFT® ECS-50

5,000 pounds capacity, 24 inch load center

MODEL ECS-50 Weight with 2,700 lb.

	130" Standard	130" Hi-Lo
lead-acid battery	9,140 lbs.	9,200 lbs.

CAPACITY.....Capacity Rating 5,000 lbs. at 24" load center (See capacity chart for other ratings)

DIMENSIONS

Length (to front face of forks)	77⅜"
Wheelbase	47"
Width	40½"
Tread (drive)	31"
Tread (steer)	28"
Turning radius	70"
Basic aisle for right angle stacking (add load length)	83½"

UNDERCLEARANCES

Upright	3"
Drive axle	3"
Steer axle	3½"
Center of frame	4¼"
Counterweight	4¾"
Grade clearance at counterweight	52%

SPEEDS AND GRADES AT 36 VOLTS

Travel speed, forward and reverse. Loaded, up to 6.0 m.p.h.
Travel speed, forward and reverse. Empty, up to 6.5 m.p.h.
Gradeability with rated load 10%

	STANDARD Loaded	Empty
Lifting Speed (f.p.m.)	40	90
Lowering speed (f.p.m.)	65	80

BATTERY CONNECTOR. Anderson type SB, 175 ampere continuous rating with ample capacity for overloads. Both halves are identical and interchangeable.

POWER SUPPLY

Lead-acid battery in steel trays, 36 volt, having adequate kilowatt hours capacity.

18 cells, 23 plate, 3 x 6 layout
Exide Types: TSC C&D Types: HYL
Gould Types: 85T K-W Types: HT

Standard compartment size.....39½" W x 28" L x 23" H
Optional compartment size....39½" W x 30¾" L x 23" H
39½" W x 32¾" L x 23" H

MOTORS. Drive motor is dual wound. Pump motor is series wound. Both motors are fan-cooled, ventilated and protected by class "F" insulation.

DRIVE AXLE. Heavy-duty drive axle by Clark, with double reduction of bevel and spur gears. Final gear reduction is at the drive wheels through pinion and internal ring gear; sealed in grease for longer life.

BRAKES. SERVICE BRAKES: foot brake, torque multiplied, hydraulic internal expanding double shoe with bonded brake lining; **PARKING BRAKE:** mounted on the drive motor armature shaft and applies when operator leaves the seat.

STEERING. Vanadium steel steer axle is mounted on two torsional rubber bushing assemblies, with inclined king pins. Recirculating ball type steering gear with 18" diameter steering hand wheel.

UPRIGHT. Nested-roller-type telescopic upright. I-beam inner section of SAE 1045 modified steel is nested within the SAE 1045 modified steel outer channel. Carriage has lateral thrust rollers mounted on outside. Dual tilt cylinders have chrome plated rods. Anti-cavitating control valve prevents drifting. Tilting range is 10° back and 6° forward.

LIFT CYLINDER. Piston type, with free-floating mounting to eliminate side strains. Oil drain line to sump prevents external seal leakage. Flow regulator controls lowering speed.

FORKS AND FORK CARRIAGE

	Length	Width	Thickness
Standard	40"	5"	1¾"
Optional	Contact Factory		

Forks are heat-treated and upset-forged from SAE 1045 steel; bottom is tapered from chisel tip 30 inches to specified thickness. Fork spread from 0" inside to 36" outside width. Carriage is welded construction from SAE 1045 steel.

MAINTENANCE. Removable hood and side plates provide top and side removal of battery.

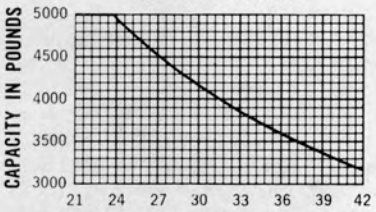
GENERAL FEATURES. The following are all standard equipment: driver's overhead guard and load back rest, electric horn, shock mounted direct reading hour meter and battery discharge indicator. All exposed surfaces are shot blasted and prime painted with weather resistant paint.

DIMENSIONAL SPECIFICATIONS

CLARKLIFT® ECS-50

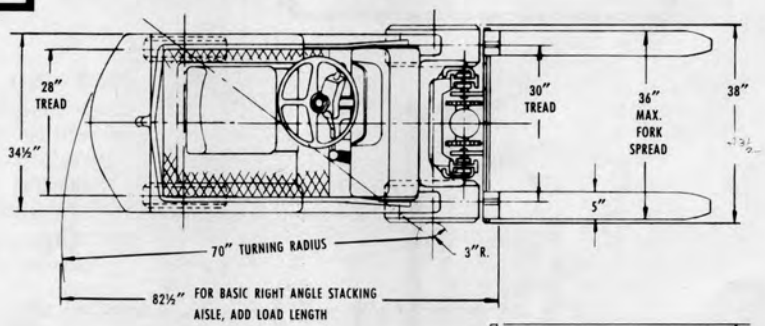
5,000 pounds capacity, 24 inch load center

CAPACITY CHART*



LOAD CENTER IN INCHES FROM FRONT FACE OF FORKS

* RATED CAPACITIES SHOWN ABOVE ARE COMPUTED WITH UPRIGHTS IN VERTICAL POSITION. THEY APPLY ONLY ON MAXIMUM FORK HEIGHTS UP TO AND INCLUDING 144".



UPRIGHT DIMENSION TABLE

MFH		Overall	Free Lift		
Std. Hi-Lo	TSU & FFL TSU	Height Lowered	Std.	Hi-Lo & FFL TSU**	TSU
70	—	53	17¼	—	—
76	—	56	17¼	—	—
82	—	59	17¼	—	—
88	—	62	17¼	—	—
94	135	65	17¼	45½	12½
100	144	68	17¼	48½	12½
*106	*153	71	17¼	51½	12½
112	162	74	17¼	54½	12½
118	171	77	17¼	57½	12½
124	180	80	17¼	60½	12½
*130	*189	83	17¼	63½	12½
136	—	86	17¼	66½	—
—	198	88	—	68½	12½
142	—	89	17¼	69½	—
148	—	92	17¼	72½	—
—	207	93	—	73½	12½
*154	—	95	17¼	75½	—
—	216	98	—	78½	12½
160	—	99	17¼	79½	—
166	—	102	17¼	82½	—
—	*225	103	—	83½	12½
172	—	106	17¼	86½	—
*178	—	109	17¼	89½	—

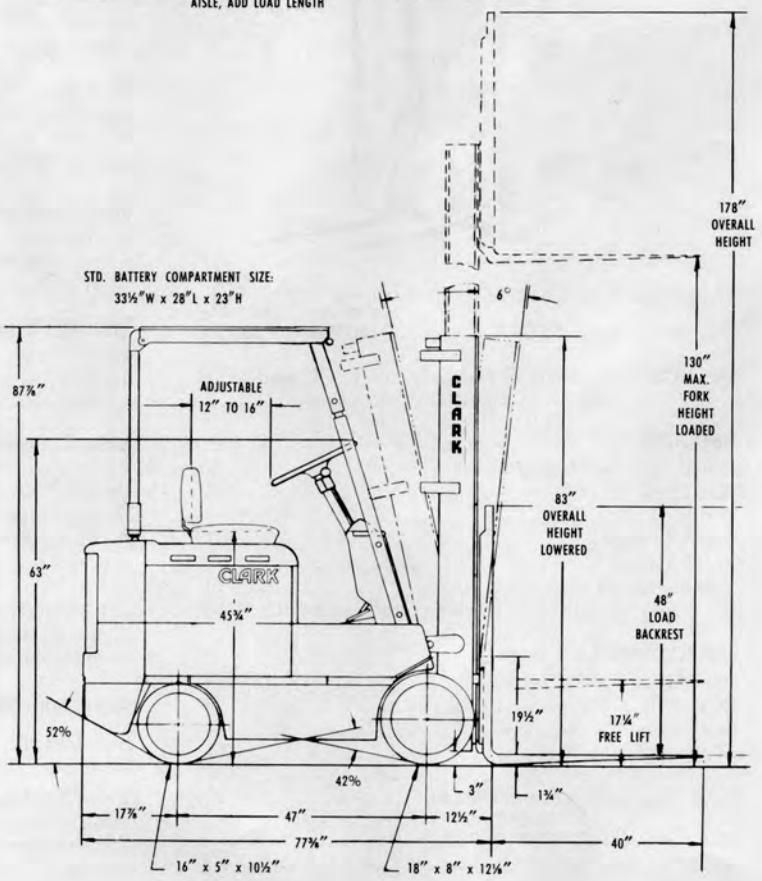
FOR OVERALL HEIGHT RAISED — ADD 48" TO MFH

*INDICATES PREFERRED STANDARD SIZES

**LESS LOAD BACKREST

CERTIFIED BY CLARK ENG/SERVICE DEPT

Clark products and specifications are subject to improvements and changes without notice.



CLARK EQUIPMENT **Industrial Truck Division**
Battle Creek, Michigan

GAS/DIESEL/ELECTRIC FORK LIFTS
ELECTRIC NARROW AISLE TRUCKS
ELECTRIC HAND TRUCKS/STRADDLE CARRIERS
TOWING TRACTORS/COMPLETE LINE OF HANDLING DEVICES

SS 2305 46715ME

PRINTED IN U.S.A.

INDUSTRIAL TRUCK DIVISION

SPECIFICATIONS FOR ECS50

GENERAL:

Type of vehicle..... Electric Rider
Overall length with forks ..... 117 3/8 inches
Overall length without forks... 75 5/8 inches
Overall width..... 40 inches
Overall height with 130" MFH upright.....
.... 83" Lowered, 178" Raised

Single Drive:

Tread drive tires..... 31 inches
Tread steer tires..... 28 inches
Basic aisle for right angle stacking (add length of load) ..... 82 1/2 inches
Turning radius, outside ..... 70 inches
Turning radius, inside ..... 3 inches
Ground clearance - under counterweight .....
..... 4 3/4 inches
Ground clearance - under rear axle .. 3 1/2 inches
Ground clearance - under front axle .. 3 inches
Ground clearance - under upright ... 3 inches
Ground clearance between axles ..... 4 1/4 inches
Grade clearance 52%

Travel Speeds:

Loaded: 1st..... 6.0 MPH
Empty: 1st..... 6.5 MPH

Gradeability:

Loaded 10%

Lifting & Lowering Speeds:

Lift	STANDARD	HI-LO	TRIPLE STAGE	
Loaded	40	38	38	FPM
Empty	90	69	62	FPM
Lower				
Loaded	65	70	70	FPM
Empty	80	80	70	FPM

STEER AXLE:

Axle Alignment:

Toe-In ..... 0 degrees
Camber Angle ..... 1 degree
Caster ..... 0 degrees

Left-hand Turning Radius Angle:

Left wheel ..... 77 degrees
Right wheel ..... 54 degrees

Right-hand Turning Radius Angle:

Left wheel ..... 54 degrees
Right wheel ..... 77 degrees

DRIVE AXLE:

Ratio ..... 4.4 to 1
Differential Capacity ..... 5 Pints
Wheel End Capacity (each end) ... 1 1/4 lbs.

WHEELS AND TIRES:

Size .. 18x9x12 1/8... (Front) ..... Non-
..... Directional
Size .. 16x5x10 1/2... (Rear) ..... Non-
..... Directional

SPLIT RIM WHEELS:

Drive Wheel Nuts..340-350 ft. lbs. (Dry Thread)
Steer Wheel Bolts..115-125 ft. lbs. (Dry Thread)
Steering Gear Pitman Arm Lock Nut Torque.....
..... 100-125 foot pounds
Steering Gear Mounting Bolts and Clamp Bolt Torque 40-50 foot pounds

HYDRAULIC SYSTEM:

Sump Tank Capacity ..... 6.67 gallons
Sump Tank Filter (Replaceable) .....
..... 25-40 micron
Sump Tank Breather (Replaceable) .....
..... 40 micron
Sump Tank Filter Attaching Bolts Torque ....
.... 35 to 45 inch lbs.

Hydraulic Pumps:

Main Pump:

Type ..... Gear Type Dual Outlet
Capacity .....
Lift 10.9 G.P.M. at 1800 Motor R.P.M.
Tilt 2.7 G.P.M. at 1800 Motor R.P.M.

Hydraulic Valve:

Pressure Relief Valve Setting .....
Lift 2000 P.S.I.
Tilt 1700-1800 P.S.I.

BRAKE SYSTEM:

Type ..... Hydraulic
Brake Pedal Free Travel ...3/8-5/8
(as measured from top pedal position -to-where pedal meets resistance from the master cylinder)..

BATTERY: Lead Acid, 36 Volts

15 Cell 29 Plate (3x5 Layout)
16 Cell 25 Plate (4x4 Layout)
18 Cell 23-27 Plate (3x6 Layout)
Exide-TSC
Gould-72x, 85T
C & D-HC
K-W-FH

TORQUE VALUES:

Axle MTG. Ring Bolts-Body Fit..	950-1000 lb.ft.
Axle MTG. Ring Bolts-Tapered Head.....	650-700 lb.ft.
Steering Handwheel to Shaft Nut..	35-40 lb.ft.
Counterweight Mounting Bolts...	175-200 lb.ft.
Axle End to Adaptor Bolt.....	75-85 lb.ft.
Axle End to Adaptor Stud.....	75-85 lb.ft.
Axle End to Adaptor Stud Nut...	90-95 lb.ft.
Silent Block to Axle Bolts.....	150-175 lb.ft.
Silent Block to Frame.....	210-260 lb.ft.

INDUSTRIAL TRUCK DIVISION

NEW MACHINE 50 HOUR SERVICE AND INSPECTION

Axle Adapter Level Check	100H 073
Battery, Terminals, Cables, Receptacles Inspect	8H 473
Brake Pedal Free Travel, Check and Adjust	100H 302
Brakes, Master Cylinder Level Check	100H 303
Brake Interlock Switch Check and Adjust	100H 273
Carbon Pile Actuator and Accumulator, Check and Adjust	1000H 173
Contactor Panel, Switchettes, Check and Adjust	100H 674
First Point of Power Switch, 2MS Switch Check and Adjust	100H 475
Hydraulic Sump Tank Strainer, Clean	500H 173
Lift Chain, Adjust	100H 403
Lubricate Machine	100H 773
Nuts, Bolts and Capscrews, Tighten	500H 072
Pressure Check Main Hydraulic System	1000H 1507
Pump Control Switches Adjust	100H 473
Seat Safety Brake Switch, Check and Adjust	100H 274
Seat Safety Brake Linkage, Check and Adjust	1000H 1173
Speed Control Cylinder, Level Check	100H 173
Steering Gear, Level Check	100H 603

N O T E

PERFORM THIS SERVICE AND INSPECTION AFTER THE FIRST 50 HOURS OF OPERATION ON NEW MACHINES.

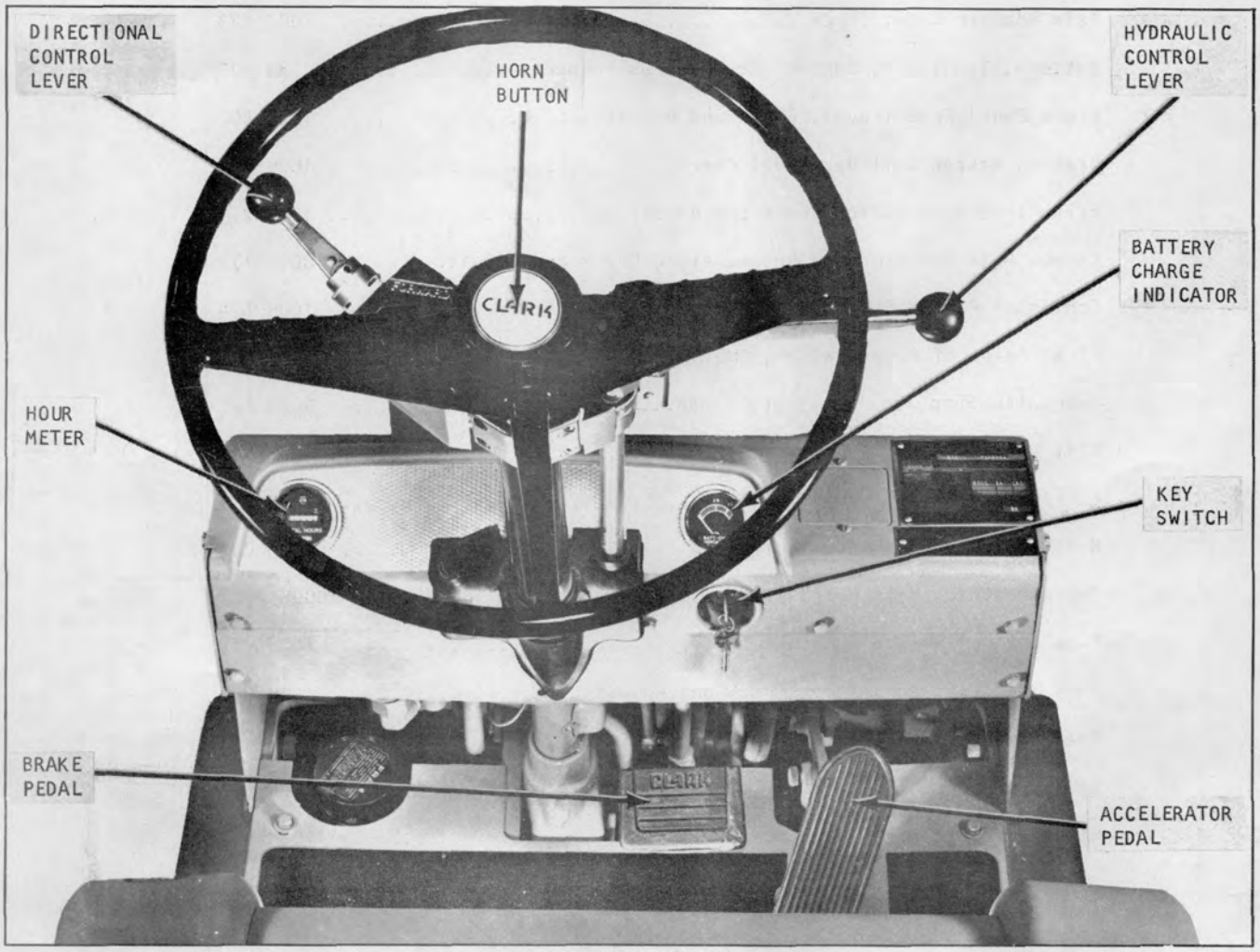


Plate 7412. Overall Controls

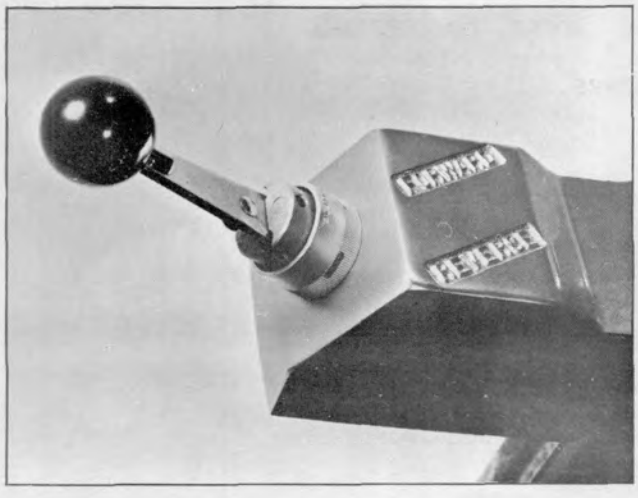


Plate 7216. Directional Control Lever

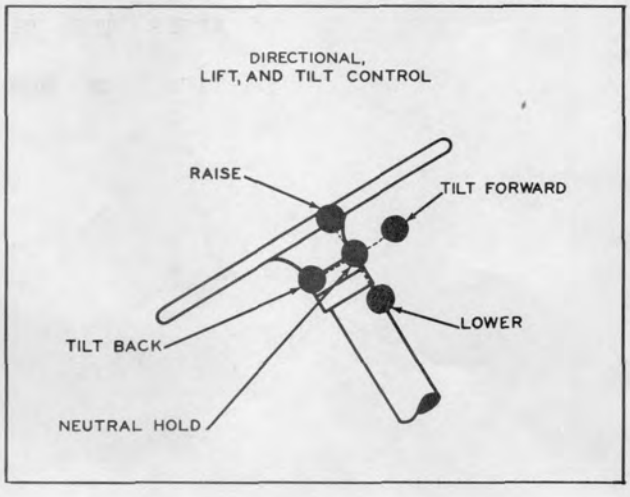


Plate 4448. Hydraulic Control Lever

Plate 7388. Battery Charge Indicator

With the key switch in the "on" position the battery charge indicator will show the available battery voltage. When the indicator needle registers in the red portion of the indicator scale the battery should be recharged. It is recommended that at this time a specific gravity test be taken with a hydrometer to more accurately determine battery condition.

Plate 7162. Hour Meter

The hour meter accurately records the actual hours of machine operation. This will serve as an aid in determining the time intervals for lubrication and preventative maintenance services.

TO OPERATE MACHINE

1. When the driver's seat is occupied, the seat safety brake (deadman brake) will be released.

2. Place directional control lever in neutral position.

3. Turn switch key to the "on" position, allow accelerator pedal and brake pedal to assume its free or undepressed position.

4. Move the directional lever in position for the desired direction of travel.

5. Depress accelerator pedal as required for the speed desired.

TO STOP MACHINE

Remove foot from accelerator pedal and depress brake pedal sufficiently to allow a safe smooth stop. If the machine is to be parked, turn switch key to "off" and place directional control lever in neutral (centered) position. When the driver's seat is unoccupied, the (deadman brake) parking brake is applied.

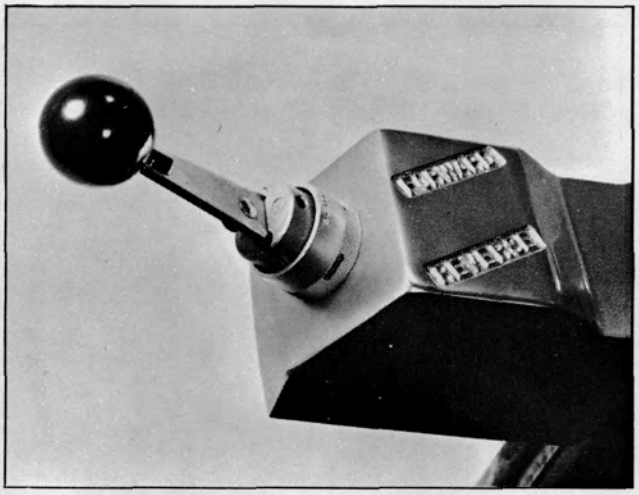


Plate 7216. Directional Control Lever

SOLID STATE CONTROL UNITS ONLY
(GENERAL ELECTRIC SCR UNIT)

WARNING
BATTERY POLARITY MUST BE CORRECT OR ELECTRICAL SYSTEM WILL BE DAMAGED

To Move A Load.

The forks should be adjusted sidewise on the fork bars to obtain firm support and maximum balance of the load. Raise or lower the forks to the proper level and engage the load by driving forward. Tilt the upright backward sufficiently to adequately cradle the load, and raise load sufficiently to clear obstructions. Back away from stack.

The operator should have clear vision ahead when moving in a forward direction. When this is not possible, the operator should drive in reverse and turn in his seat to obtain clear vision backward.

When the load is to be deposited, enter the area squarely, especially when placing one load on top of another, in order that all piles will be square and secure. Place load directly over desired area and slowly lower into position. Disengage forks from the load by using necessary lift-tilt and then back away.

Loads will vary in size, shape, method of packaging, stacking procedures, etc. The best way to handle a load will depend on these factors. If in doubt, consult with your supervisor.

I M P O R T A N T

EVERY 8 OPERATING HOURS (OR EVERY SHIFT) ELEVATE

UPRIGHT TO THE UPPER LIMIT. THIS WILL PROVIDE

LUBRICATION TO THE TOP PORTION OF THE LIFT

CYLINDER. CHECK FOR NORMAL SEQUENCE OF OPERATION.

OPERATING SAFETY RULES AND PRACTICES.

1. Operators of powered industrial trucks should be physically qualified. An examination should be made on an annual basis and include such things as field of vision, hearing, depth perception and reaction timing.

2. Only trained and authorized operators should be permitted to operate a powered industrial truck. Methods should be devised to train operators in the safe operation of powered industrial trucks. It is recommended that badges or other visual indication of the operator's authorization should be displayed at all times during work period.

GENERAL.

1. Safeguard the pedestrians at all times. Do not drive a truck up to anyone standing in front of a bench or other fixed object.

2. Do not allow anyone to stand or pass under the elevated portion of any truck, whether loaded or empty.

3. Unauthorized personnel should not be permitted to ride on powered industrial trucks. A safe place to ride should be provided where riding of trucks is authorized.

4. Do not put arms or legs between the uprights of the mast or outside the running lines of the truck.

5. When leaving a powered industrial truck unattended, load engaging means should be fully lowered, controls should be neutralized, power shut off, brakes set, key or connector plug removed. Block wheels if truck is parked on an incline.

6. Maintain a safe distance from the edge of ramps or platforms and do not, while on any elevated dock or platform, push freight cars. Do not use trucks for opening or closing freight doors.

7. Have brakes set and wheel blocks in place to prevent movement of trucks, trailers, or railroad cars while loading or unloading. Fixed jacks may be necessary to support a semi-trailer during loading or unloading when the trailer is not coupled to a tractor. Check the flooring of trucks, trailers, and railroad cars for breaks and weakness before driving onto them.

8. Be sure of sufficient headroom under overhead installations, lights, pipes, sprinkler system, etc.

9. Use an Overhead Guard and Load Backrest Extension unless conditions prevent their use.

```
x x x x x x x x x x x x x x x x x x x x x x x x x
x                                               x
x                    W A R N I N G              x
x                                               x
x  AN OVERHEAD GUARD IS INTENDED TO OFFER       x
x                                               x
x  PROTECTION FROM THE IMPACT OF SMALL          x
x                                               x
x  PACKAGES, BOXES, BAGGED MATERIAL, ETC.,      x
x                                               x
x  REPRESENTATIVE OF THE JOB APPLICATION,       x
x                                               x
x  BUT NOT TO WITHSTAND THE IMPACT OF A         x
x                                               x
x  FALLING CAPACITY LOAD.                       x
x                                               x
x x x x x x x x x x x x x x x x x x x x x x x x x
```

10. Use only approved industrial trucks in hazardous locations.

11. Elevate personnel only on an approved safety platform firmly secured to the lifting carriage and/or forks.

12. Report all accidents involving personnel, building structures, and equipment.

13. Fire aisles, access to stairways, and fire equipment should be kept clear.

TRAVELING.

1. Observe all traffic regulations including authorized plant speed limits. Under normal traffic conditions, keep to the right. Maintain a safe distance, approximately three truck lengths from the truck ahead, and keep the truck under control at all times. Use of truck on public roads should conform to local traffic regulations.

2. Yield the right of way to ambulances, fire trucks, or other vehicles in emergency situations.

3. Do not pass another truck traveling in the same direction at intersections, blind spots, or at other dangerous locations.

4. Slow down and sound horn at cross aisles and other locations where vision is obstructed. If the load being carried obstructs forward view travel with the load trailing.

5. Cross railroad tracks diagonally wherever possible. Do not park closer than 8 feet from center of railroad tracks.

6. Look in the direction of, and keep a clear view of the path of travel.

7. Ascend or descend grades slowly.

When ascending or descending grades in excess of 10%, loaded trucks should be driven with the load upgrade.

Unloaded trucks should be operated on all grades with the load engaging means downgrade.

On all grades the load and load engaging means should be tilted back if applicable, and raised only as far as necessary to clear the road surface.

8. Under all travel conditions the truck should be operated at a speed that will permit it to be brought to a stop in a safe manner.

9. Travel with load engaging means or load low and, where possible, tilted back. Do not elevate the load except during stacking.

10. Make starts, stops, turns or direction reversals in a smooth manner so as not to shift load and/or overturn the truck.

11. Stunt driving and horseplay should not be permitted.

12. Slow down for wet and slippery floors.

13. Before driving over a dockboard or bridgeplate, be sure that it is properly secured. Drive carefully and slowly across the dockboard or bridgeplate and never exceed its rated capacity.

14. Do not run vehicles 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 personnel leave the elevator before a truck is allowed to enter or leave.

15. Avoid running over loose objects on the roadway surface.

LOADING.

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

2. Handle only loads within the rated capacity of the truck.

3. Adjust for long or high (including multiple tiered) loads which may affect capacity.

4. When attachments are used, particular care should be taken in securing, manipulating, positioning, and transporting the load. Operate trucks equipped with attachments as partially loaded trucks when not handling a load.

5. Place load engaging means under the load as far as possible and carefully tilt the mast backward to stabilize the load. Caution should be used in tilting backward with high or segmented loads.

6. Use extreme care when tilting load forward or backward particularly when high tiering. Do not tilt forward with load engaging means elevated except to pick up a load. Do not tilt an elevated load forward except when the load is in a deposit position over a rack or stack. When stacking or tiering use only enough backward tilt to stabilize the load.

OPERATOR CARE OF THE TRUCK.

1. Give special consideration to the proper functioning of tires, horn, lights, battery, controller, lift system (including load engaging means, chains, cable, and limit switches), brakes and steering mechanism. If at any time

OPERATOR CARE OF THE TRUCK (CONT.).

a powered industrial truck is found to be in need of repair, defective, or in any way unsafe, the matter should be reported immediately to the designated authority, and the truck should be taken out of service until it has been restored to safe operating condition.

2. Do not make repairs or adjustments unless specifically authorized to do so.

3. Do not use open flames for checking electrolyte level in storage batteries.

WIRING DIAGRAM

On the inner side of the coverplate for the contactor panel, will be found, in an envelope, a wiring diagram for the electrical system/s of the machine.

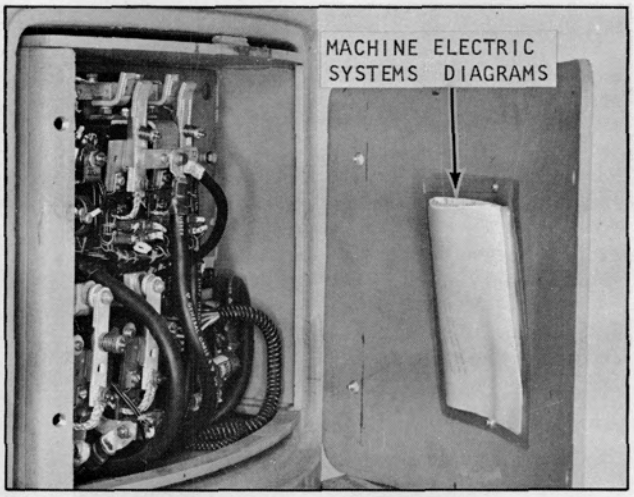
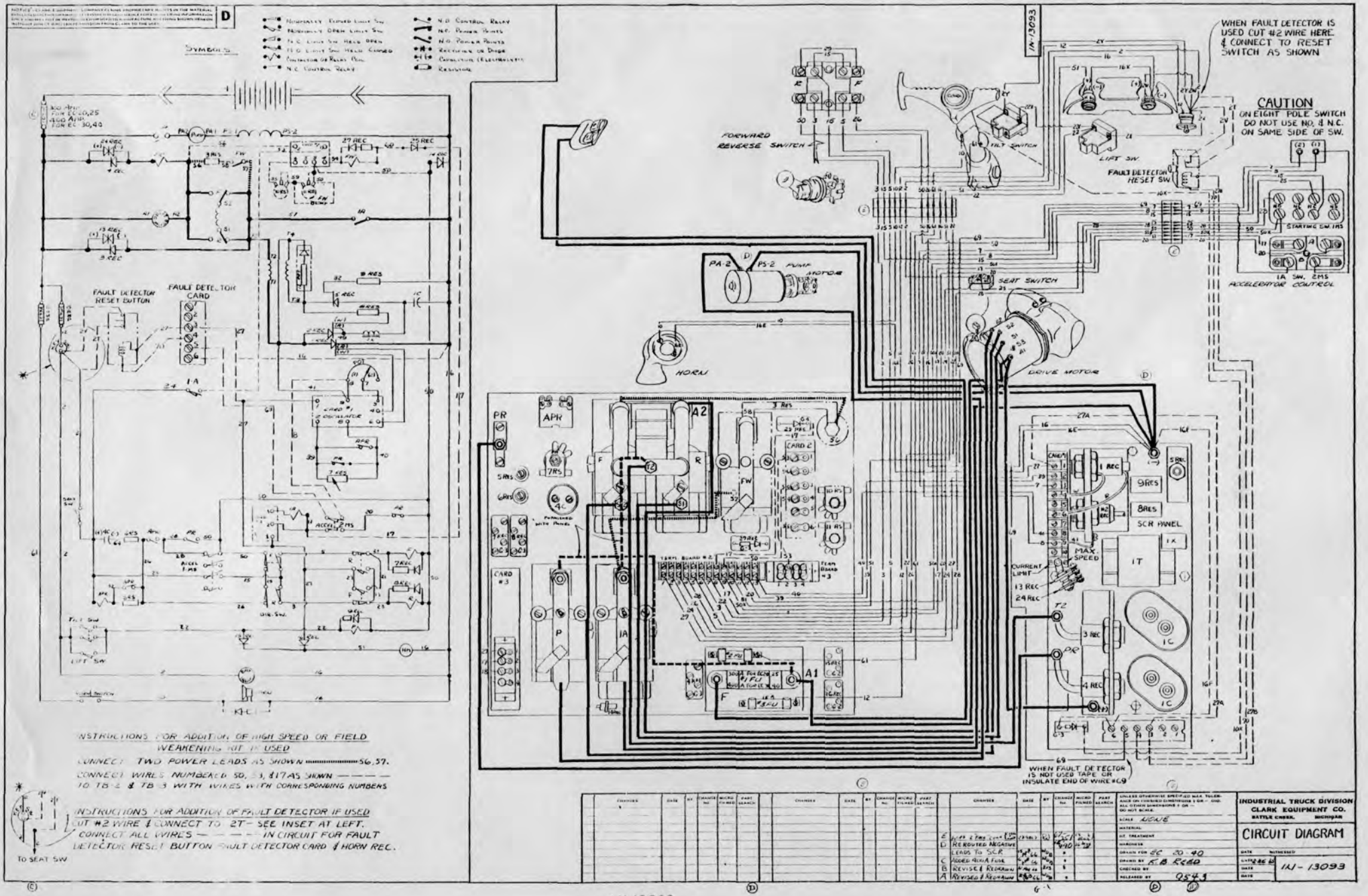
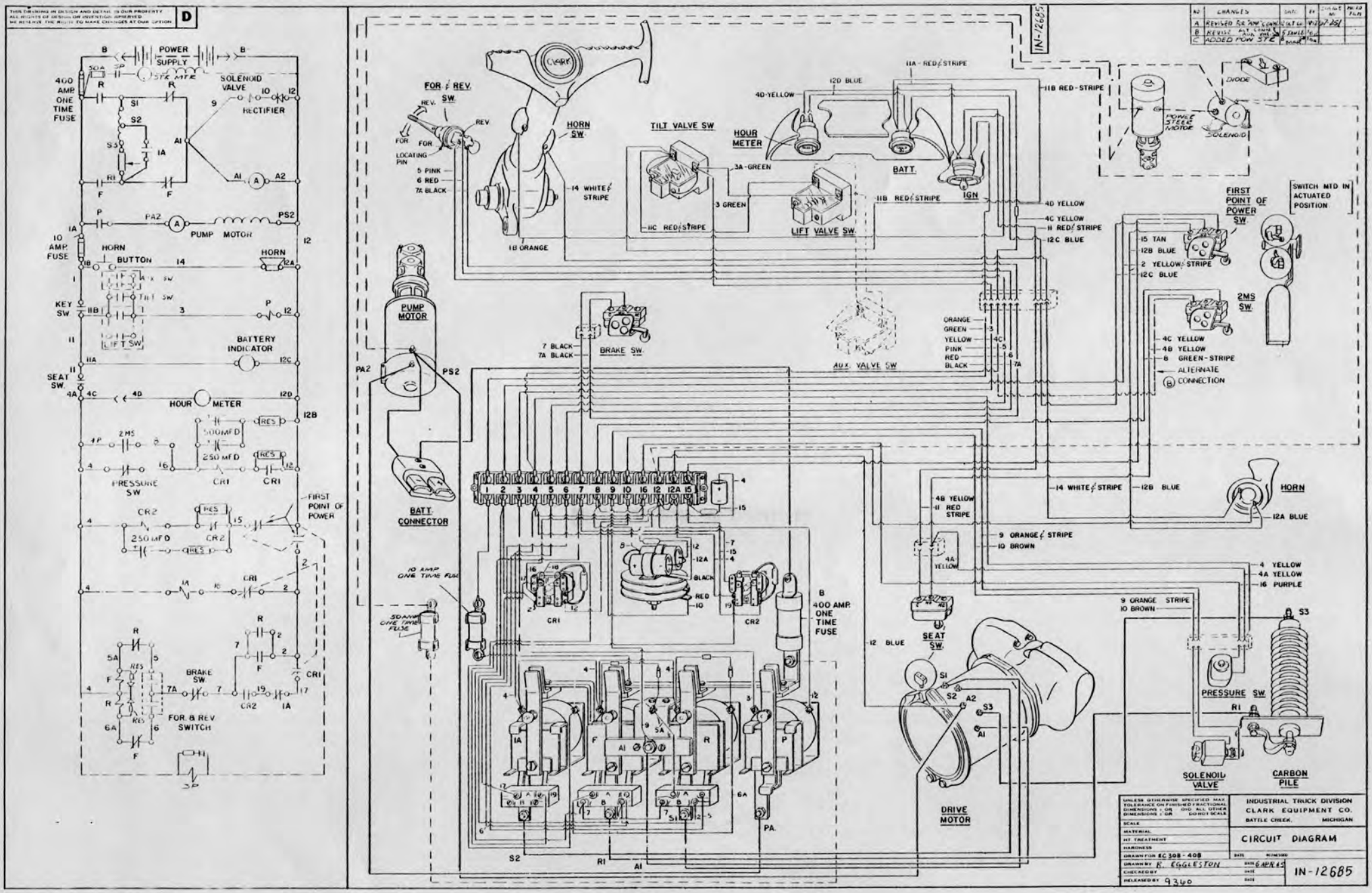


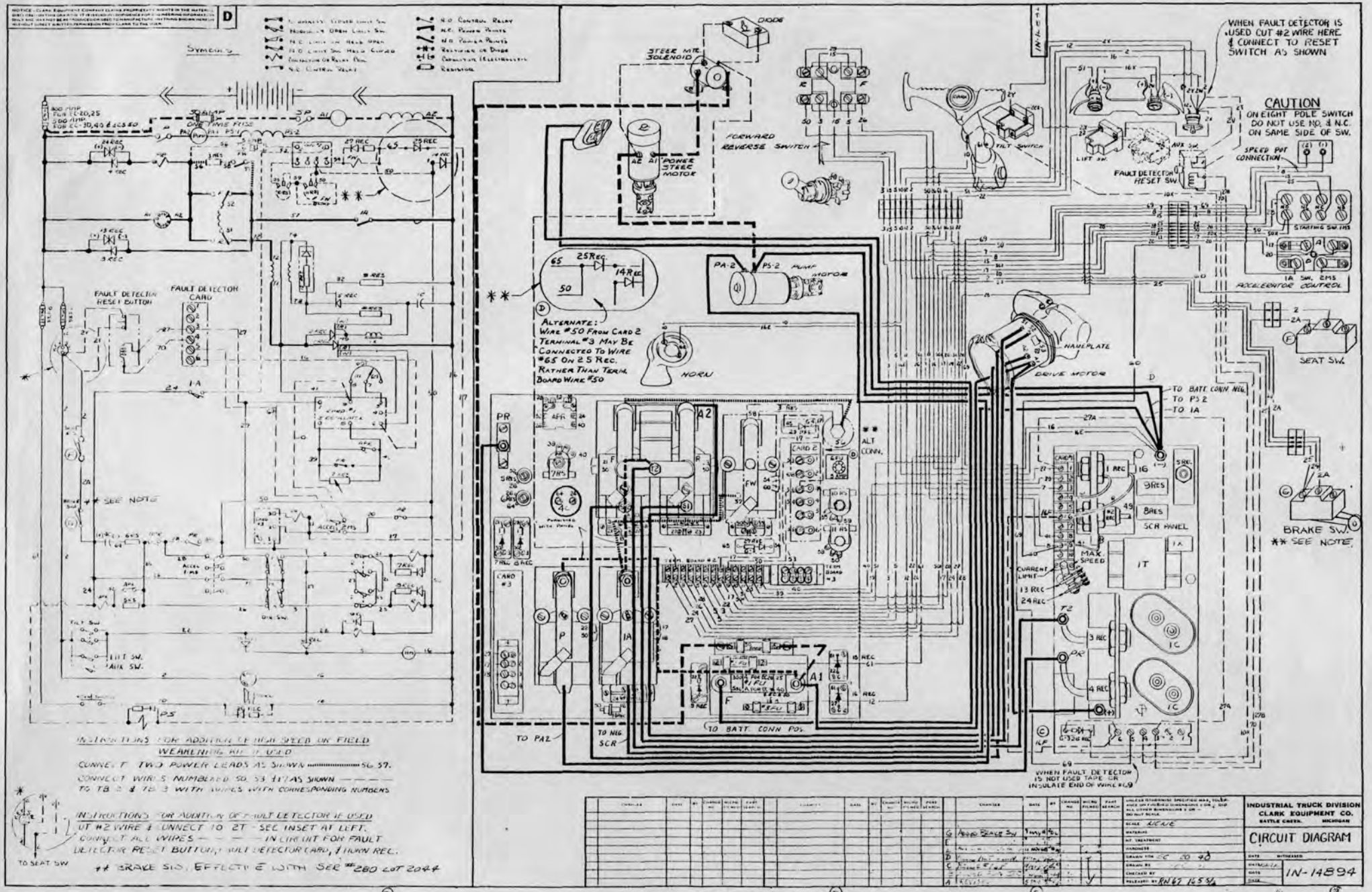
Plate 8924. Electric System Diagram


SYMBOLS
Normally Closed Limit Sw.
Normally Open Limit Sw.
N.C. Limit Sw. Held Open
N.O. Limit Sw. Held Closed
Contactor or Relay Coil
N.C. Control Relay
N.O. Control Relay
N.C. Power Points
N.O. Power Points
Resistance or Diode
Capacitor (Electrolytic)
Resistor
WHEN FAULT DETECTOR IS USED CUT #2 WIRE HERE & CONNECT TO RESET SWITCH AS SHOWN
CAUTION
ON EIGHT POLE SWITCH DO NOT USE NO. & N.C. ON SAME SIDE OF SW.
FORWARD REVERSE SWITCH
TILT SWITCH
LIFT SW.
FAULT DETECTOR RESET SW.
STARTING SW. 1M3
1A SW. EMS
ACCELERATOR CONTROL
SEAT SWITCH
PA-2
PS-2 PUMP MOTOR
HORN
DRIVE MOTOR
FAULT DETECTOR RESET BUTTON
FAULT DETECTOR CARD
SCR PANEL
MAX. SPEED
CURRENT LIMIT
LIFT SW.
TO SEAT SW
INSTRUCTIONS FOR ADDITION OF HIGH SPEED OR FIELD WEAKENING NOT IN USED
CONNECT TWO POWER LEADS AS SHOWN ..... 56, 57.
CONNECT WIRES NUMBERED 50, 53, & 17 AS SHOWN ———
TO TB 2 & TB 3 WITH WIRES WITH CORRESPONDING NUMBERS
INSTRUCTIONS FOR ADDITION OF FAULT DETECTOR IF USED
CUT #2 WIRE & CONNECT TO 2T- SEE INSET AT LEFT.
CONNECT ALL WIRES — — — IN CIRCUIT FOR FAULT DETECTOR RESET BUTTON FAULT DETECTOR CARD & HORN REC.
69 WHEN FAULT DETECTOR IS NOT USED TAPE OR INSULATE END OF WIRE #69
INDUSTRIAL TRUCK DIVISION
CLARK EQUIPMENT CO.
BATTLE CREEK, MICHIGAN
CIRCUIT DIAGRAM
IN-13093

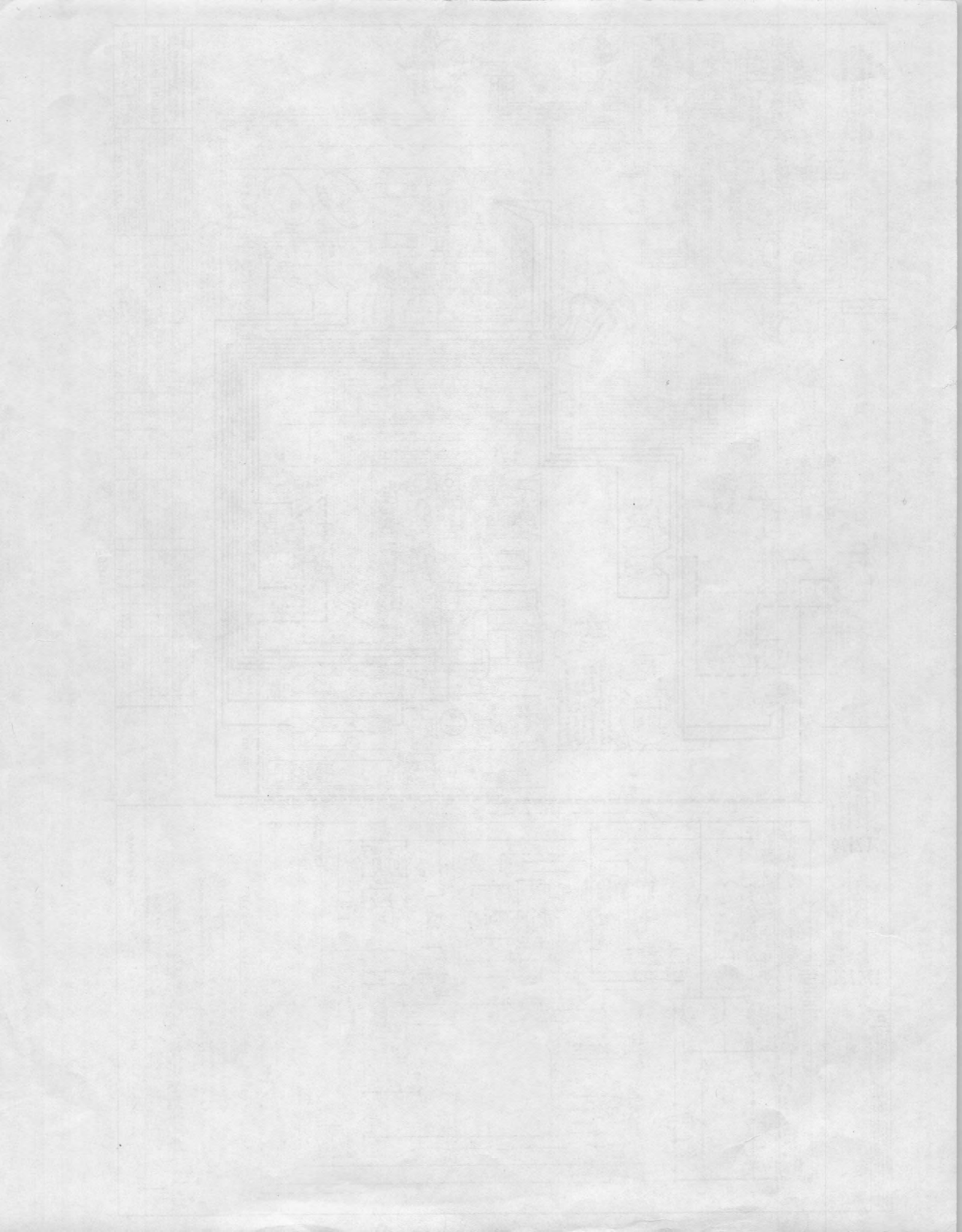
IN-13093


IN-12685
POWER SUPPLY
STR. MTR.
SOLENOID VALVE
RECTIFIER
400 AMP ONE TIME FUSE
10 AMP. FUSE
HORN BUTTON
HORN
KEY SW.
SEAT SW.
LIFT SW.
TILT SW.
BATTERY INDICATOR
PUMP MOTOR
HOUR METER
PRESSURE SW.
FIRST POINT OF POWER
BRAKE SW.
FOR. & REV. SWITCH
FOR. & REV. SW.
HORN SW.
TILT VALVE SW.
LIFT VALVE SW.
AUX. VALVE SW.
BATT.
IGN.
DIODE
POWER STEER MOTOR
SOLENOID
2MS SW.
FIRST POINT OF POWER SW.
SWITCH MTD IN ACTUATED POSITION
ALTERNATE
CONNECTION
BATT. CONNECTOR
10 AMP ONE TIME FUSE
50 AMP ONE TIME FUSE
400 AMP ONE TIME FUSE
SEAT SW.
DRIVE MOTOR
SOLENOID VALVE
CARBON PILE
INDUSTRIAL TRUCK DIVISION
CLARK EQUIPMENT CO.
BATTLE CREEK, MICHIGAN
CIRCUIT DIAGRAM
DRAWN BY R. EGGLESTON
IN-12685

IN-12685


CAUTION
ON EIGHT POLE SWITCH DO NOT USE NO. 4 N.C. ON SAME SIDE OF SW.
WHEN FAULT DETECTOR IS USED CUT #2 WIRE HERE & CONNECT TO RESET SWITCH AS SHOWN
DIODE
STEER MTR. SOLENOID
FORWARD REVERSE SWITCH
POWER STEER MOTOR
TILT SWITCH
LIFT SW.
AUX SW.
FAULT DETECTOR RESET SW.
SPEED POT CONNECTION
STARTING SWITCH
1A SW. EMS ACCELERATOR CONTROL
SEAT SW.
NAMEPLATE
DRIVE MOTOR
HORN
FAULT DETECTOR RESET BUTTON
FAULT DETECTOR CARD
ALTERNATE: WIRE #50 FROM CARD 2 TERMINAL #3 MAY BE CONNECTED TO WIRE #65 ON 25 REC. RATHER THAN TERM. BOARD WIRE #50
PA-2
PS-2 PUMP MOTOR
TO BATT CONN NEG
TO PS 2
TO 1A
SCR PANEL
MAX SPEED
CURRENT LIMIT
BRAKE SW.
** SEE NOTE
ALT CONN.
TO PA2
TO NEG SCR
TO BATT. CONN POS.
WHEN FAULT DETECTOR IS NOT USED TAPE OR INSULATE END OF WIRE #69
INSTRUCTIONS FOR ADDITION OF HIGH SPEED OR FIELD WEAKENING RELAY USED
CONNECT TWO POWER LEADS AS SHOWN ..... 56, 57.
CONNECT WIRES NUMBERED 50, 53, 17 AS SHOWN — — — —
TO TB 2 & TB 3 WITH WIRES WITH CORRESPONDING NUMBERS
INSTRUCTIONS FOR ADDITION OF FAULT DETECTOR IF USED
CUT #2 WIRE & CONNECT TO 2T - SEE INSET AT LEFT.
CONNECT ALL WIRES — — — IN CIRCUIT FOR FAULT DETECTOR RESET BUTTON, FAULT DETECTOR CARD, & 1 NON REC.
TO SEAT SW
** BRAKE SW. EFFECTIVE WITH SER. NO. 280 LOT 2044
INDUSTRIAL TRUCK DIVISION
CLARK EQUIPMENT CO.
BATTLE CREEK, MICHIGAN
CIRCUIT DIAGRAM
IN-14894

IN-14894



PREVENTIVE MAINTENANCE:

1. Arrange for systematic inspection and lubrication. See that the truck is properly lubricated and in good repair at all times. Refer to pertinent lubrication chart for lubrication instructions.

2. Avoid overloading the truck, as a safety measure against possible injury to the driver and fellow workmen. Overloading also shortens the life of the truck and increases maintenance. Refer to Name (Serial No.) Plate.

3. Take proper care of the battery. Check height of electrolyte solution daily. Never allow the water level to be below the top of the plates. When replacing evaporation, fill cells to proper level only -- overfilling causes loss of acid and reduces capacity. Use only water approved for battery use. Keep top of battery clean and dry at all times. A light coating of vaseline or a light cup grease on the battery terminals will help prevent corrosion. If terminals become corroded, wash off corrosion with a soda and water solution and rise thoroughly. See that the battery is properly charged after each day or shift.

4. Wiring should be checked periodically to make certain all connections are tight and intact.

5. The hydraulic system should be checked periodically for worn hoses, loose fillings and/or leaks, and security of mountings.

6. A periodic check of the brake system should be made for lining wear. Proper brake adjustment should be maintained at all times.

7. Charging equipment should be carefully maintained. Maintenance, operation, and service of charging equipment should be carried out in accordance with the battery manufacturers instructions.

CHANGING AND CHARGING STORAGE BATTERIES:

N O T E

The two types of batteries in common use are (1) lead and (2) nickel-iron. They contain corrosive chemical solutions, either acid or alkali, and therefore present a chemical hazard. On charge, they give off hydrogen and oxygen which, when mixed with air in certain concentrations, may be explosive. They are of relatively small bulk and great weight making handling a special consideration.

1. Battery charging installations should be located in areas designated for that purpose. Facilities should be provided for flushing and neutralizing spilled electrolyte, for fire protection, for protecting charging apparatus from damage by trucks, and for adequate ventilation for dispersal of fumes from gassing batteries.

2. When racks are used for support of batteries, they should be made of materials not conducive to spark generation or be coated or covered to achieve this objective.

Handling Batteries:

1. A conveyor, overhead hoist, or equivalent material handling equipment should be provided for handling batteries.

2. Chain hoists should be equipped with load-chain containers. When hand hoist is used, uncovered batteries should be covered with a sheet of plywood or other non-conducting material to prevent the hand chain from shorting on cell connectors or terminals. A properly insulated spreader bar should be used with any overhead hoist.

3. Reinstalled batteries should be properly positioned and secured in the truck.

4. A carboy tilter or shiphon should be provided for handling electrolyte. Always pour acid into water; not water into acid. Personnel maintaining batteries should wear protective clothing such as face shield, long sleeves and gauntlet gloves.

5. Electrical installations should conform to the National Electrical Code (NEPA No. 70; USA Standard C1-1965) and any local ordinances.

6. Trained and authorized personnel should change or charge batteries.

7. Trucks should be properly positioned and brake applied before attempting to change or charge batteries.

8. When charging batteries, the vent caps should be kept in place to avoid electrolyte spray. Care should be taken to assure that vent caps are functioning. The battery (or compartment) cover (s) should be open to dissipate heat.

9. Smoking should be prohibited in the charging area.

10. Precautions should be taken to prevent open flames, sparks, or electric arcs in battery charging areas.

11. Tools and other metallic objects should be kept away from the top of uncovered batteries.

INDUSTRIAL TRUCK DIVISION

LUBRICATION AND PREVENTIVE MAINTENANCE INDEX

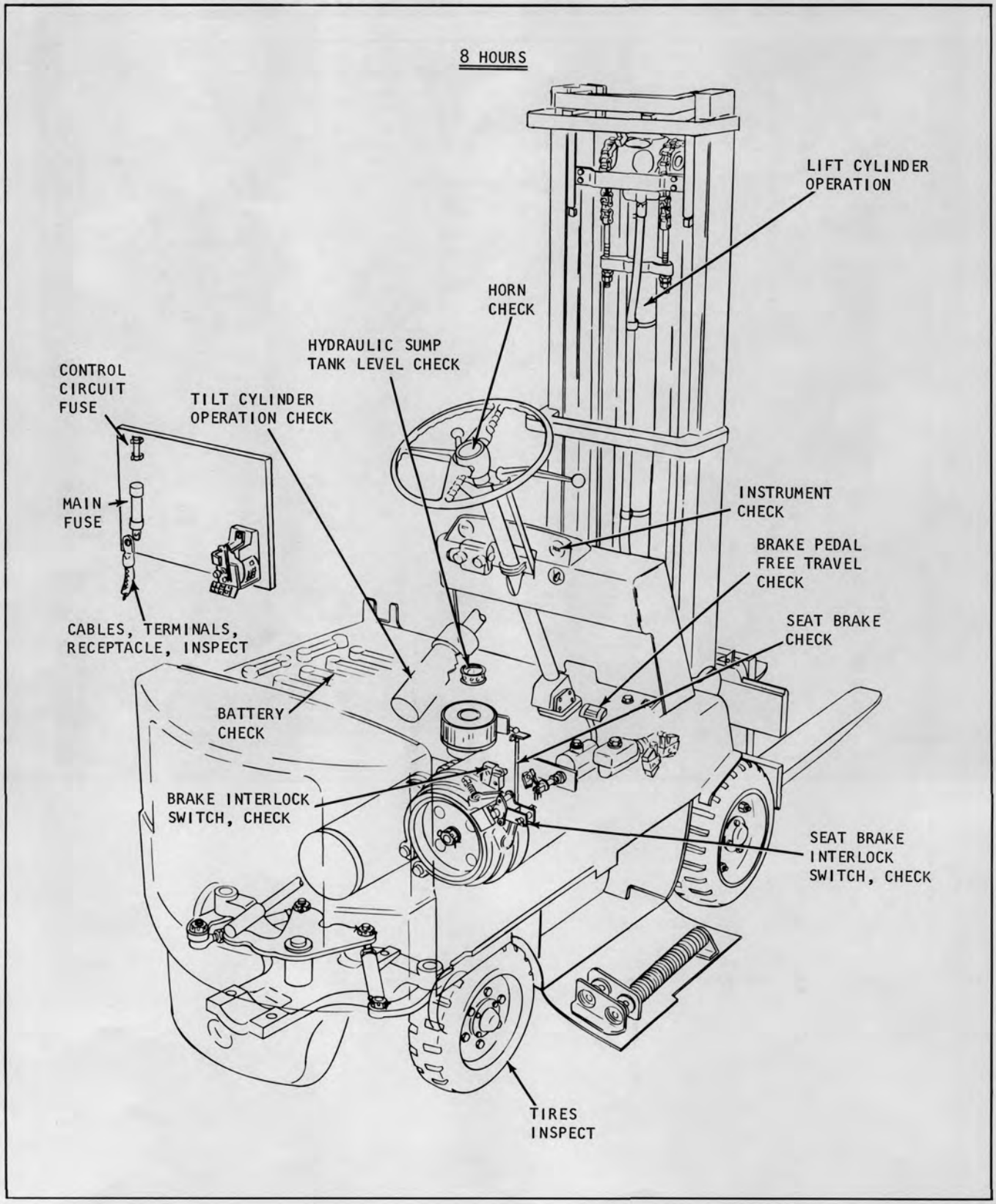


Plate 8925. Lubrication and Preventive Maintenance Illustration

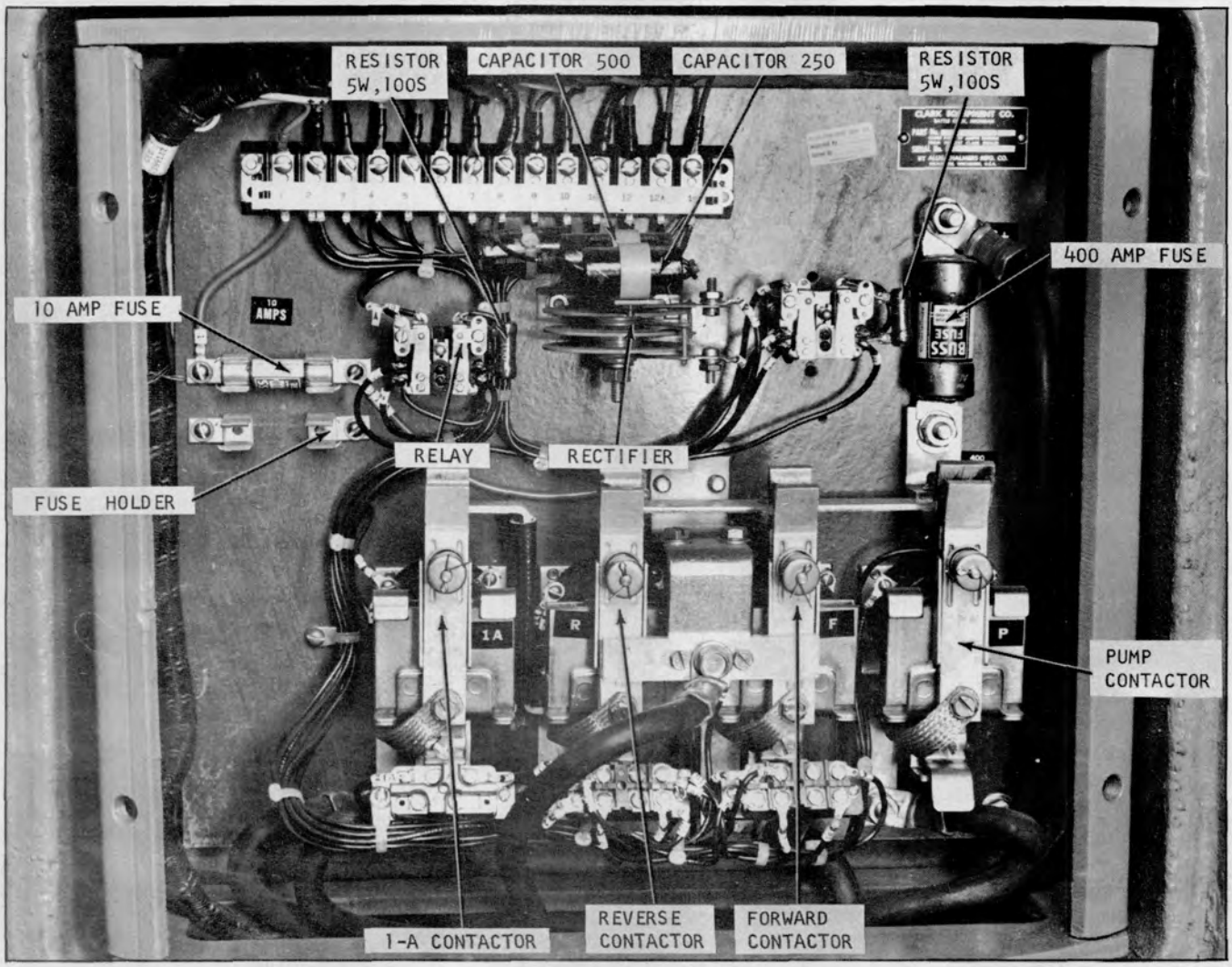


Plate 7213. Contactor Panel

HORN

Check to be sure the horn is working properly.

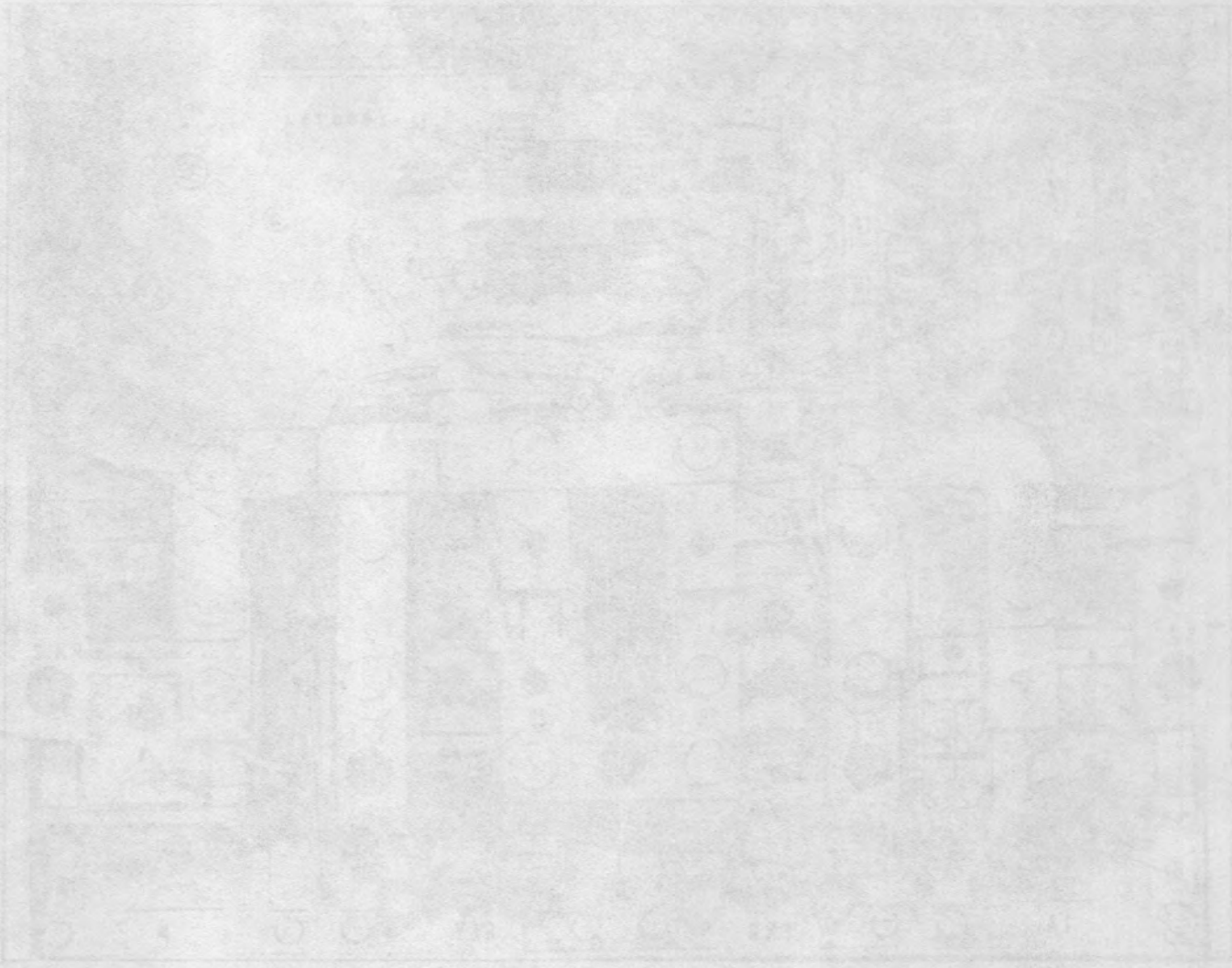
LIGHTS (Machines so equipped)

Check all lights to see if they are functioning properly.

SYSTEM FUSES

Control Circuit Fuse..... 10 amp.

Main Fuse ..... 400 amp.



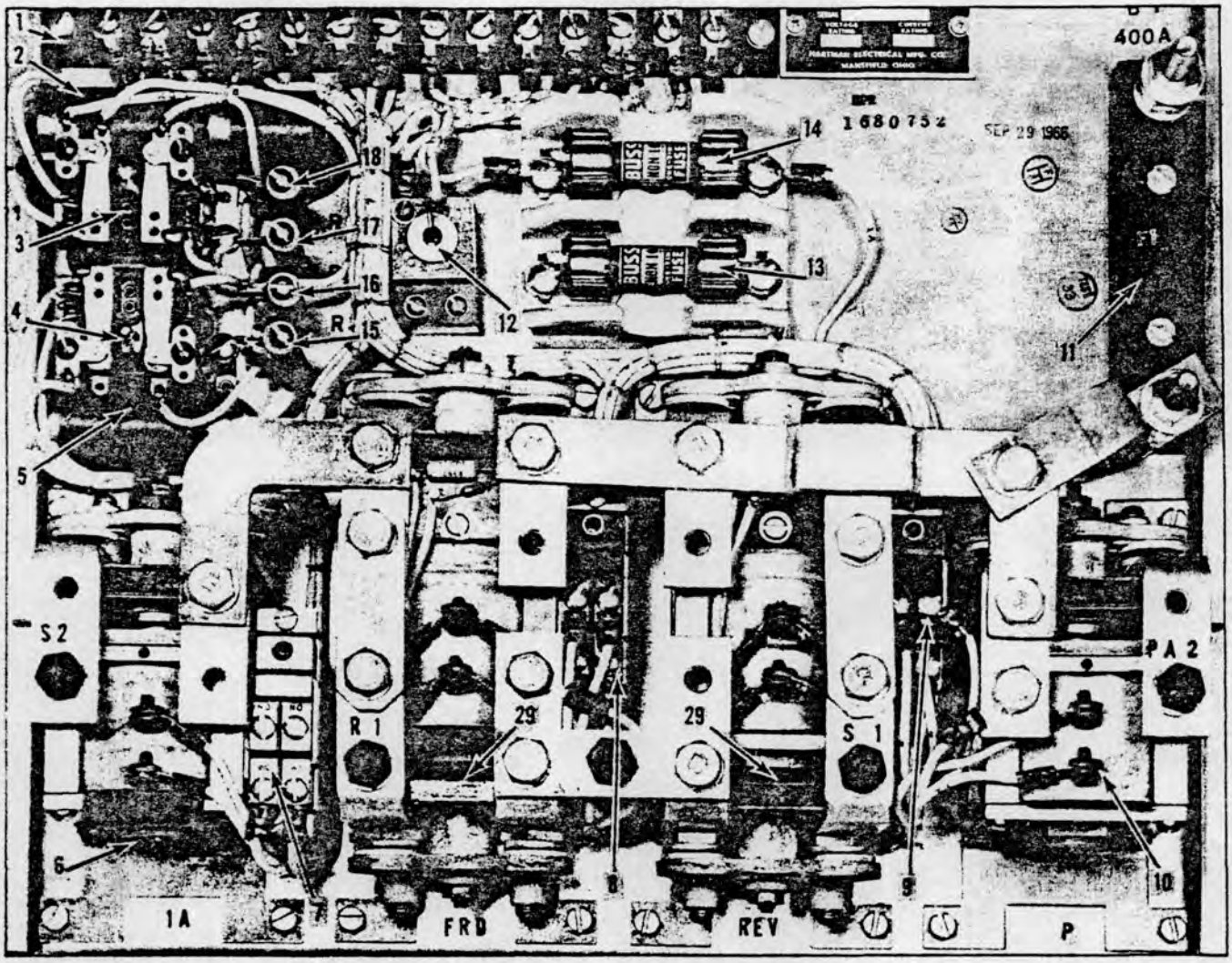


Plate 9220. Hartman Contactor Panel (Machines so equipped)

1. Terminal Strip (36S)
2. Capacitor, CR1 Relay (C1)
3. CR1 Relay (CR1)
4. CR2 Relay (CR2)
5. Capacitor, CR2 Relay (C2)
6. (1A) Contactor 1A
7. Switchette, 1A Contactor
8. Switchette, Forward Contactor (FRD) Forward Contactor
9. Switchette, Reverse Contactor
10. (P) Pump Contactor
11. 400 Amp (Main) Fuse
12. Diode Rectifier (D1)
13. Spare Fuse (10 Amp)
14. 10 Amp Fuse (F2)
15. 10 Ohm Resistor, 12 Watt (R4)
16. 125 Ohm Resistor, 12 Watt (R3)
17. 125 Ohm Resistor, 12 Watt (R2)
18. 10 Ohm Resistor, 12 Watt (R1)

ITEM 29: Forward and Reverse Adjusting Nuts

REFER TO PAGE TS 862 THRU TS 870 FOR MAINTENANCE, ADJUSTMENTS, AND TROUBLE SHOOTING; PANEL SPECIFICATIONS ARE ON PAGE TS 870.

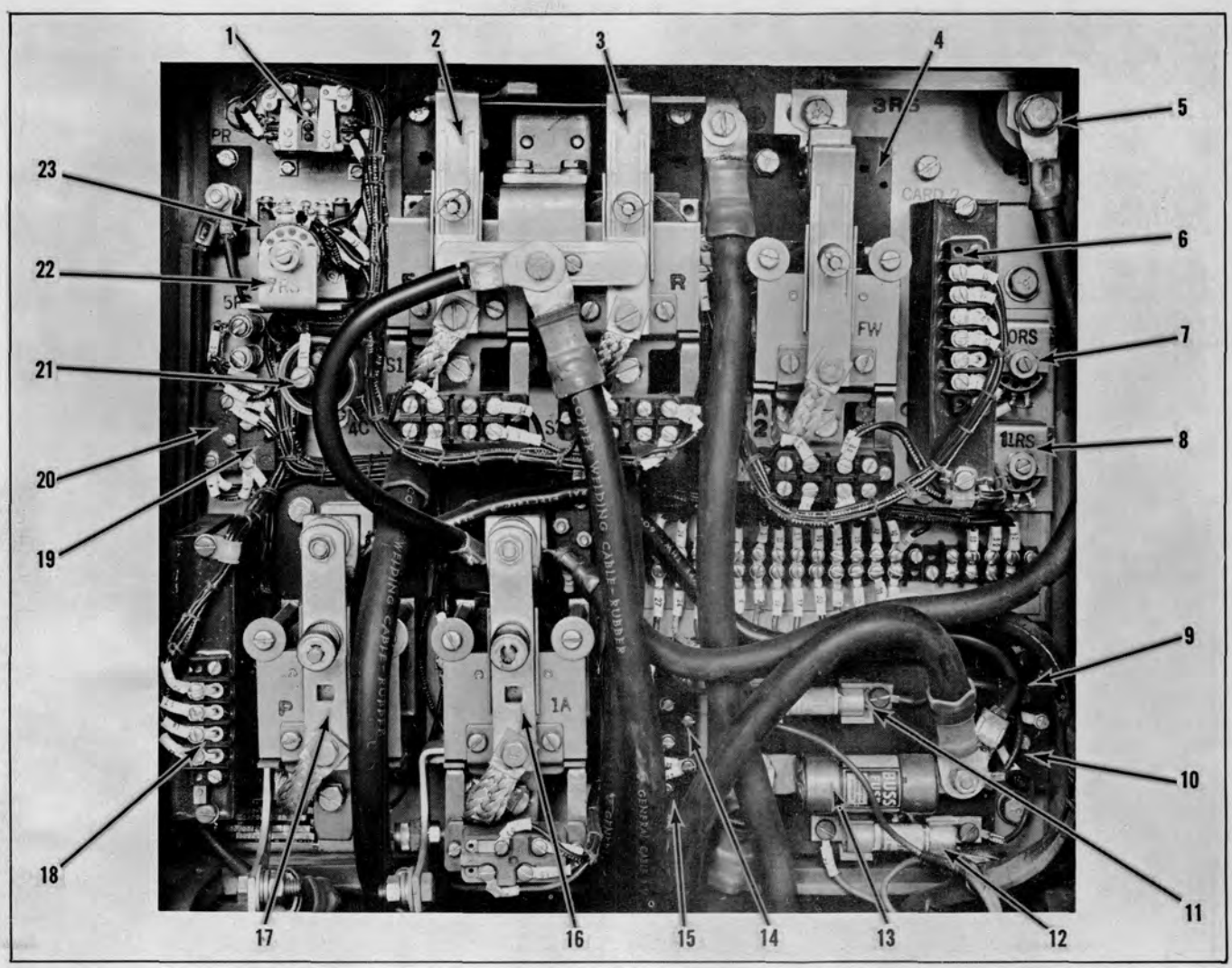


Plate 8942. Typical Magnetic Panel

1-AUXILIARY PLUGGING RELAY
2-FORWARD CONTACTOR
3-REVERSE CONTACTOR
4-FIELD WEAKENING CONTACTOR
5-56
6-CARD 2
7-10 RS
8-11 RS
9-15 REC
10-16 REC
11-10 AMP FUSE

OPTIONAL EQUIPMENT

12-15 AMP FUSE
13-400 AMP FUSE
14-27 REC
15-9 REC
16-BY-PASS CONTACTOR (1A)
17-PUMP CONTACTOR
18-CARD 3
19-8 REC
20-7 REC
21-TIMING CAPACITOR FOR APR
22-PLUGGING POTENTIOMETER
23-PLUGGING RELAY

EC20,25C/EC30,40B/ECS50C

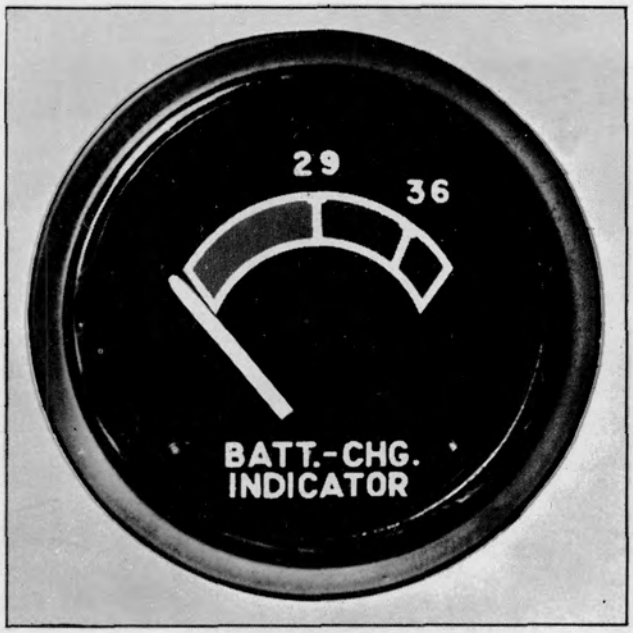


Plate 7388. Battery Charge Indicator

With the key switch in the "on" position the battery charge indicator will show the available battery voltage. When the indicator needle registers in the red portion of the indicator scale the battery should be recharged. It is recommended that at this time a specific gravity test be taken with a hydrometer to more accurately determine battery condition.

Plate 7162. Hour Meter

The hour meter accurately records the actual hours of machine operation. This will serve as an aid in determining the time intervals for lubrication and preventative maintenance services.

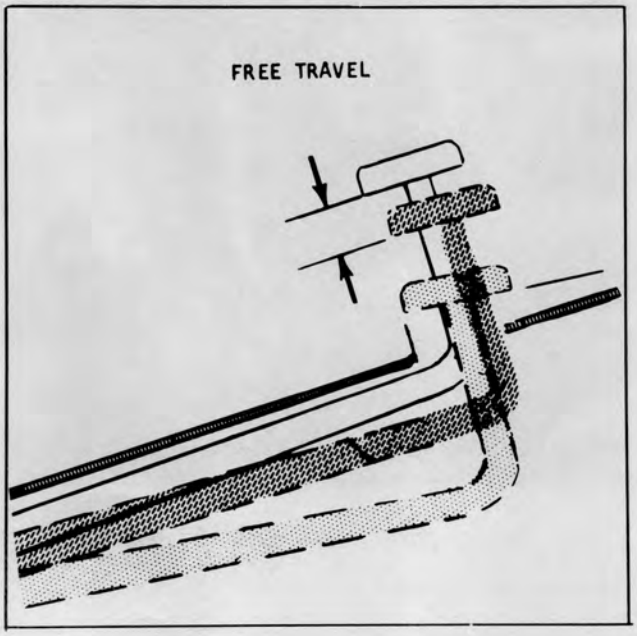


Plate 7048. Brake Pedal Free Travel

BRAKE PEDAL

1. Brake pedal should have 1/2 inch free travel. Depress pedal by hand. When pedal meets resistance from the master cylinder, the distance traveled should be as specified.

2. Depress brake pedal and hold foot pressure for at least ten seconds. Pedal must be solid, not be spongy or drift under foot pressure.

SEAT SAFETY BRAKE

The Safety Brake (Dead man Brake) is mounted to the end of the drive motor and is operated by means of linkage attached to the driver's seat.

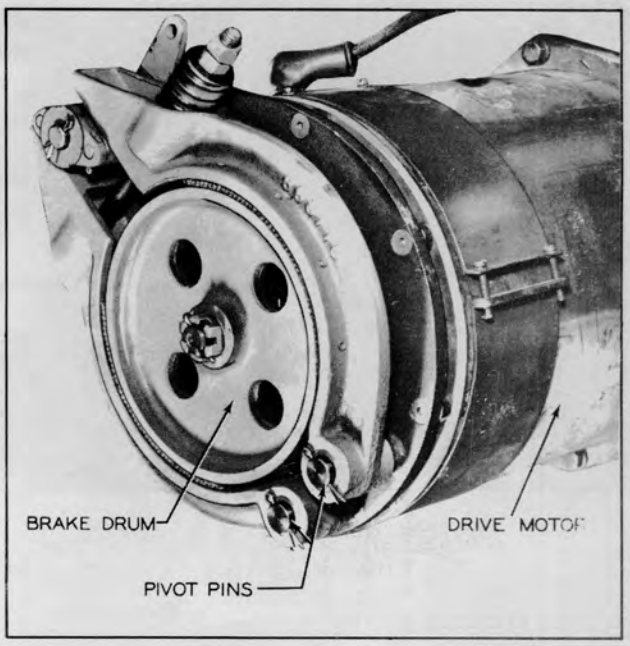


Plate 5031. Seat Safety Brake

SEAT BRAKE EFFECTIVENESS

The brake must be capable of holding the truck, with full rated load on a 15% grade. To test: Remove seat linkage pin (Plate 7410). The driver's seat should be occupied and truck power off.

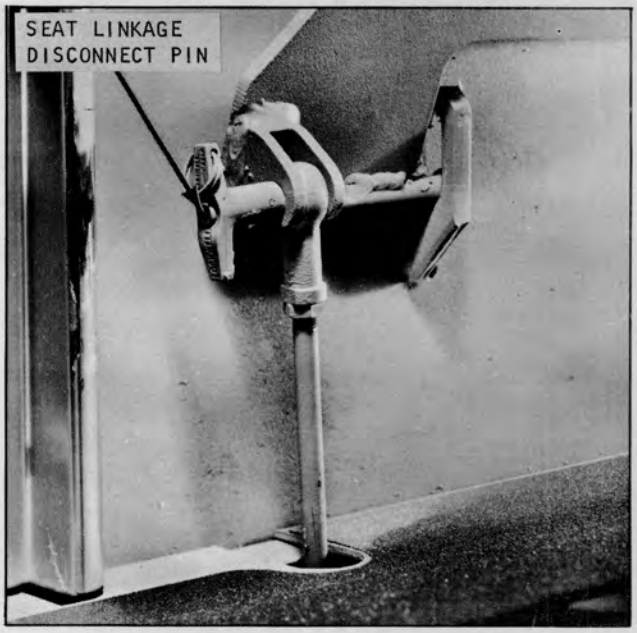


Plate 7410. Seat Linkage Disconnect Pin

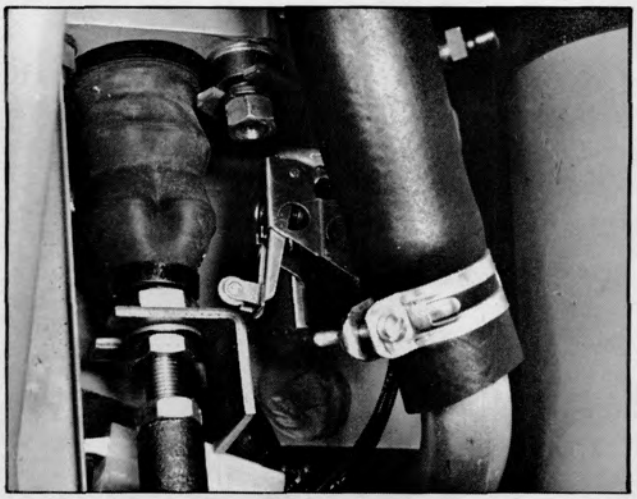


Plate 7615. Typical Brake Interlock Switch

BRAKE INTERLOCK SWITCH

This normally closed switch is so mounted that when the brake pedal is in the up position the switch is closed. This switch should actuate (open) during the free travel portion of the brake pedal stroke, thus cutting all power to the drive motor.

C A U T I O N

THE SWITCH ARM MUST NOT OVER-TRAVEL DURING APPLICATION OF THE BRAKES. ANY OVER-TRAVEL WILL CAUSE PREMATURE FAILURE OF THE SWITCH.

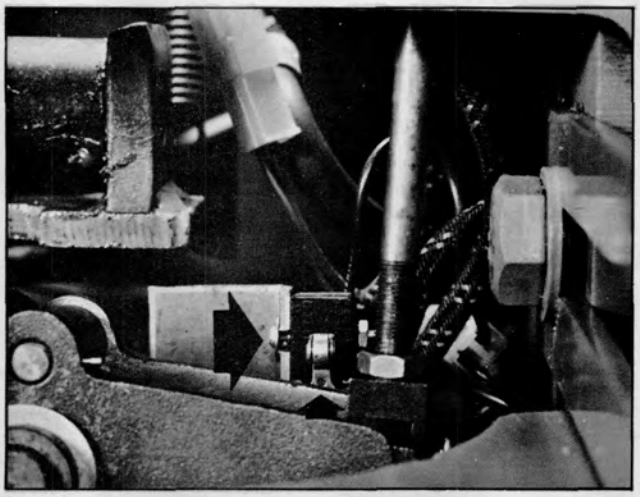


Plate 7207. Seat Safety Switch

SEAT SAFETY SWITCH

This normally open switch should actuate when the seat frame bumpers are approximately 2 to 3 inches from the battery compartment hood during the seat downward travel. In this manner the switch will close as soon as the safety brake is released thus providing a complete circuit.

BATTERIES - LEAD-ACID

The lead-acid battery has a lead peroxide positive plate, a sponge lead negative plate, and the electrolyte is a solution of sulphuric acid.

The battery does not store electricity. When the battery is connected to an electrical circuit, a chemical reaction starts inside the battery. This chemical action produces lead sulphate on both the positive and negative plates, and the chemical actions produces the electric current through the electrical circuit. This action continues only as long as the circuit is complete from negative pole to the positive pole. As the battery plates become coated with lead sulphate the voltage output of the battery decreases. When both the positive and negative plates have become thoroughly coated with lead sulphate, both plates act alike (or like similar metals). This causes the current to stop flowing.

When the point is reached where the battery is discharged, the battery must be charged. Charging is accomplished by connecting the battery to a direct current source in such a manner that the electricity flows through the battery in the opposite direction of the normal battery current.

BATTERY LIFE

Economical and efficient operation of the electric fork lift truck depends, to a great extent, upon the efficiency and life of the battery.

During the operation of the fork lift truck, many things occur which, if not corrected or prevented, can greatly reduce the life of the battery.

The operator should be acquainted with the limits, capacities and capabilities of his truck. He should know the correct point of power to use to move all loads up to the rated capacity of the truck.

Batteries are rated in ampere hours over a set period of time, and should be of a proper size for the particular work intended. Extending the work means over-discharging the battery. This will greatly shorten its life. Overcharging the battery by using too high a rate of charge, will cause it to gas vigorously after it has reached its fully charged state and will also shorten its life.

If service requirements demand only partial discharge of the battery, it is unnecessary to recharge following each partial discharge. When the hydrometer reading indicates the battery is 75% discharged, (approximately 1130 specific gravity) arrangements should be made to recharge.

Controlling the "charge" and "discharge" of the battery is a very important contributing factor in determining battery life.

The discharge of a battery can be controlled in several ways.

Batteries are rated according to the job for which they are being used. A fully charged battery is capable of doing a certain amount of work or lasting a certain length of time in a specific service. With information of this type, a schedule or duty cycle can be worked out and the batteries can be changed or serviced with very few failures.

Experienced operators can tell from the action of the truck, when the battery is reaching the point where it should be charged or changed. Prompt action in seeing that the battery is serviced at this time can result in longer battery life.

Several "meters" or "indicators" are available for use on battery powered trucks. These indicators show the operator the state of charge of the battery, how much useful power is left in the battery, or just simply warns the operator when the battery should be charged.

MAINTENANCE

Keep the "tops" of the battery clean and dry at all times. Normally wiping the top of the battery with a damp cloth is sufficient. If the battery is removed from the truck, it can be hosed off with clean water. If electrolyte is spilled, it will not dry off. Neutralize the acid with a solution of ordinary "bicarbonate of soda" and rinse thoroughly with clean water.

A light coating of vasoline or a light cup grease on the terminals will help prevent corrosion. If the terminals have become corroded, wash off the corrosion with a soda solution and rinse thoroughly.

The vent plugs should be in place at all times when using, cleaning, and charging the battery. They should be cleaned weekly by immersing in a bucket of clean water for one half hour. Check the vent holes in the vent plugs and clean out.

The vent holes must be open to allow gas to escape from the cell.

The batteries should be numbered and assigned to a given truck. A record should be kept of (1) daily hydrometer reading on a pilot cell at the beginning of each charging, (2) a weekly reading of the pilot cell after charge, and (3) a hydrometer reading of all cells and temperature of one cell each "4" months before and after charging. When battery shows nonuniformity of these readings and an inability to work through a shift, it is an indication that replacement is necessary.

Plate 4018. Hydrometer Check Method

TWO-RATE CHARGING

"Two-Rate" charge, as the name implies, consists of two average rates. A "high" rate is provided at the beginning of the charge, while, toward the end of the charge, this is automatically changed to a "low" rate. (In actual operation, both high and low-rate is obtained in modern charging equipment by the use of a voltage relay in a rate charging circuit). When the battery cell voltage rises to approximately 2.37 volts per cell, at 77° F., the voltage relay automatically lowers the charging rate. The same voltage relay operating with a time switch can also be used to stop the charge automatically.

"Two-Rate" charging is generally used with rectifiers, although it is also used with a generator when the voltage is too high for the taper charge. For dependable, day-in and day-out repeat performance, the quality of the voltage relay and time switch is important.

TAPER-CHARGING

The "Taper" charge (Modified constant potential) is obtained inherently (a natural characteristic) in a circuit design by balancing the charging voltage source against the battery voltage rise during charge. As the battery voltage rises, it approaches the value of the charging source and hence, there is less difference between the charging source and battery voltage. As a consequence, the flow of charging current will taper off in value opposite to the way the battery voltage rises.

"Taper" charge requires a close tolerance (plus or minus 3%) of charging source voltage (2.63 times the number of cells) when more than one charge circuit is on the same machine. A single circuit taper charge does not need this close voltage limit as the inherent taper is obtained as a natural part of the shunt generator load characteristic.

However, taper charge circuits are specifically designed for a definite number of cells, in the battery, to achieve the inherent taper. The only duty performed by a voltage relay time switch control, on the taper circuit, is to stop the charge.

NICKEL-IRON-ALKALINE STORAGE BATTERIES

The alkaline storage battery is known as the "nickel-iron-alkaline type" because nickel oxide is used in the positive elements, and iron in the negative elements; while the electrolyte is an alkaline solution containing potash and lithia.

TYPE AND SERIES

Each cell bears a distinguishing type letter and size number plainly stamped upon the cover. A serial number, just under the type letter and size number combination, denotes date of manufacture. All cells having the same type letter are similar in operating characteristics and

are made from the same class of plates and size. Therefore, the capacity of the cell simply varies with the number of plates. The "size number" indicates the number of positive plates. The total number of positive and negative plates is one more than twice the size number.

INSPECTION ON RECEIPT

Alkaline batteries are shipped in either a "charged" or "discharge" condition. The cells shipped charged, are intended for service within a short time without further charging. If the cells are not put into service within a month, it will be found advisable to charge one or two hours before using.

A red label, included with the battery in each shipment, indicates that the cells are charged ready for immediate use on receipt.

A green label, indicates that the cells are in a discharged condition and must be given an extra charging time as specified by the manufacturer.

Upon receipt of the battery, inspect each cell for solution height. Use a glass tube for this purpose. DO NOT use a match or other open flame for inspection.

If electrolyte has been spilled, if plate tops are visible above the surface of the solution, or if the inside of packing case, etc., shows yellowish stains. The loss must be replaced; preferably with Refill Alkaline Storage Battery Solution, or lacking this, with RENEWAL Solution diluted to a specific gravity of 1.215 by the addition of distilled water. The proper height of solution above plate tops is as follows: Cell type is stamped on the cover of each cell.

"A" Type Cells - 1/2"
"C" Type Cells - 1"
"D" Type Cells - 1 1/4"

When the level of solution is only a small amount below the proper height, fill with pure distilled water and in the future, use pure distilled water for replenishing the solution.

CONNECTIONS

The positive pole of an "alkaline cell" is designated by a red bushing around the pole and a plus (+) mark stamped on the cell cover.

The negative pole, is designated by a black bushing around the pole; no designating mark on the cover.

The connections between cells, in a tray, are made of solid wire with lugs on both ends. These are known as "connectors". The flexible, rubber-covered cables used to join trays together are known as "jumpers".

To avoid unnecessary electrical losses, all electrical connections must be tight. (To obtain this, it is necessary to see that all the contact surfaces between the poles and lugs are clean and make good contact.) Remove any Esbaline, grease, or dirt that may stick to the tapered surfaces of the poles or the inside of the lugs before connecting. If necessary, use 00 sandpaper or 00 emery cloth for this purpose. NEVER use a file or anything that will harm the contact surfaces.

A loose or dirty contact on a cell pole will cause excessive heating, and may be detected by touching the connectors after the current has been passing through them for some time.

DISCONNECTING LUG

A "disconnecting jack" or "lug puller" is supplied with each battery. This jack is designed to straddle the connector or jumper lug and, by means of a jack screw, break the lug loose from the cell pole.

CHARGING

Direct current must be used to charge any storage battery. If only alternating current is available, it is necessary to convert to direct current by the use of a motor generator set, mercury arc rectifier, or other suitable form of current rectifier.

An alkaline battery may be charged at either a constant current rate throughout the entire charging period, or at a modified constant potential rate. In either case the average rate should be such that the battery can be brought from a discharged state to full charge within between six and seven hours. In connecting a battery to the charging circuit, always connect the positive terminal to the positive side of the line, and the negative terminal to the negative side of the line.

It is not necessary to take specific gravity reading during charge, as the electrolyte does not change appreciably.

Before starting to charge, see that the solution is at the proper level. If the solution is low, bring it to the proper level by adding pure distilled water as instructed under watering. If the battery is in a compartment, open the cover before starting a charge. DO NOT charge in a hot place or allow the temperature of the solution to exceed 115° Fahrenheit on charge.

CHARGE TEST FORK

The charge test fork was developed to provide an easy means of determining the state of charge of an alkaline battery.

Plate 4008. Charge Test Fork Check

This is done by obtaining a key voltage reading which, on reference to the charts supplied for use with instrument, will indicate the amount of charge necessary to restore the battery to a fully charged condition.

ELECTROLYTE

The specific gravity of the electrolyte in fully charged alkaline cells has a normal operating range of between 1.215 and 1.160, with electrolyte at the proper level and corrected for temperature.

The specific gravity reading of the electrolyte (of an alkaline cell) has no value in determining its state of charge, as the specific gravity does not change during the charging or discharging periods to any marked extent. It, therefore, is only necessary to take infrequent readings, to determine if the specific gravity has dropped to the point where a change of electrolyte is desirable.

There are two kinds of alkaline potash electrolyte which are normally used when a "change" of solution is found necessary. Renewal solution, which has a specific gravity of approximately 1.250; is normally used to replace old electrolyte, the gravity of which has dropped to the low limit ranging between 1.160 and 1.170. Refill solution has a specific gravity of approximately 1.215 and is used to replace spillage. DO NOT use any potash solution other than alkaline electrolyte, as the presence of impurities or improper compounding of such solution may permanently injure your battery.

WATERING CELLS

Before putting a new electric filler into service; see that the tank is washed thoroughly to remove any foreign matter and then rinse tank, hose and filler thoroughly by running distilled water through them. Then fill the tank with distilled water and mount in a convenient place at least four or five feet above the cells to be watered.

To operate, insert the nozzle into the filler opening in the top of the cell. If the solution is already at the proper height, the bell signal will ring. If bell does not ring, start flow of water by opening valve by pushing down lever on filler handle. When the bell rings, remove the nozzle from the cell, close cell filler cap and proceed to next cell.

LAYING UP BATTERY

If battery is to be laid up for any length of time (in excess of one year) be sure that the plates are covered to the proper height with solution and that the battery is discharged and short circuited. The battery should be stored in a cool dry place.

Alkaline batteries are easy to lay up. Merely discharge to zero voltage and short circuit. They may be left standing idle indefinitely, without injury, if stored in this short circuited condition. The battery may be stored for 6 months to a year without discharging and short circuiting.

C A U T I O N S

NEVER put lead battery acid into an alkaline battery or use utensils that have been used with acid; you may ruin the battery.

NEVER bring a "lighted match" other "open flame" near a battery.

NEVER lay a "tool" or any piece of "metal" on a battery. Always keep the filler caps closed except when necessary to have them open for filling as provided for in these instructions.

ALWAYS keep batteries clean and dry externally.

ALKALINE ELECTROLYTE is injurious to the skin or clothing and must be handled carefully. Solution spilled on the person should be immediately washed away with plenty of water.

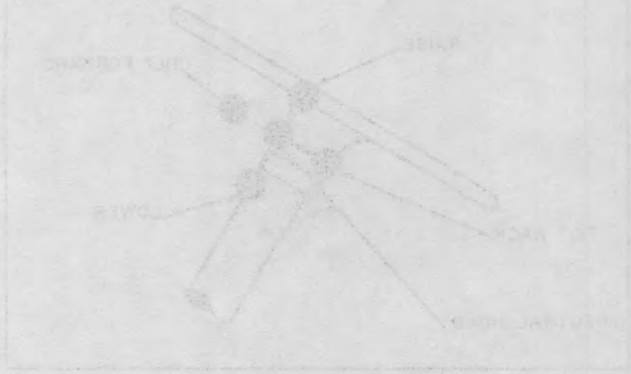
DO NOT use the electric filler, or fill cells while a battery is on charge.

USE ONLY pure distilled water for watering the battery.

WEAR GOGGLES when cleaning or changing solution.

CABLES, TERMINALS AND BATTERY RECEPTACLE.

Check cables, terminals and receptacle for condition and security of mounting. Correct as necessary.



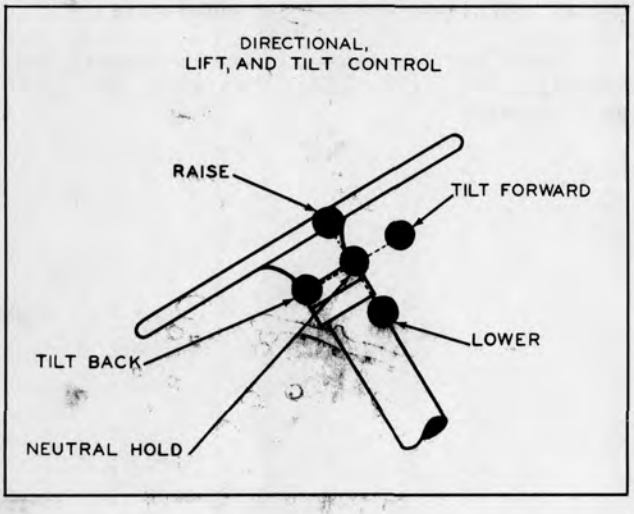


Plate 4448. Lift and Tilt Lever

Check lift and tilt operation. The lift and tilt cylinders should actuate when lift or tilt levers are moved either way from neutral position.

When load is elevated and control lever returned to neutral position, load should remain in elevated position with no noticeable downward drift. If load drifts downward excessively, this may indicate lift cylinder U-cup or seal damage. Report to designated person in authority.

With tilt lever in neutral position, upright should remain steady with no noticeable backward or forward drift. If upright drifts excessively either way, this may indicate tilt cylinder seal or U-cup damage. Also report to designated person in authority.

C A U T I O N

NEVER ALLOW LOADED OR UNLOADED LIFT CARRIAGE TO REMAIN IN AN ELEVATED POSITION FOR ANY PROLONGED PERIODS. LIFT CARRIAGE SHOULD BE LOWERED WHEN NOT IN USE. DO NOT HOLD CONTROL LEVERS IN EXTREME POSITIONS AFTER A LOAD HAS REACHED ITS LIMITS. TO DO SO WILL RESULT IN HIGH OIL PRESSURE THAT MAY RESULT IN HEATING OF THE HYDRAULIC OIL.

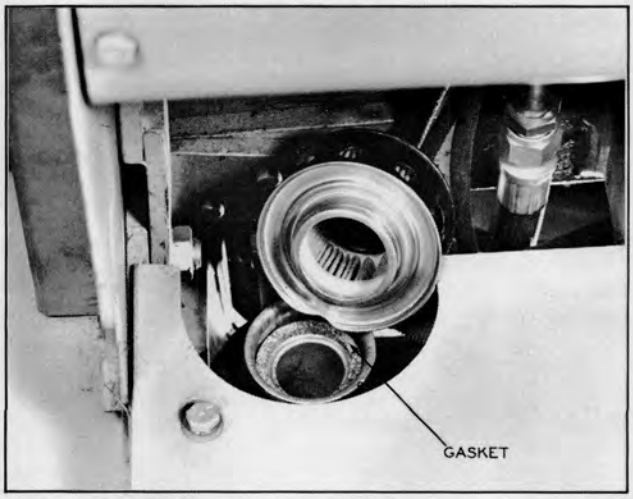


Plate 6586. Sump Tank Fill

SUMP TANK LEVEL CHECK

1. If the up right can be raised to the highest position, this will indicate a full tank

2. If the upright cannot be raised to the highest position, lower the upright to the floor turn key switch to the "off" position, add 1 quart of hydraulic fluid (Clark specification MS 68, Part #885385), and again see if the upright will go to the highest position. If not, repeat the proceedure.

3. Once the upright does go to the top, add 2 more quarts of fluid.

N O T E

For machines equipped with maximum lift uprights, add 1 quart at a time to see if the fluid surges out on the down stroke.

INDUSTRIAL TRUCK DIVISION

LUBRICATION AND PREVENTIVE MAINTENANCE

TIRE AND RIM MAINTENANCE

1. Inspect tires regularly - remove all sharp objects picked up by treads before they have a chance to cut further into the rubber and cause chipping or possible separation of the rubber from the base metal.

2. Avoid overloading and do not allow vehicle to stand under heavy loads for prolonged periods as this will cause a "flat" spot on the tires.

3. Check steering axle alignment regularly to protect against fast, irregular tread wear and separation.

4. If rubber tires come in contact with oils, grease, and gasoline they should be wiped off without delay.

5. Regular lubrication of all wheel bearings will assure free-rolling and elimination of tire drag when stopping or starting.

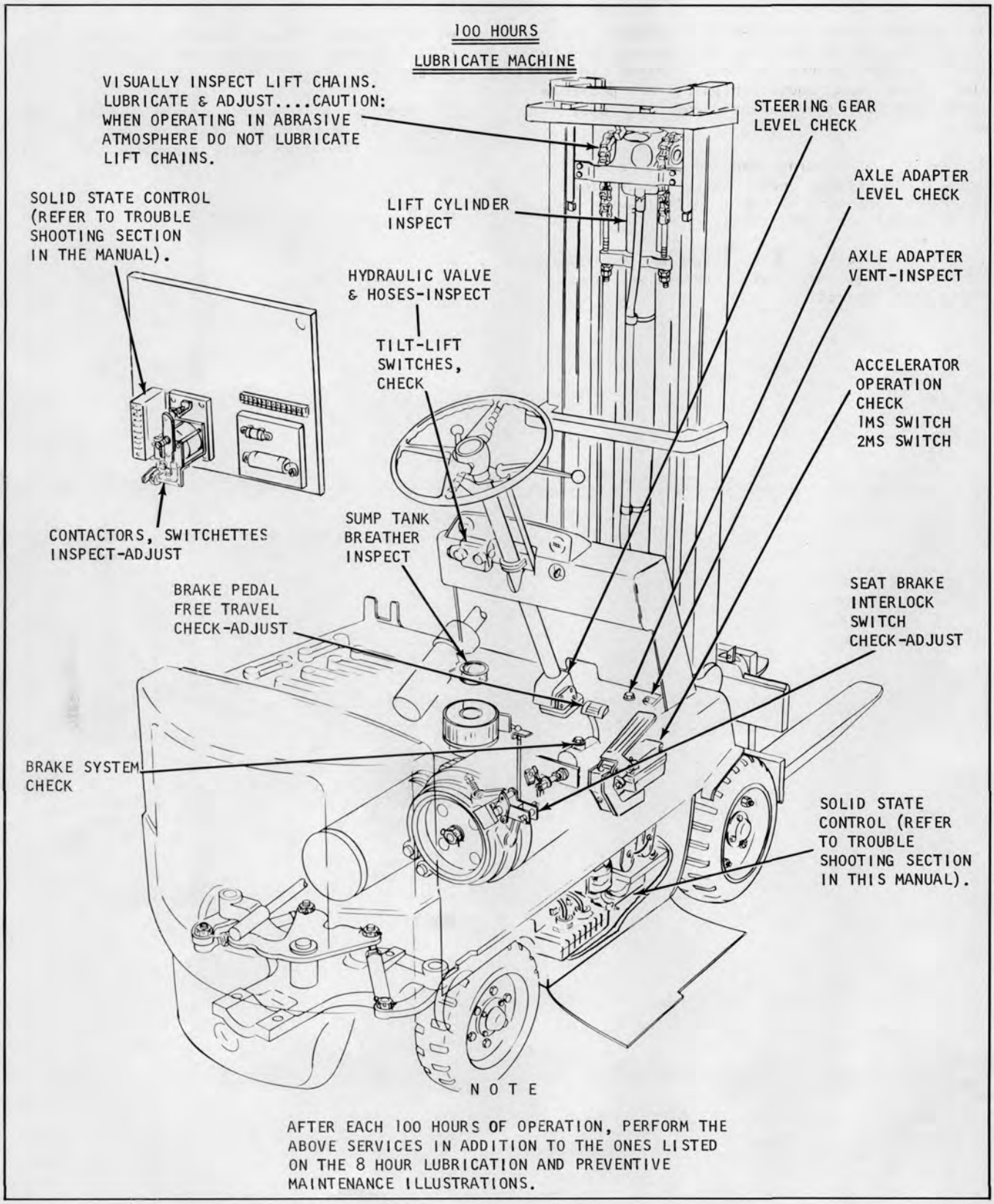


Plate 8929. Lubrication and Preventive Maintenance Illustration (Solid State Control Equipped Units).

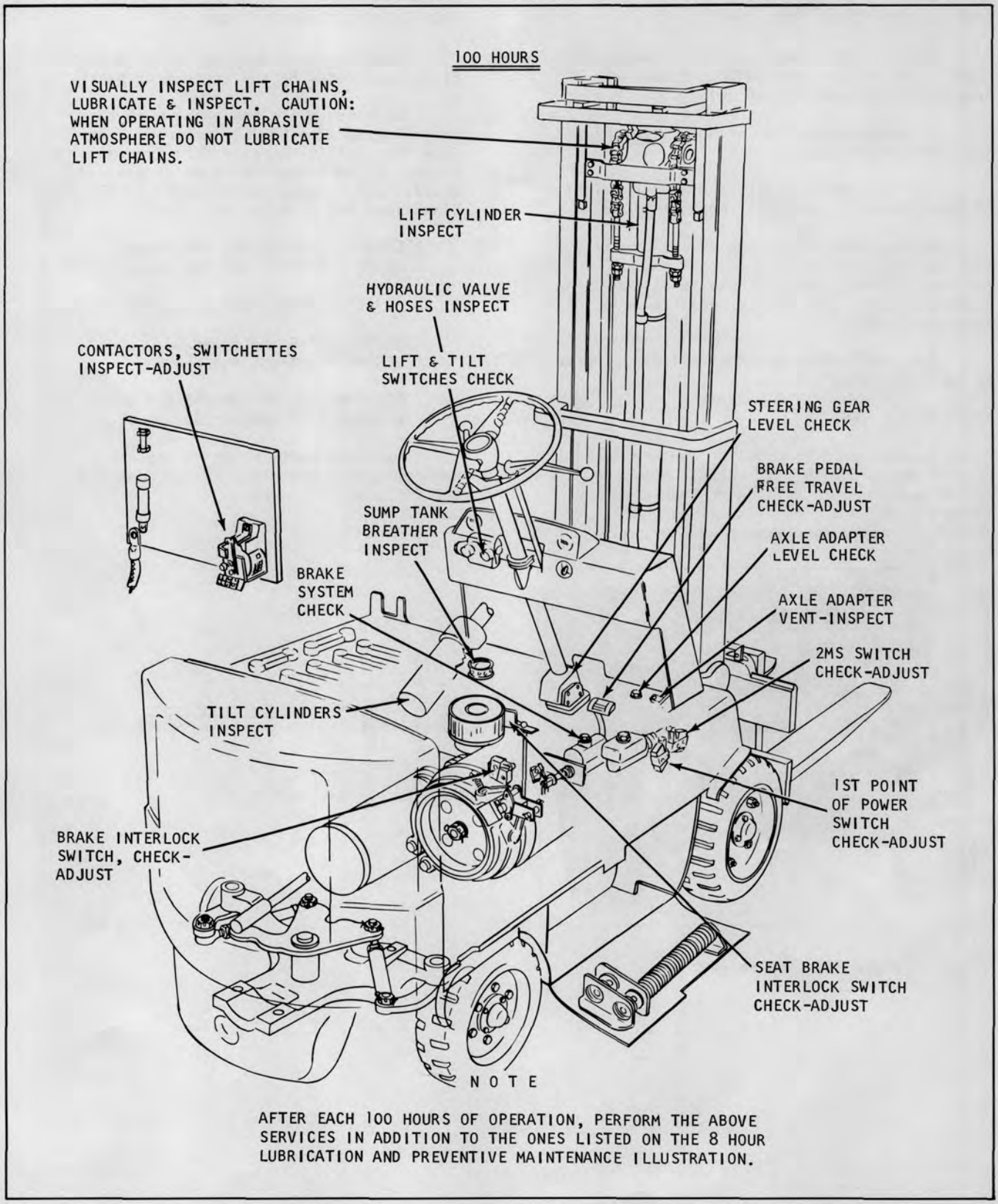


Plate 8926. Lubrication and Preventive Maintenance Illustration

AXLE ADAPTOR FLUID LEVEL CHECK

Verify fluid level....fill if necessary until level reaches the height of the Axle Adaptor LEVEL PLUG OPENING (E).

1. Clean dirt from around filler plug (D), and remove plug.

2. Fill until level reaches the height of the level plug opening. Replace plugs.

Do not overfill as the excess quantity will serve no useful purpose. If the oil is too high, it will cause excessive oil churning and attendantly high oil temperature and possible leakage.

For LUBRICATION RECOMMENDATIONS....refer to the right hand column.

AXLE ADAPTOR VENT

Inspect Axle Vent (C) to be sure it is free of obstructions. If vent is not open, remove and clean in a Stoddard type cleaning solvent. Be sure vent is completely dry before replacing in the axle adaptor.

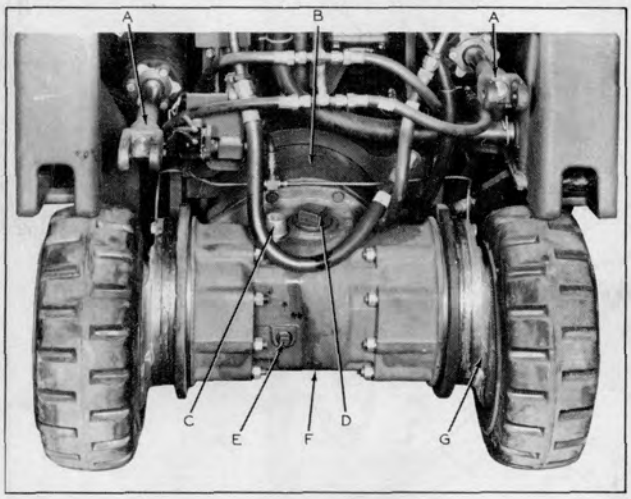


Plate 5988. Axle Adaptor

LUBRICATION RECOMMENDATIONS

Refer to your Machine Serial Number Plate....located on the instrument panel.

Machines built beginning with the following Machine Serial Numbers....use Type "A", Suffix "A" Automatic Transmission Fluid. Fluid Containers must display a qualification number prefixed by AQ-ATF. Clark Part No. 879803.

EC20C & EC25C-1-763 and above
EC30B & EC40B-1-764 and above

EC30C & EC40C-1-919 and above

ECS50C-1-919 and above
EC50-60-70-1-831 and above

ECLS20B & ECLS25B-1-983 and above
ECLS30B & ECLS40B-1-984 and above

Machines built prior to the above Machine Serial Numbers.....use EPGL SAE #90 Gear Lubricant.

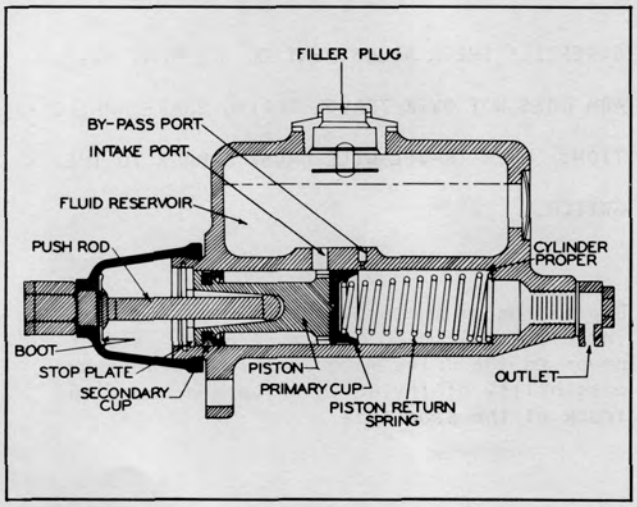


Plate 5772. Speed Control Cylinder (EC MODELS)

Speed Control Cylinder: Verify fluid level. Fluid should be within 1/4 inch of the top. Fill with S.A.E. 70R3 Heavy Duty Brake fluid.

Cylinder Filler Cap Vent Hole: Check cap vent hole for obstruction. Vent hole must be open at all times. Clean if necessary.

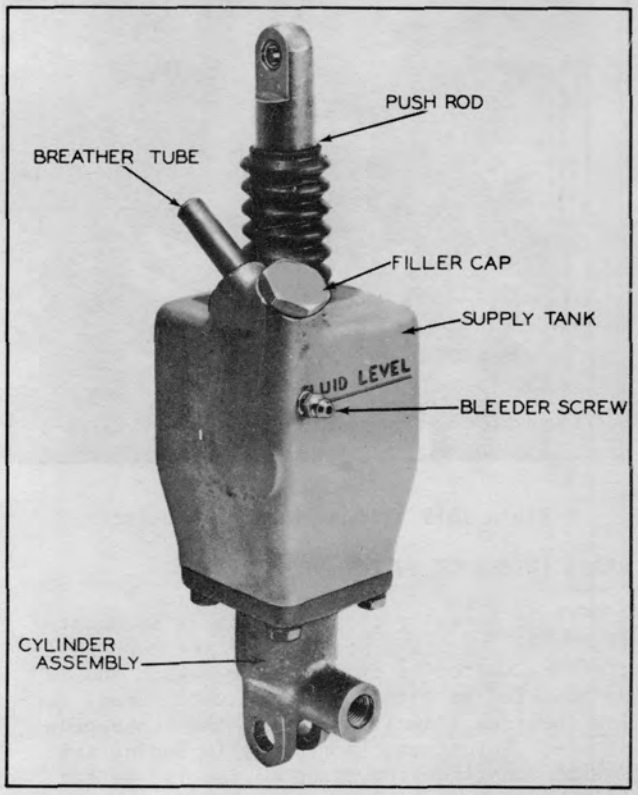


Plate 5334. Speed Control Cylinder (ECLS MODELS)

Speed Control Cylinder: Verify fluid level. Fluid should be to the height of the level bleed screw. Fill if necessary with S.A.E. 70R3 Heavy Duty Brake fluid.

Cylinder Vent Tube: Cylinder vent must be open at all times. Clean vent hole if necessary.

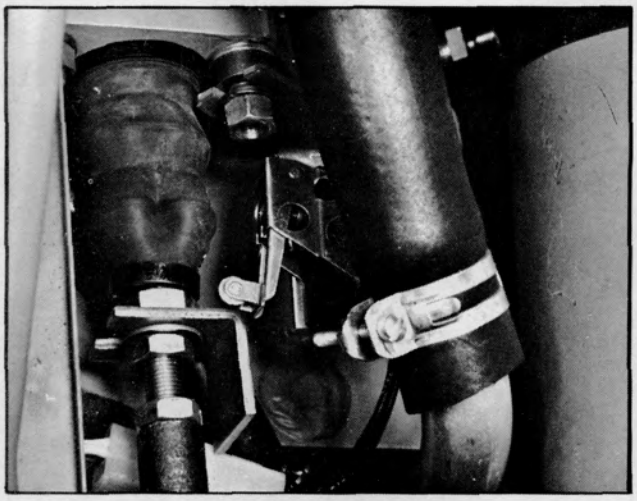


Plate 7615. Brake Interlock Switch

BRAKE INTERLOCK SWITCH ADJUSTMENT

This normally closed switch is so mounted that when the brake pedal is in the "up" position the switch is closed. The switch should be adjusted so that it will actuate (open) during the free travel portion of the brake pedal stroke. Adjustment is made by loosening the switch mounting screws and moving the switch in the necessary direction to attain the correct adjustment. Tighten the screws retaining the switch to its mounting bracket without moving switch out of adjustment.

C A U T I O N

CAREFULLY CHECK ADJUSTMENT TO SEE THAT SWITCH ARM DOES NOT OVER-TRAVEL DURING BRAKE APPLICATION. OVER-TRAVEL WILL CAUSE DAMAGE TO THE SWITCH.

N O T E

Depression of the brake pedal will cause the interlock switch to open a circuit, cutting all power to the drive motor. This prevents the possibility of trying to drive and brake the truck at the same time.

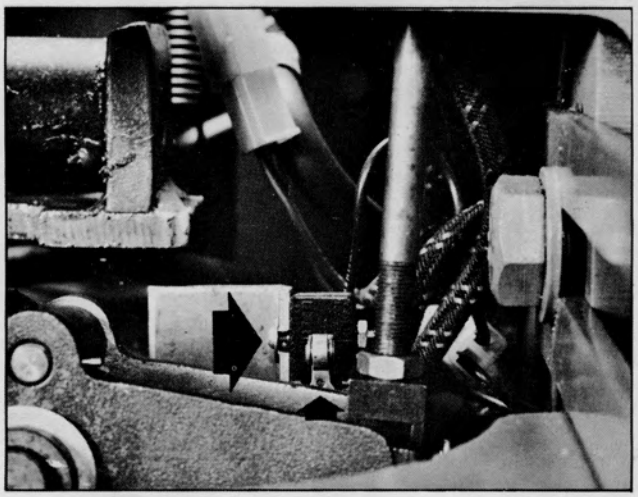


Plate 7207. Seat Safety Switch

SEAT SAFETY SWITCH ADJUSTMENT

This normally open switch should be adjusted so that it will actuate (close) when the seat frame bumpers are approximently 2 to 3 inches from the hood during the seat downward travel. The adjustment is made by loosening the switch mounting screws and moving the switch fore or aft as required on the elongated mounting bracket holes. Securely tighten mounting screws when correct adjustment is obtained.

BRAKE PEDAL FREE TRAVEL

Using a rule, measure pedal free travel at either of the two places shown below.

Depress brake pedal by hand. When pedal meets resistance from the master cylinder, the distance traveled should be 1/2 inch — if free travel is incorrect, adjust as follows:

1. Loosen lock nut, see Plate 6633.

2. Rotate adjuster to obtain specified pedal free travel.

3. Tighten lock nut to hold adjustment.

ACTUATION STROKE

The Automatic Brake Adjustors will maintain pedal stroke, with little variation, until such time as the brake linings require replacement. At this time the brake pedal will drop toward the floor board.

If brake pedal travels beyond this point------ this indicates either lack of fluid in the master cylinder; air in the system, or the brake linings require replacement.

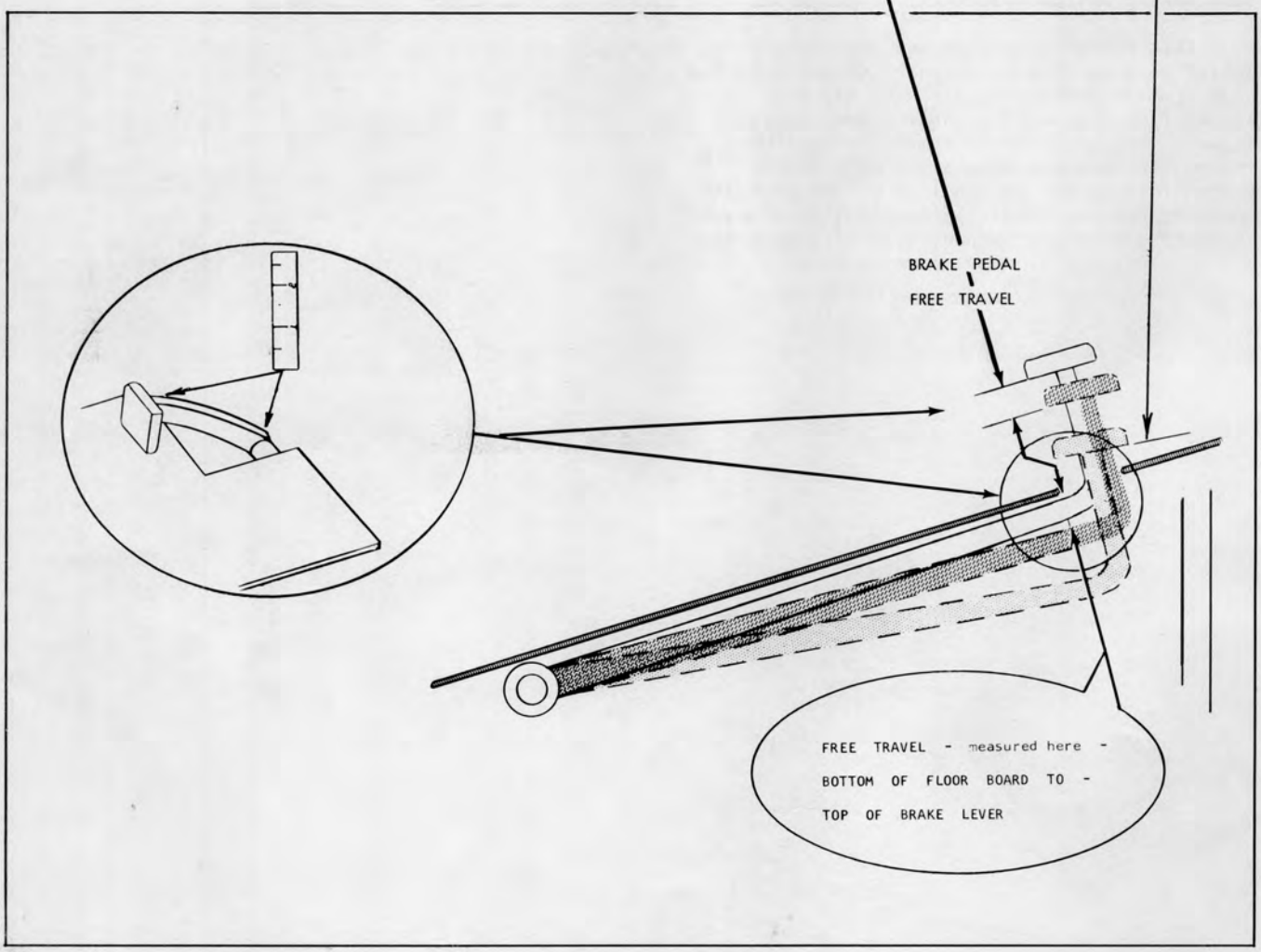


Plate 7042. Brake Pedal Check and Adjustment

BRAKE SYSTEM

Check brake fluid level in the master cylinder. Brake fluid should be within 1/4 inch of the top. Fill with S.A.E. 70 R3 Heavy Duty Hydraulic Brake Fluid.

Master Cylinder Filler Cap Vent Hole: Check cap vent hole for obstruction. Vent hole must be open at all times. Clean if necessary, see Plate 6633.

BRAKE PEDAL

W A R N I N G

CORRECT BRAKE PEDAL FREE TRAVEL IS IMPORTANT FOR SAFE OPERATING BRAKES.

A correctly adjusted brake pedal is important so that the internal ports in the master cylinder are not blocked by the cylinder piston. The following lists two important reasons for proper brake pedal free travel.

Inadequate pedal free travel will block the internal ports so that upon releasing the brake pedal fluid will be trapped in the lines and hold the brake linings in contact with the brake drums. Resulting in lining wear and premature discharge of the battery.

Brake Pedal Adjustment: Refer to Plate 7042 and follow the instructions and diagrams.

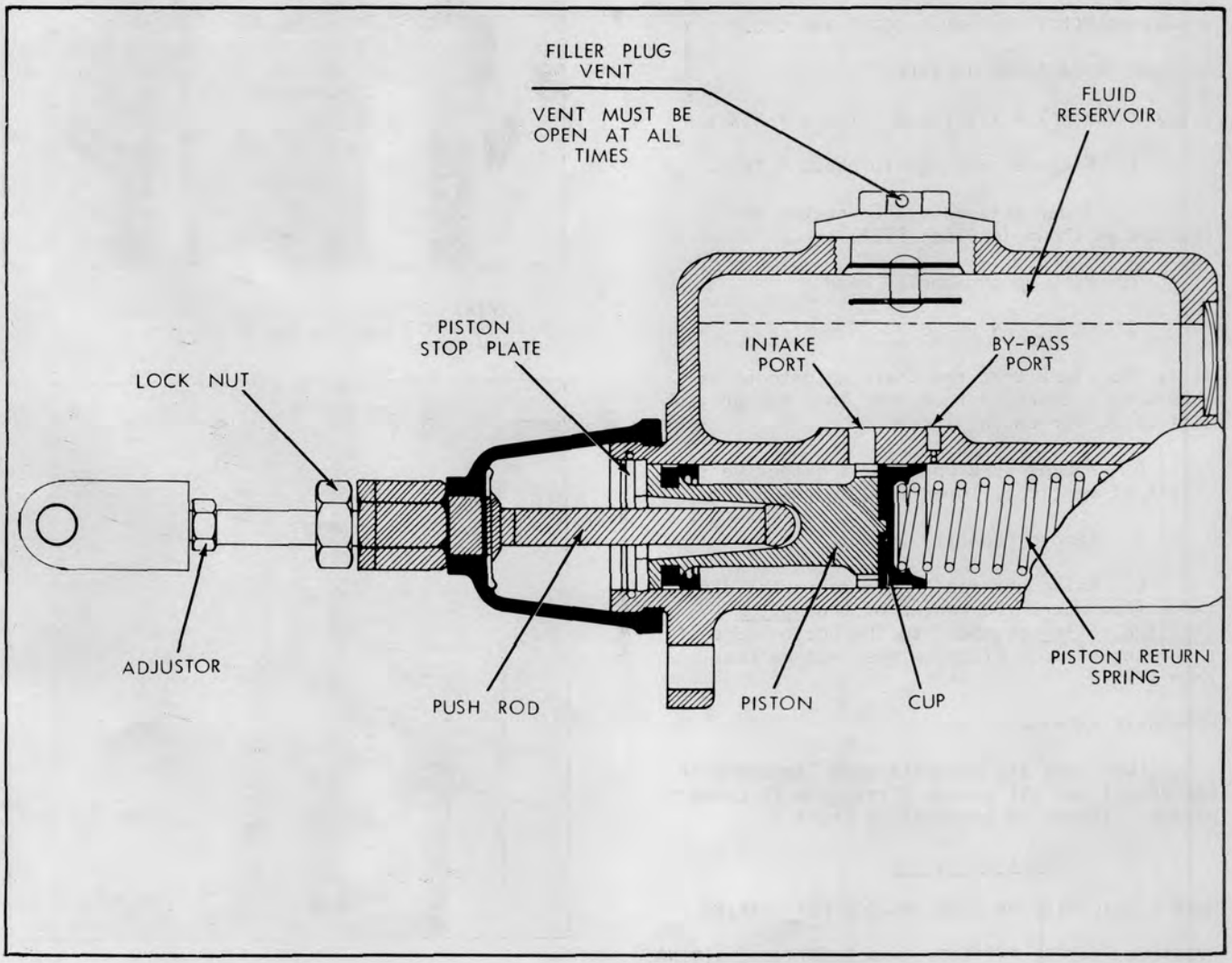


Plate 6633. Brake Pedal Adjustment

LIFT AND TILT CYLINDERS

Check for drift, leakage at packings, damage and security of mountings. (Anchor pivot pins, flanges and mounting rings.)

LIFT CHAINS

The lift chains are mounted to the chain anchors on the lift carriage and at the chain anchor rods near the lift cylinder piston head.

If it becomes necessary to adjust the lift chains, proceed as follows:

X X X X X X X X X X X X X X X X X X X X X X X

WARNING

KEEP CLEAR OF LOAD AND CARRIAGE WHEN MAKING ADJUSTMENTS TO AVOID INJURY IF ANY MALFUNCTION SHOULD OCCUR AND CAUSE LOAD OR CARRIAGE TO FALL.

X X X X X X X X X X X X X X X X X X X X X X X

1. Elevate carriage to about 4 feet.

2. Smear grease on the innerslide channel as shown in Plate 8622.

3. Pick up a capacity load.

NOTE

It is important that the chain adjustment be made with a capacity load. In this manner you will allow for chain stretch.

4. Making sure upright is either vertical or aft of vertical, lower load to the bottom.

5. Remove capacity load.

6. Raise carriage and measure the distance from where the center of the <u>bottom carriage roller</u> stopped, to the bottom edge of the inner slide. Distance must not be less than 1/2".

LUBRICATE MACHINE

Lubricate all miscellaneous linkage with SAE 20 oil and all grease fittings with chassis grease. (Refer to Lubrication Chart.)

<u>CAUTION</u>

WHEN LUBRICATING MACHINE INSPECT FOR LEAKING HYDRAULIC LINES, FITTINGS, AND ELECTRICAL WIRING.

HYDRAULIC CONTROL VALVE AND LINES

Inspect for damage, leakage and security of mounting.

LIFT BRACKET

Inspect for damage, bent forks, etc.

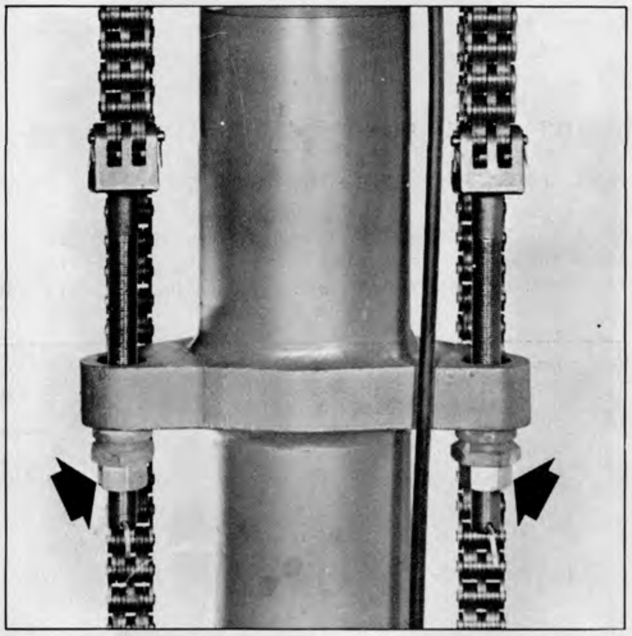


Plate 6634. Lift Chain Adjustment (Chain Anchor Rods)

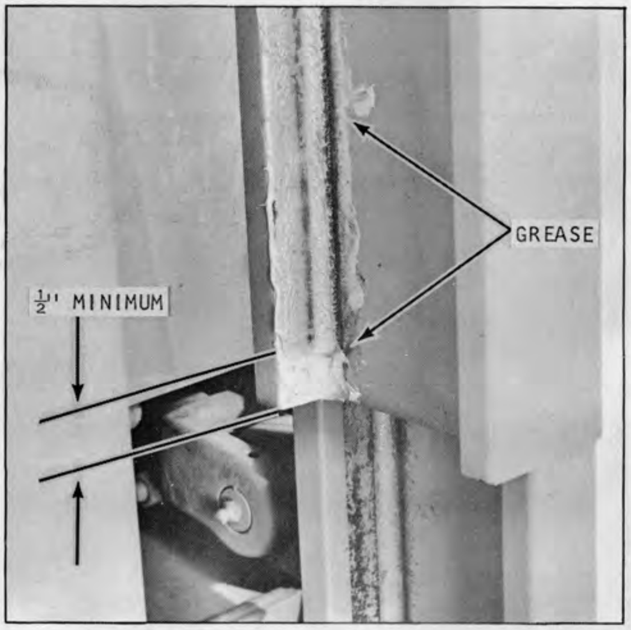


Plate 8622. Lift Chain Adjustment

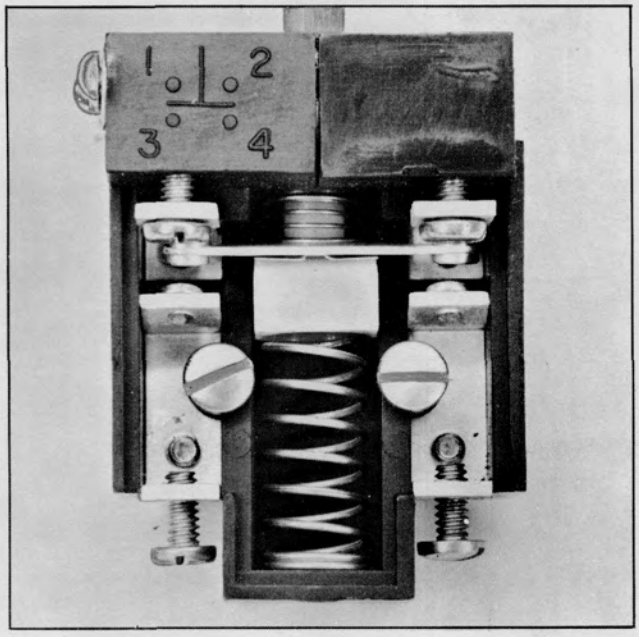


Plate 7443. Typical Pump Control Switch

PUMP CONTROL SWITCHES

The pump control switches are mounted at the valve spool end covers and are activated by movement of the valve spool.

SWITCH ADJUSTMENT

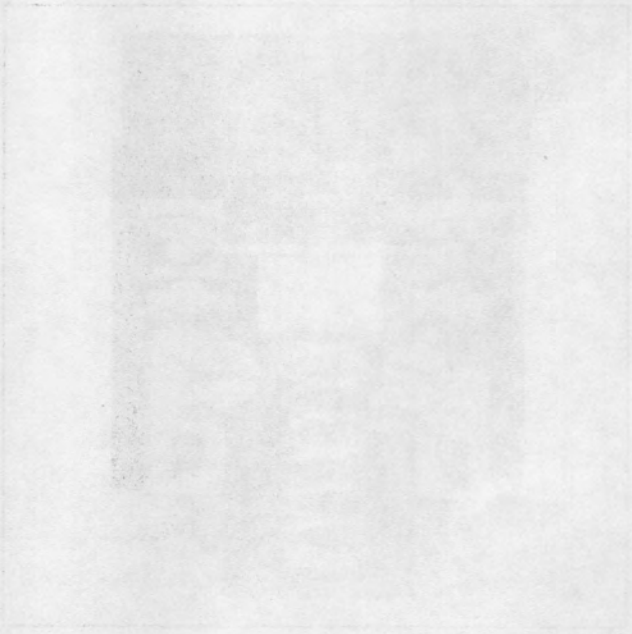
1. Loosen the two screws clamping switch to valve.

2. Position switch on spool end cover so that movable switch contacts are centered between stationary contacts. (Switch contacts are viewed thru clear plastic cover on switch.)

N O T E

ADJUSTMENT OF SWITCHES MUST BE MADE WITH VALVE SPOOL IN NEUTRAL POSITION.

3. After correct adjustment is obtained tighten switch clamping screws.



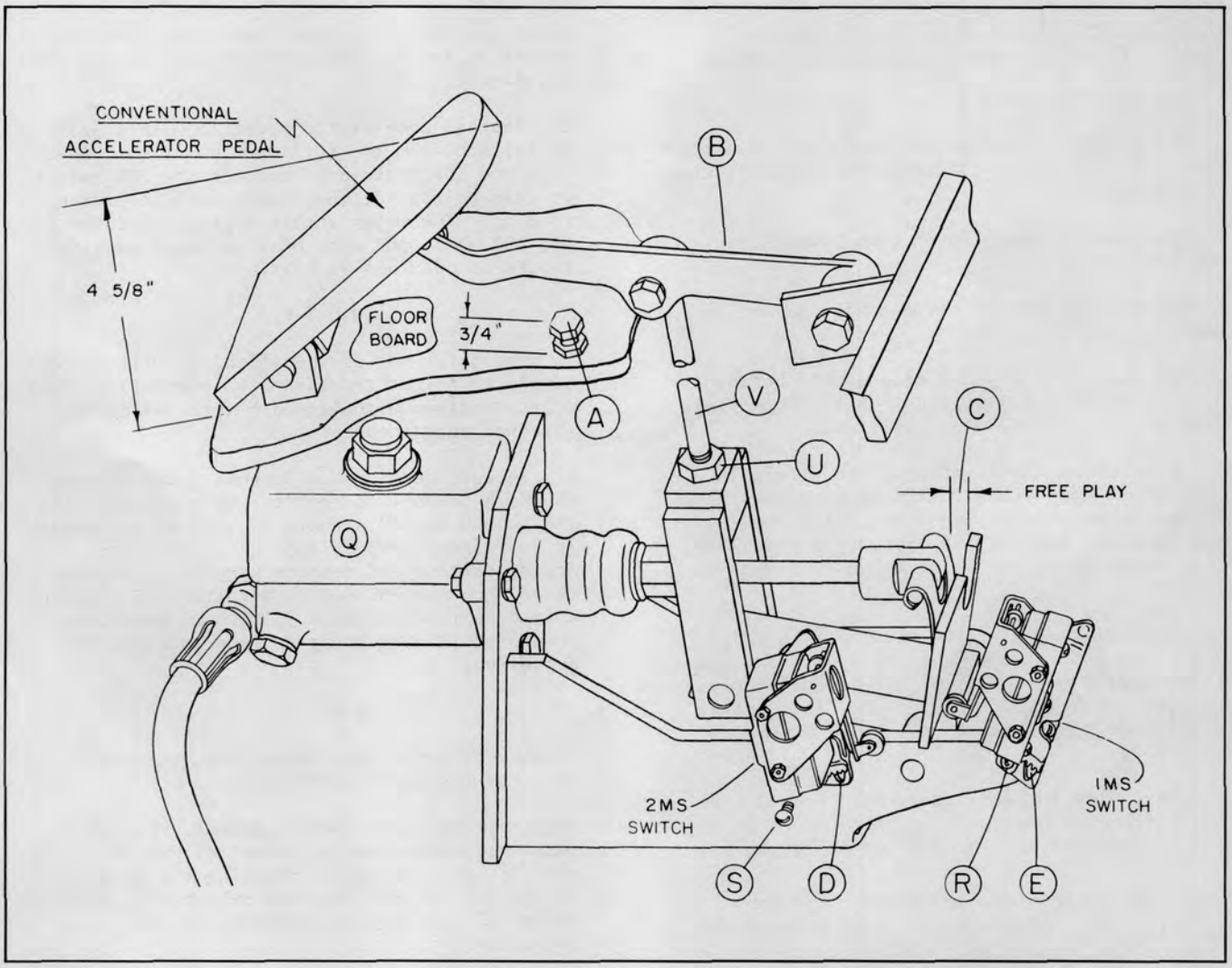


Plate 7551. First Point of Power Switch Adjustment
2MS Switch Adjustment
Accelerator Pedal Adjustment

CARBON PILE CONTROL ADJUSTMENTS

First Point of Power Switch Adjustment

Loosen screws (item R). Insert screwdriver into slot (item E). Turn screwdriver to adjust switch. Normally open switch contacts must open within freeplay (item C). Switch must be adjusted to open contacts when freeplay gap is 1/8 ". Tighten screws (item R).

2MS Switch Adjustment

(CAUTION: Make pedal height and stop adjustment as outlined above before proceeding). Loosen screw (item S). Insert screwdriver into slot (item D). Turn screwdriver to adjust switch. Normally closed switch contacts must open when accelerator pedal is $\frac{1}{2}$" from accelerator stop bolt (item A). Tighten Screw (item S).

Accelerator Pedal Adjustment

Loosen nut (item U). Detach accelerator rod (item V) from accelerator lever (item B). Adjust accelerator rod up or down to obtain the 4 - 5/8 dimension shown. Check dimension after reassembly of accelerator rod to accelerator lever. Tighten nut. Adjust stop bolt (item A) to 3/4 inch dimension as shown.

EC, ECSV-50-60-70 SOLID STATE CONTROL
ACCELERATOR SWITCH AND POTENTIOMETER CHECKS:

N O T E

If any of the following checks are not as specified, refer to the adjustment procedures in the next column.

1. Disconnect wire 37 from card 1 which is terminal No. 3.

2. Connect an ohmeter between wire 37 and negative wire 16.

3. The accelerator pedal stop should be adjusted so that the pedal is parallel to floor plate when pedal is in the down position.

4. Upon depressing accelerator pedal within 3/16 of an inch of the full down position, the 2MS switch must actuate and the meter reading must register between 300 ohms and 0 ohms (300 MAX., desired setting is as close to 0 ohms as possible).

5. Depressing accelerator pedal a MAX of 1/4 of an inch must actuate the 1MS switch and the meter reading must register between 3,500 ohms and 5,000 ohms (5,000 MAX., 3,500 MIN.; should be adjusted to actuate as close to maximum as possible).

6. When releasing the accelerator pedal, the 1MS switch must switch off either before or just as the pedal reaches the full up position.

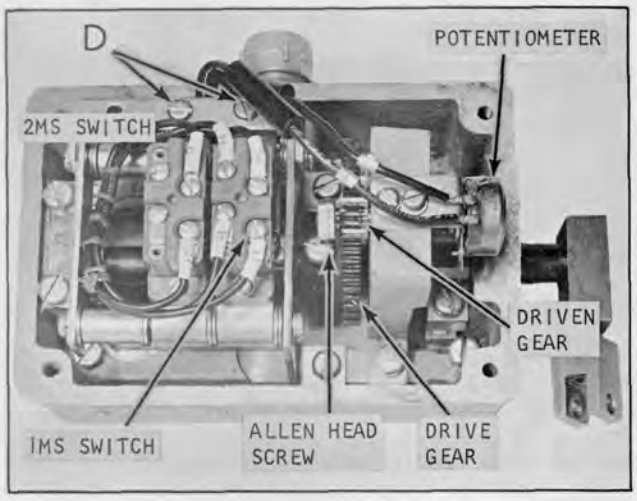


Plate 8940. Accelerator Box

ACCELERATOR SWITCH AND POTENTIOMETER ADJUSTMENTS:

1. Remove cotter pin from rod (B) and pull rod free of accelerator pedal, then...Loosen lock nut and rotate pedal stop bolt (A) to position pedal parallel with the floor plate. Pedal should be in the down position when making this adjustment.

2. Depress accelerator pedal to within 3/16 of an inch from the full down position. Adjust rod (B) to trip or actuate the 2MS switch at this point. At this time check the meter reading. The meter should register between 0 and 300 ohms (300 ohms MAX., a lower reading should be obtained if possible).

N O T E

If reading is not as specified, it will be necessary to adjust the assembly internally. However, continue with Step 3 before making any internal adjustment.

3. Release pedal. Now depress pedal no more than 1/4 of an inch from the up position. The 1MS switch should actuate as soon as the pedal is depressed. Adjust rod (C) as required. Again, release and depress pedal. Check ohmmeter when the 1MS switch actuates. The meter should register between 3,500 ohms and 5,000 ohms with 1MS actuating as soon as pedal is depressed.

N O T E

A high reading is desireable but must not be over the maximum of 5,000 ohms.

After making the above adjustment, release pedal and note to be sure the 1MS switch switches off upon pedal reaching the up position. If the 1MS does not switch off, lengthen rod (C) but only as required for the 1MS to switch off.

2A. If reading was not as specified in Step 2 (300 ohms MAX., to 0 ohms), loosen allen head screw and pull driven gear outward (do not disengage driven gear from drive gear) enough to rotate potentiometer shaft with a pair of long nosed pliers. Rotate shaft to obtain lowest reading possible (adjust so that the 2MS switch will actuate as close to 0 ohms as possible). Install driven gear, secure with screw and check adjustment as outlined in Step 4 and Step 5 "Accelerator Switch and Potentiometer Adjustment Checks".

3A. If reading was not as specified for the 1MS switch when checking the adjustments as stated in Step 2A above, then it will be necessary to readjust the potentiometer shaft (adjust for highest reading possible (3,500 ohms to 5,000 ohms MAX.). Install driven gear, secure with screw and check complete adjustment as outlined in Step 4 and 5. If readings are still not obtainable, then the switches will have to be adjusted and the complete adjustment sequence as stated above will have

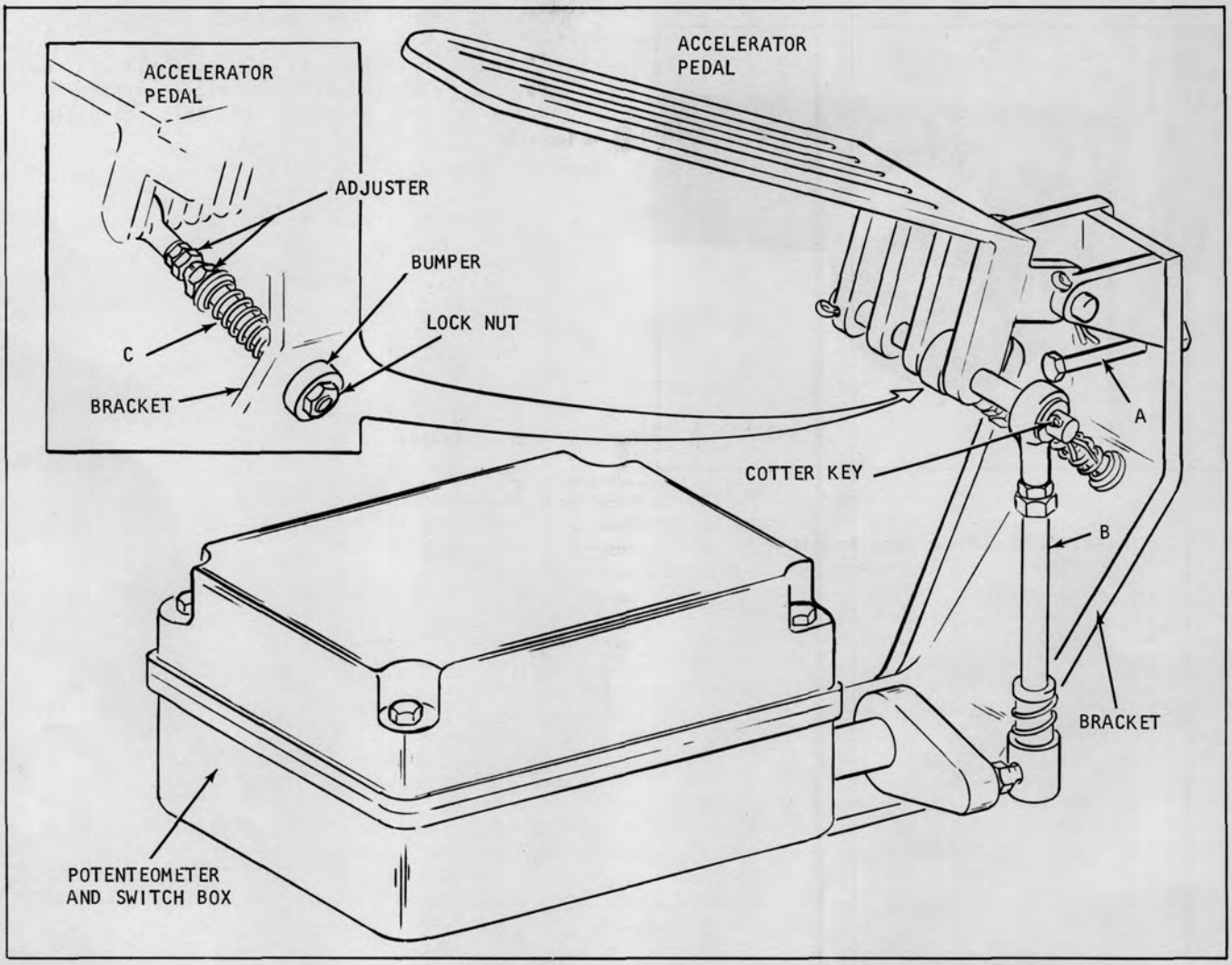


Plate 8941. Accelerator Adjustments

to be repeated.

SWITCH ADJUSTMENT:

If the 1MS switch does not actuate as soon as the accelerator pedal is depressed (must actuate within maximum pedal travel of 1/4 inch) and/or the 2MS switch does not actuate within 3/16 inch of full pedal travel, loosen locknut on screw (D) and adjust screw to obtain correct adjustment. Secure adjustment with locknut. Now repeat Steps 2 thru 3A to obtain correct readings.

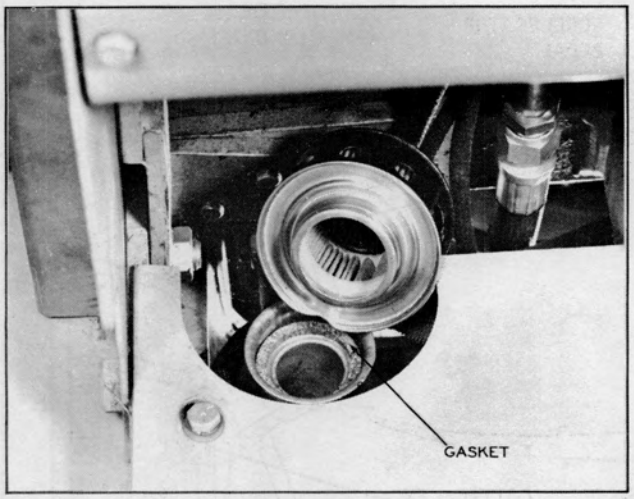


Plate 6586. Sump Tank Breather

HYDRAULIC SUMP TANK BREATHER

Check breather to be sure it is not dirty or clogged with foreign matter. Install a new breather if this condition exists.

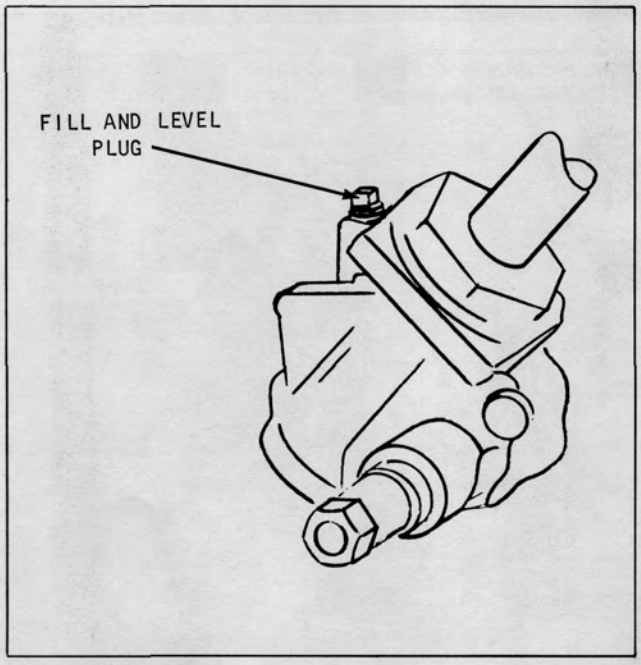


Plate 6429. Steering Gear

STEERING GEAR

The gear lubricant level should be checked every 100 operating hours and filled if necessary with NLGI #1 (Amolith grease EP #1 or its equivalent). Fill to level of filler plug opening only. Replace plug after filling.

N O T E

Before removing fill/level plug, be sure to wipe all dirt from around the plug and opening.

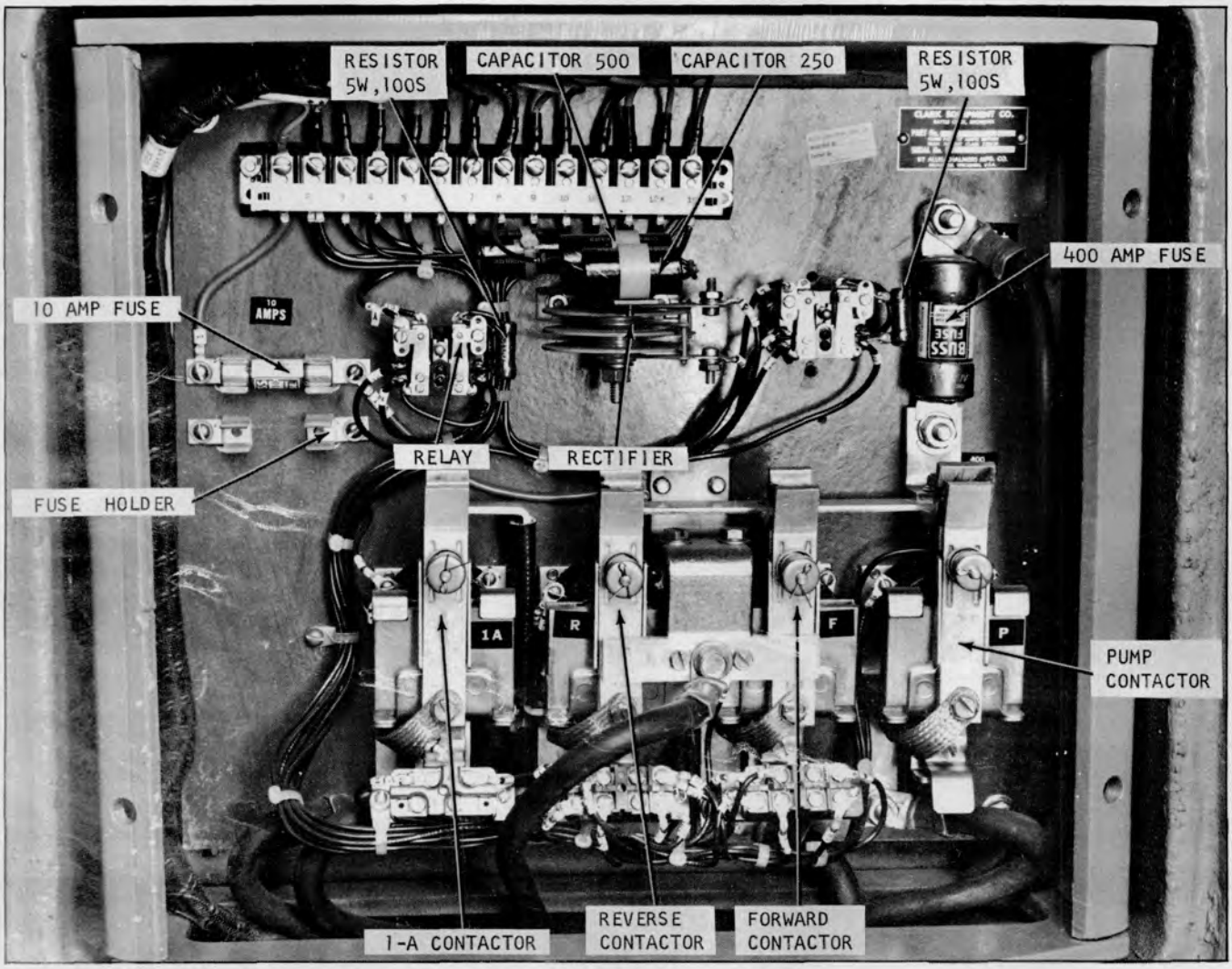


Plate 7213. Contactor Panel

CONTACTOR PANEL
(See Plate 7213)

(1) Darkening of contacts does not indicate burning; this darkening is normal. Burning is judged by actual loss of contact material or droplets of molten contact material being displaced. The contact itself may be used until the contact material has been almost completely worn away; however, it is sometimes advisable to replace tips when, in the opinion of the "maintenance department", there is not enough tip material remaining to last until the next regular maintenance check. The silver alloy portion of the tip is usable contact material. The remainder is unusable "copper" and serves as a backing for the tip.

(2) Contacts should not be filed for the purpose or removing discoloration or minor surface irregularities. Such action wastes contact material and introduces contact surface which is susceptible to sticking. A discolored appearance is normal in the proper operation of the contact. Occasionally a cone and crater may develop. To insure continuous service of such contacts, remove the "cone" only with a file - Do Not use sandpaper or emery cloth - but avoid any further filing.

N O T E

BEFORE MAKING THE FOLLOWING ADJUSTMENT CHECKS, DISCONNECT BATTERY AT RECEPTACLE.

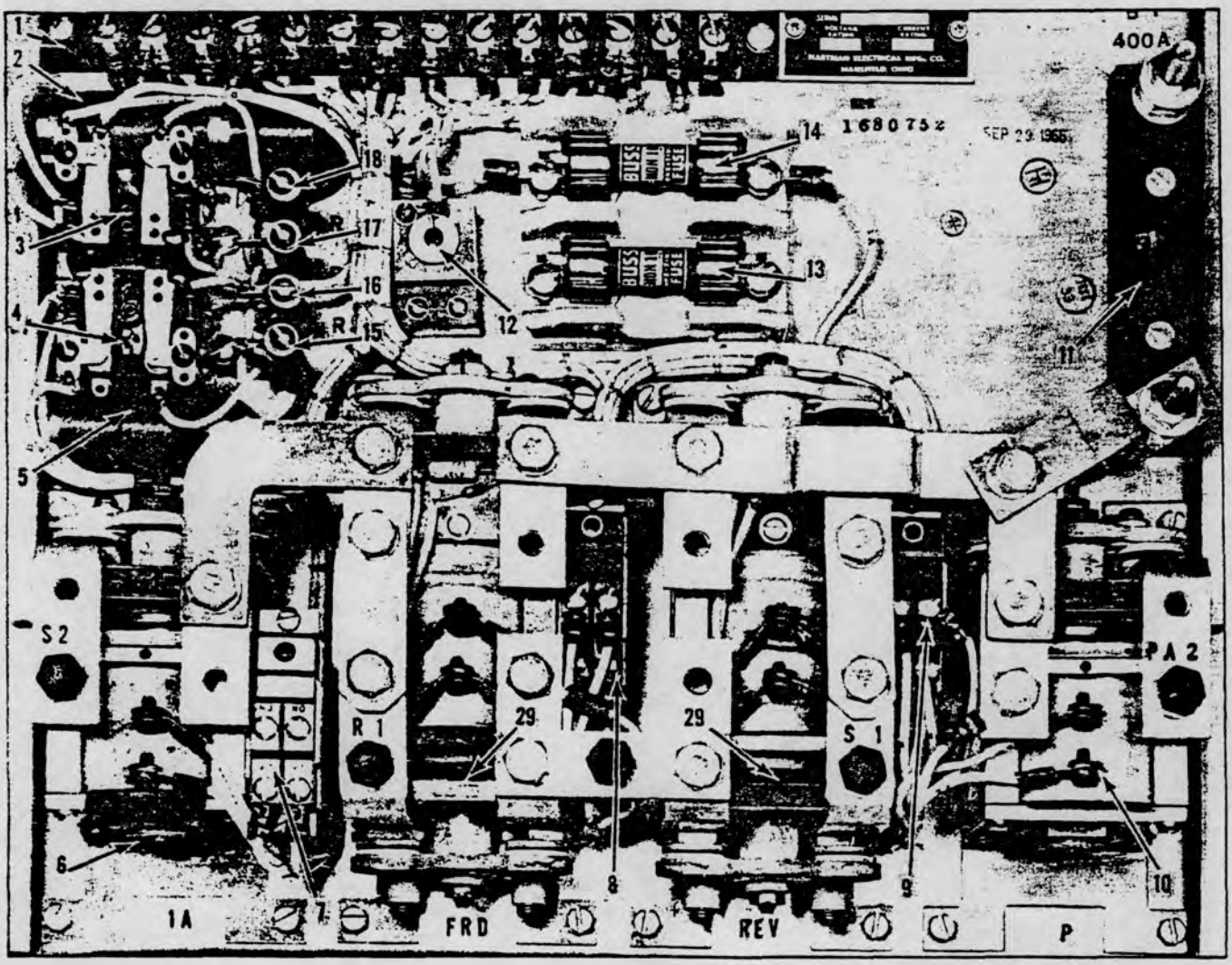


Plate 9220. Hartman (Control) Contactor Panel (Machines so Equipped)

REFER TO PAGE TS 862 THRU TS 870 FOR MAINTENANCE, ADJUSTMENTS, AND TROUBLE SHOOTING PROCEDURES.

PANEL SPECIFICATIONS ARE LOCATED ON PAGE TS 870 in rear of manual.

HARTMAN CONTACTOR PANEL*

*(MACHINES SO EQUIPPED)

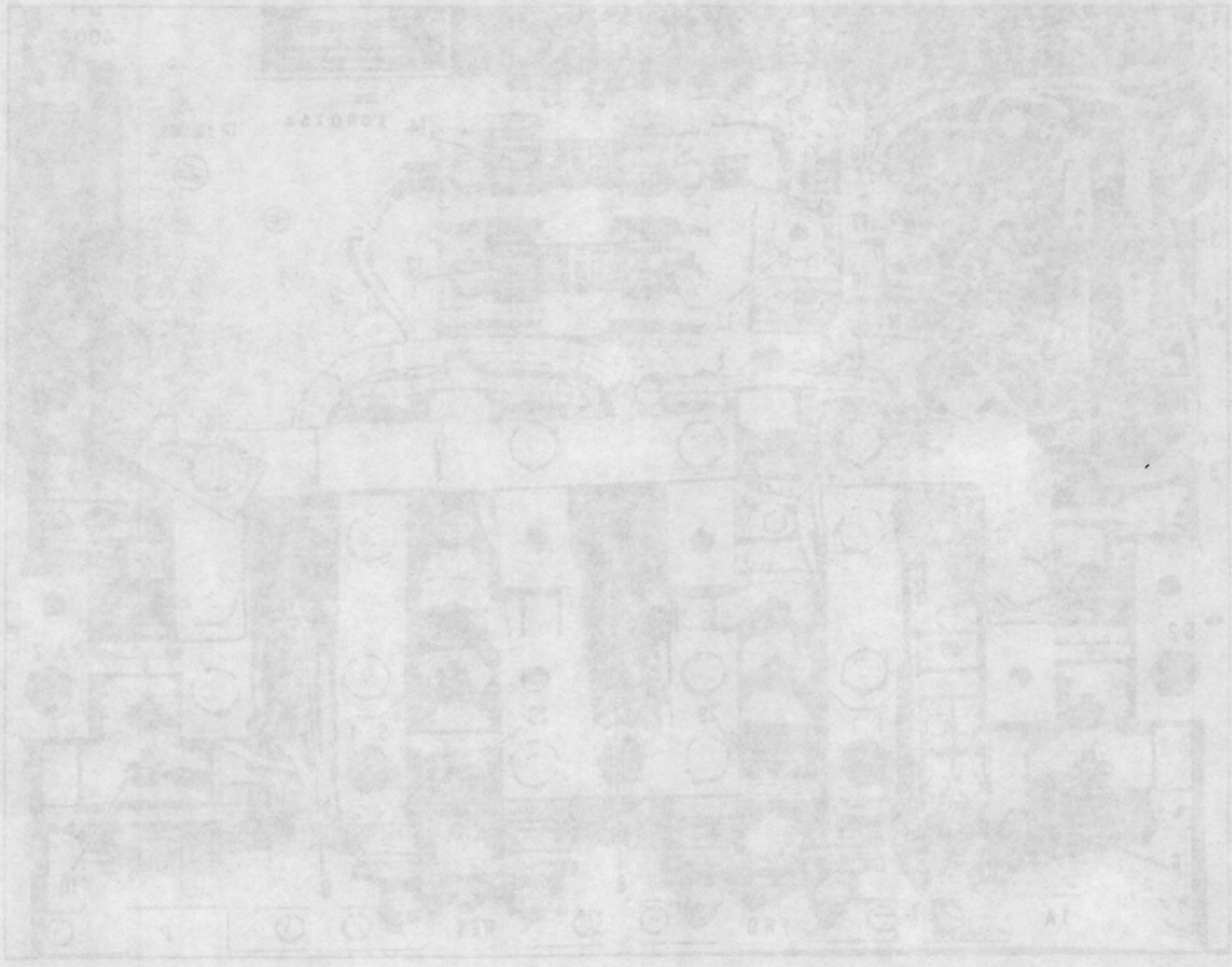


Plate 6599. Forward and Reverse Contactor Checks

(3) 1-A and Pump Contactors: (Refer to Plates 6600 and 6602 on the following pages). Contact gap at center or normally open contact tips should be 1/8" plus or minus 1/32". If adjustment is necessary, bend Armature Stops (designated by arrows on Plate 6600.) as required bend both stops equally.

(4) Forward and Reverse Contactors: (Refer to Plates 7213, 6599, 6600 and 6602). Contact gap at center of normally open contact tips should be 13/32" plus or minus 1/32". Normally closed contacts are automatically adjusted when normally open contacts are correctly adjusted. If adjustment is necessary, loosen Retainer Screws (45) and move Stationary Contact Support Bracket as required (bracket has elongated holes), see Plate 6599 and 6602. When correct adjustment is obtained, tighten retainer screws without moving support bracket.

(5) Switchettes: Switch contacts must actuate (operate) just after normally open contacts close, and deactuate just after normally open contacts open. Switch plunger must have .010" clearance to Tailpiece (2) when Armature (15) is open, see Plate 6599. Using screwdriver, push tailpiece towards panel, there should be .010" movement. Switch plunger must have .010" minimum overtravel left when Armature (15) is sealed, see Plate 6600. Using your finger or a wire hook, catch Tailpiece (2) and pull forward, as shown. If adjustment is correct, there will be .010" movement of

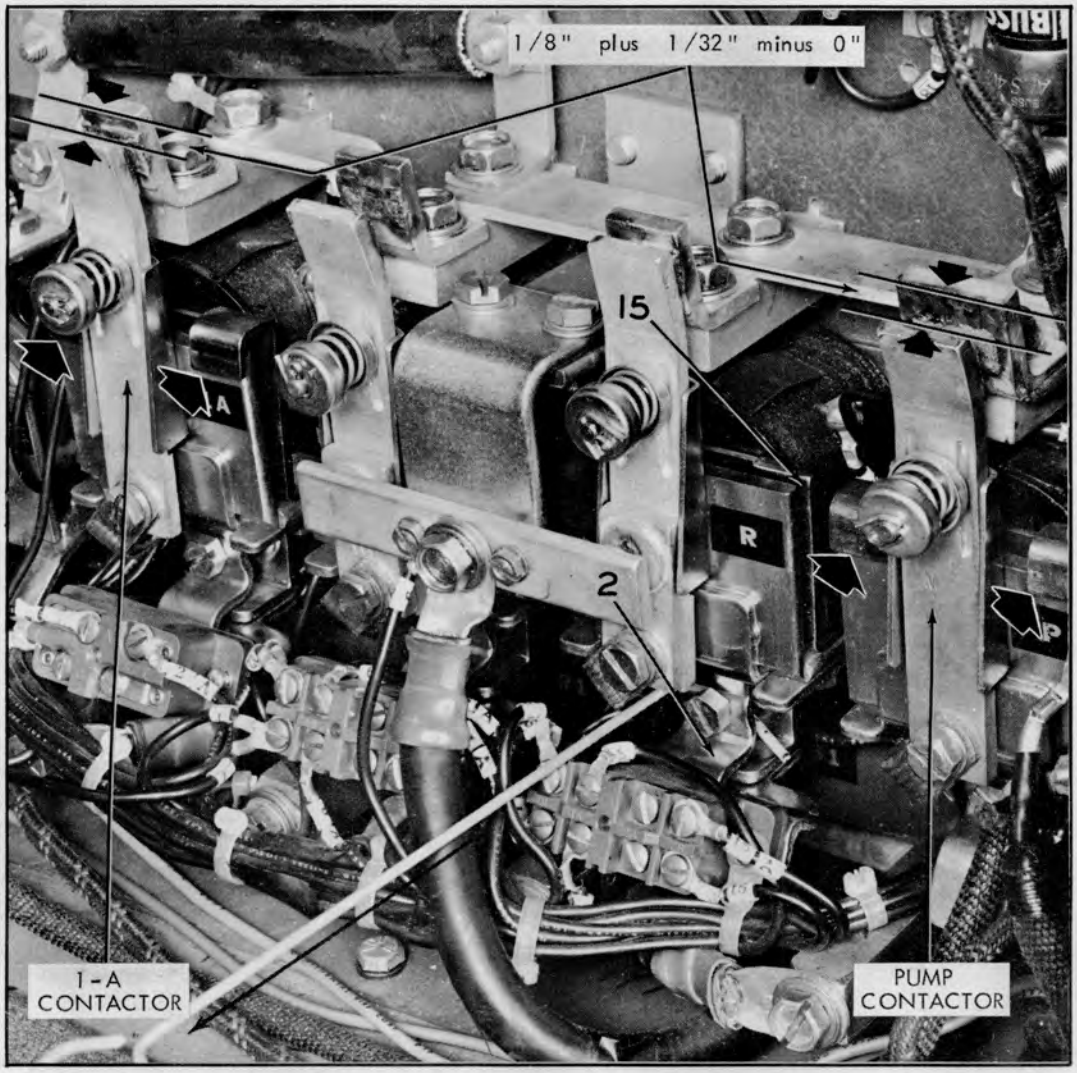


Plate 6600. Contactor Adjustment Checks

tailpiece thus there is .010" remaining switch stroke. If adjustment is necessary, bend Switch Bracket (11) as required. (See Plate 6602). Recheck switch adjustment. Switchettes must be securely mounted to prevent movement away from part used to depress switchette plunger. If the distance between part used to depress plunger and the plunger itself has increased, plunger may not be depressed far enough to open or close the circuit involved. The switchettes of the control circuit may be tested by disconnecting wires from terminals and touching "test wires" to the terminal screws while depressing "plunger" of switchette. BATTERY MUST BE DISCONNECTED DURING TEST. The switchettes on the contactors can be replaced by removing the electrical wires at the terminals on the switch and the mounting screws holding switchette to contactor. DO NOT ATTEMPT TO REPAIR A SWITCHETTE, REPLACEMENT IS NECESSARY.

(6) Return Spring Pressure: Spring Guide Screw (18) should protrude approximately 1/8" beyond end of Stop Nut (30), see Plate 6602. Calibrate spring so that not less than 2 1/2 lbs., and not more than 3 lbs., (measured at point "D") is required to move armature away from its backstop.

(7) Wiring Connections: Insulation of wiring must be maintained to prevent accidental grounding of circuit. Connections at all terminals must be kept secure to provide an electrically tight connection.

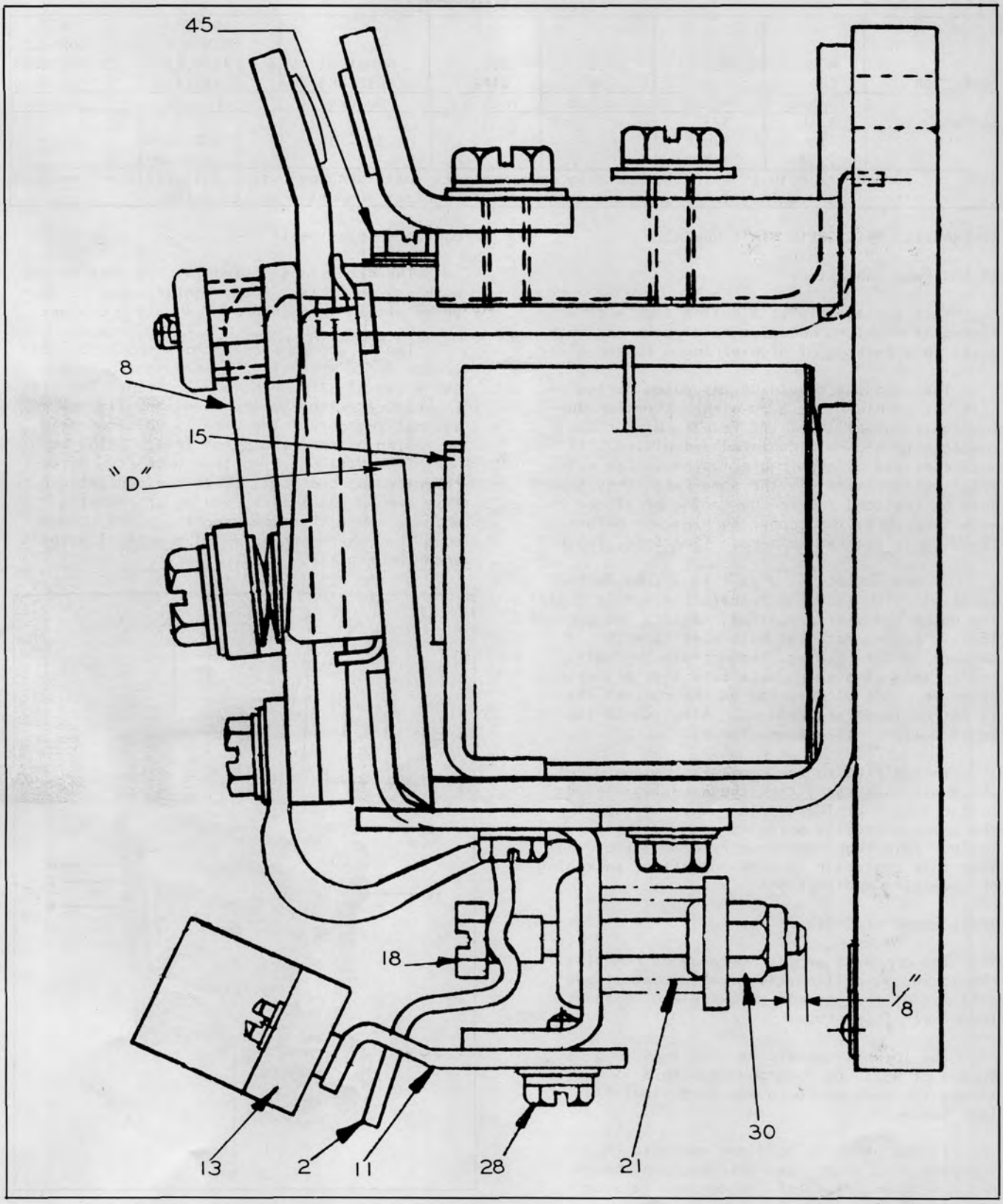


Plate 6602. Forward and Reverse Contactor Checks

-SPECIFICATIONS TABLE-

CONTACTOR	N.O. GAP	N.O. WIPE	N.C. GAP	N.C. WIPE	ARMATURE PRESSURE	N.O. CONTACT PRESSURE (INITIAL)	N.C. CONTACT PRESSURE (FINAL)
	Inches	Inches	Inches	Inches	Ounces	Pounds	Ounces
1A-Pump	3/16 to 7/32	3/32 to 1/8			35 ± 3	3 1/2 to 4 (See Note 1)	-
NOTE 1: (See Plate 8934.) With the normally open contacts just touching, use a pull scale and measure the force required to just separate the movable contact support from its guide.							

GENERAL ELECTRIC SOLID STATE CONTROL

1A And Pump Contactors

This contact tip is a button type with a facing of highly-conductive weld-resisting material on a backing of high-strength copper alloy.

The contacts should be inspected periodically but should require no other attertion during their normal life. It is natural for the contacts to become discolored and pitted. If both contacts of a pair are losing facing material at approximately the same rate, they should both be replaced before the facing of either is worn through to the copper backing, or before the wipe is reduced to zero. (See Spec. Table.)

If one contact of a pair is losing facing material which is being transferred and is building up on the mating contact, replace the contact that is losing material before it is worn through to the backing. When replacing only one contact of a pair, make sure that any high peaks or beads of material on the contact that is not replaced are removed. Also, check the contact wipe. (See Spec. Table)

In addition to the contact gaps and wipes, it is also necessary that the normally-closed contacts have at least 3/32 inches of gap at the point where the normally-open cantacts just touch. This requirement is extremely important when this contactor is used in battery switching or reversing applications.

Replacement of Contacts

The contacts can be replaced by removing the locknuts, pulling the movable-contact support out of the way and removing the contacts from their supports.

The locknuts should be tightened to a torque of 45 to 60 inch-pounds. This is the torque recommended for a standard steel 1/4-inch screw.

If you have replaced the contacts in accordance with these instructions, you should not have changed any of the contact gaps or wipes. However, you may wish to recheck these dimensions. See the section of this instruction on Contact Adjustments.

Contacts Adjustments

The dimensions listed in this section are with new contacts. Every contact must be centered within 1/16 inch of its mating contact.

The 1A and pump contactors should be adjusted for a wipe of 3/32 inch to 1/8 inch, and a gap of 3/16 inch to 7/32 inch. The wipe is measured with the armature manually seated against the core. The wipe is adjusted only by adding or removing shims (Plate 8935) beneath the stationary-contact support. After the wipe has neen set, check the contact gap. This can be adjusted by adding or removing washers under the armature-stop posts. Make sure that there are an equal number of washers under both posts.

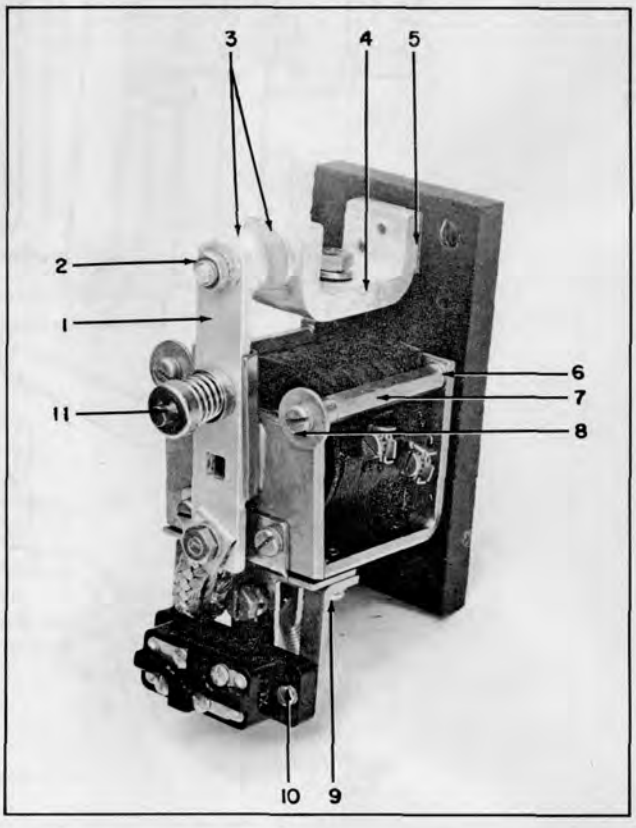


Plate 8935. Pump Contactor and 1A-Contactor With Interlock

Key to Plate 8935.

1 Movable contact support
2 Locknut
3 Contacts
4 Stationary contact support
5 Shims
6 Adjustment washer
7 Armature stop post
8 Armature stop
9 Interlock bracket screw
10 Interlock mounting screw
11 E-ring

Armature-Spring Adjustment(1A & Pump Contactor)

Measure the armature setting with a push scale at a point 1-3/4 inches from the fulcrum (point E, Plate 8937).. Apply the force perpendicular to the armature. Measure the force required to just move the armature away from its backstop (Plate 8935). If the interlock operator (Plate 8937) is touching the interlock plunger (Plate 8937) at the point when the normally llosed contacts just part, an accurate reasing cannot be made. If this ha happens, take off the interlock by removing the two mounting screws (Plate 8937) and check the force with the interlock removed.

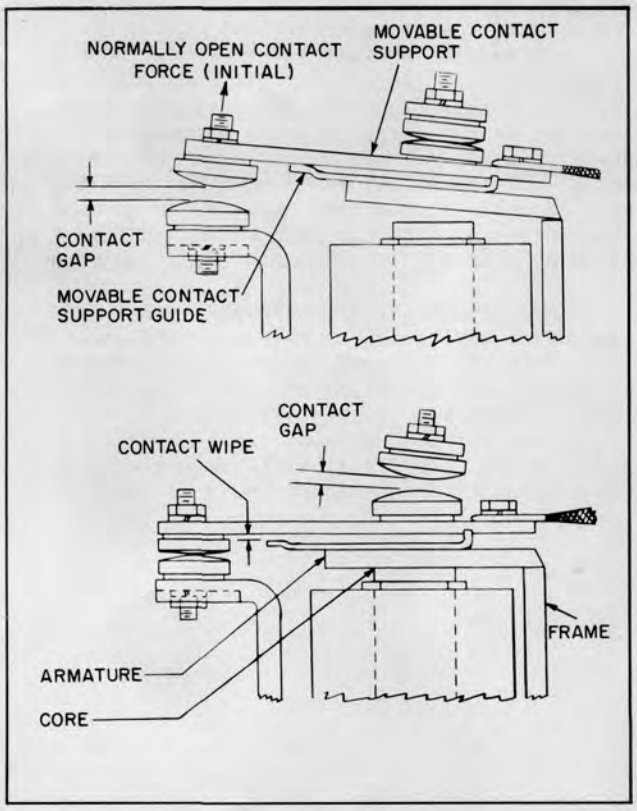


Plate 8934. Contact Adjustment

The force should agree with the values given in Specification Table. If it does not, adjust the armature-spring setting by holding the spring-adjust locknut and turning the adjusting screw. After adjusting, be sure that the rocker is properly seated in the pivot slots in the interlock operator.

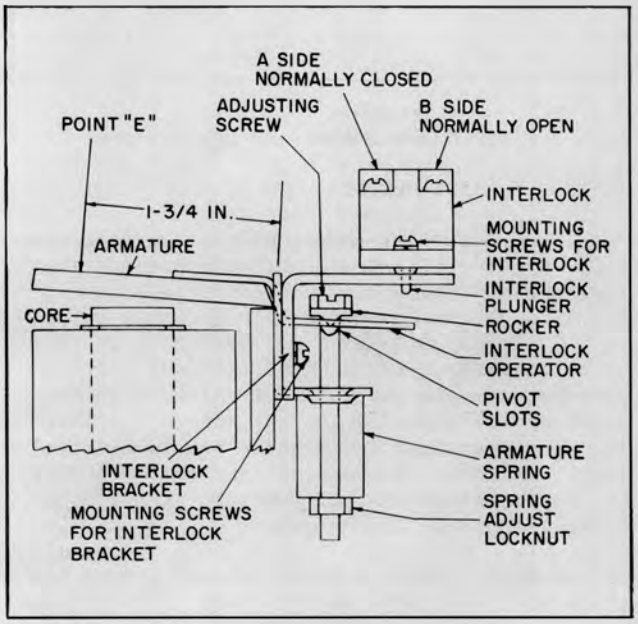


Plate 8937. Armature-spring & Interlock Assembly

Electrical Interlocks

The interlocks are snap-action type switchettes. The circuits marked A are normally closed and those marked B are normally open. (Plates 8938-8939). Polarity must be in accordance with these two plates.

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

Interlock Replacement

To replace a defective interlock, remove the mounting screws located on the interlock. Make sure the letters A and B or 1A, 1B, 2A and 2B (Plates 8938-8939) are in the same order as on the interlock that was removed. Replacing the interlock in this manner should not have disturbed any of the interlock adjustments.

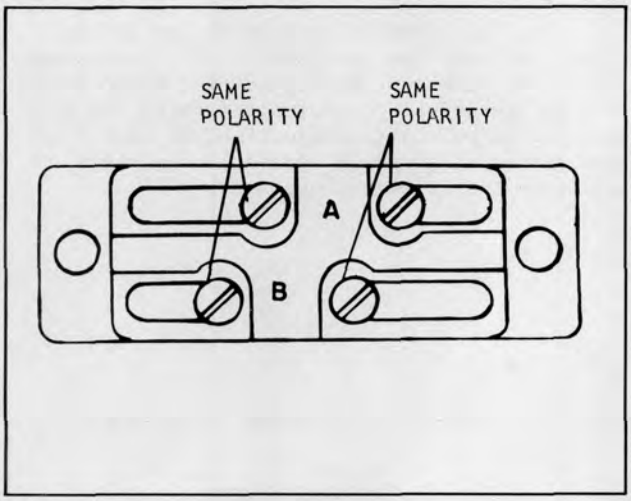


Plate 8938. Interlock Connections

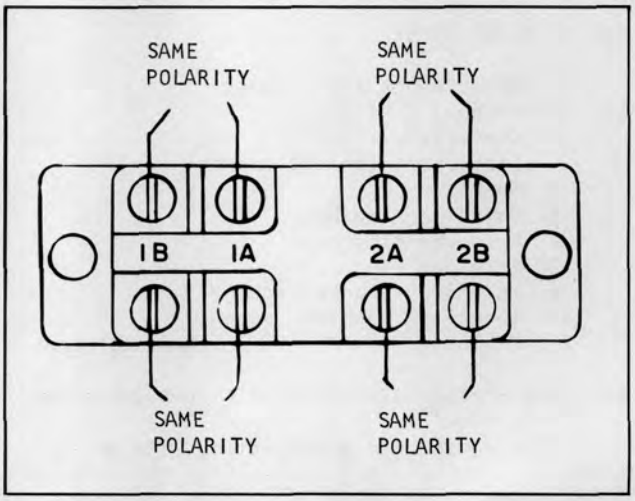


Plate 8939. Interlock Connections

INTERLOCK ADJUSTMENTS

The electrical interlock must operate with a 0.015-inch thick feeler or shim between the armature and the core. Listen for a snapping noise to determine if the interlock has operated. Furthermore, with a 0.015-inch thick feeler between the interlock operator and the plunger, the plunger must not bottom with the armature fully seated against the core. That is, make sure that the plunger has some travel left. If these requirements are not met, loosen the interlock-bracket mounting screws and slide the bracket in or out.

Before loosening these screws, remove the shunt bolt which clamps the shunt to the lower connection strap, and hold the shunt away from the electrical-interlock-bracked mounting screws. This protects the shunt from damage while making adjustment. Tighten screws and replact shunt bolt.

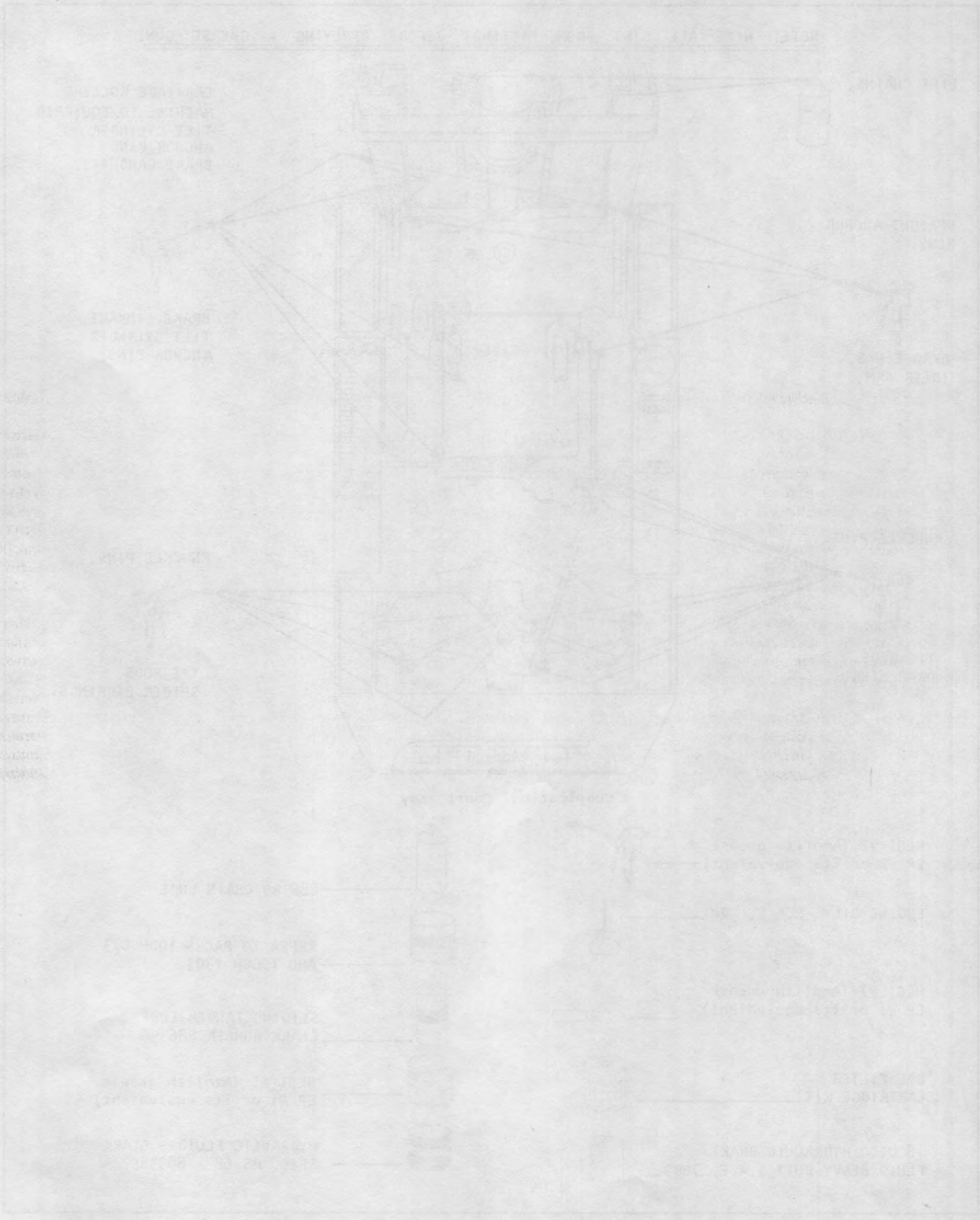
COIL REMOVAL (Pump and 1A Contactor)

First, remove the armature and interlock assembly by removing the two screws (Plate 8935). Next, remove the armature stops from the armature-stop posts.

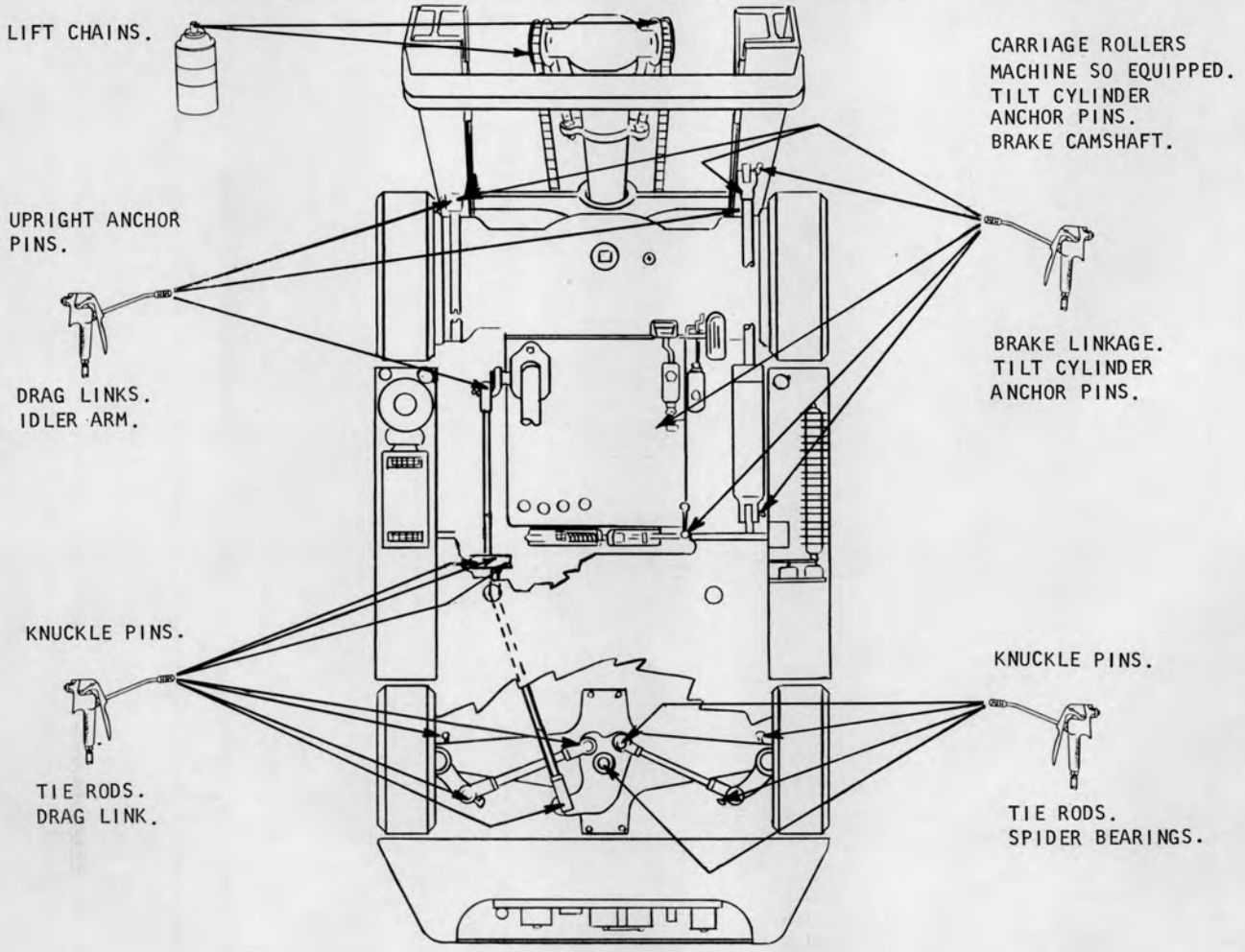
The retaining ring holding the coil can then be removed with a "spreader" tool. If this is not available, slip a screwdriver under one of the tips of the retaining ring and pry up by twisting outward. The tip should spring out of the slot in the core. Work the screwdriver around the ring, prying up until the ring is free. The coil may then be removed and replaced.

To replace the retaining ring without a "spreader" tool, force the coil down until one tip to the retaining ring can be pushed into the slot in the core. Using a screwdriver, press this tip in toward the center of the core and hold it down. At the same time, work the rest of the ring over the head of the core. The retaining ring can then be worked into place by pressing it down with the screwdriver.

Reassemble the armature and interlock assemblies and the armature stops. If this instruction is followed carefully, there will be needed only to adjust the electrical interlock as described in this instruction. However, the contact gap, wipe and alignment as given in the Specifications Table and the section on Contact Adjustments should be checked.



NOTE: WIPE ALL DIRT FROM FITTINGS BEFORE APPLYING A GREASE GUN.



Lubrication Chart Key

NLGI #2 (Amolith grease EP #2 or its equivalent)

ENGINE OIL: S.A.E. 20

NLGI #1 (Amolith grease EP #1 or its equivalent)

OIL FILTER CARTRIDGE KIT

1800200 HYDRAULIC BRAKE FLUID HEAVY DUTY S.A.E. 70R3

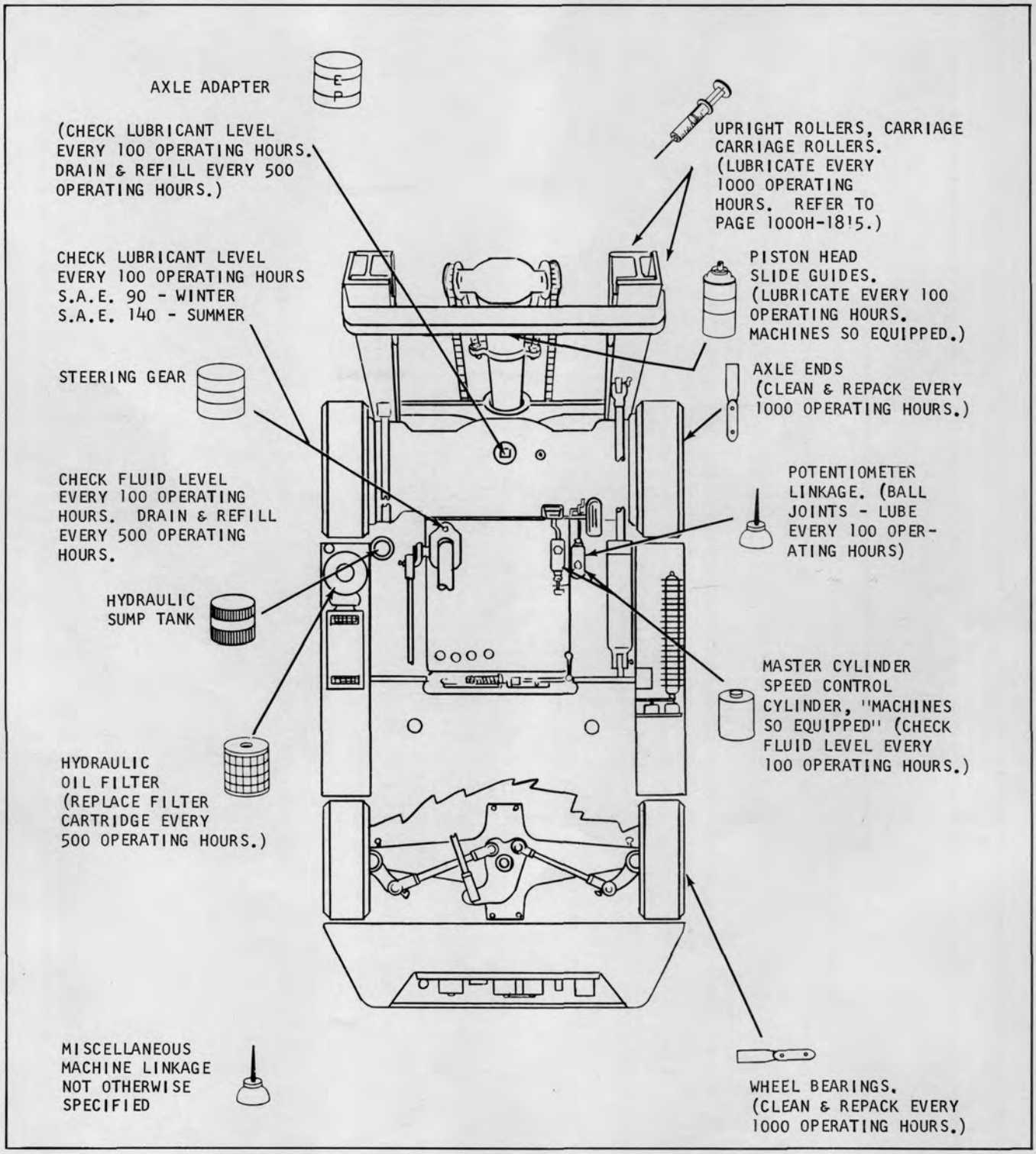
886399 CHAIN LUBE

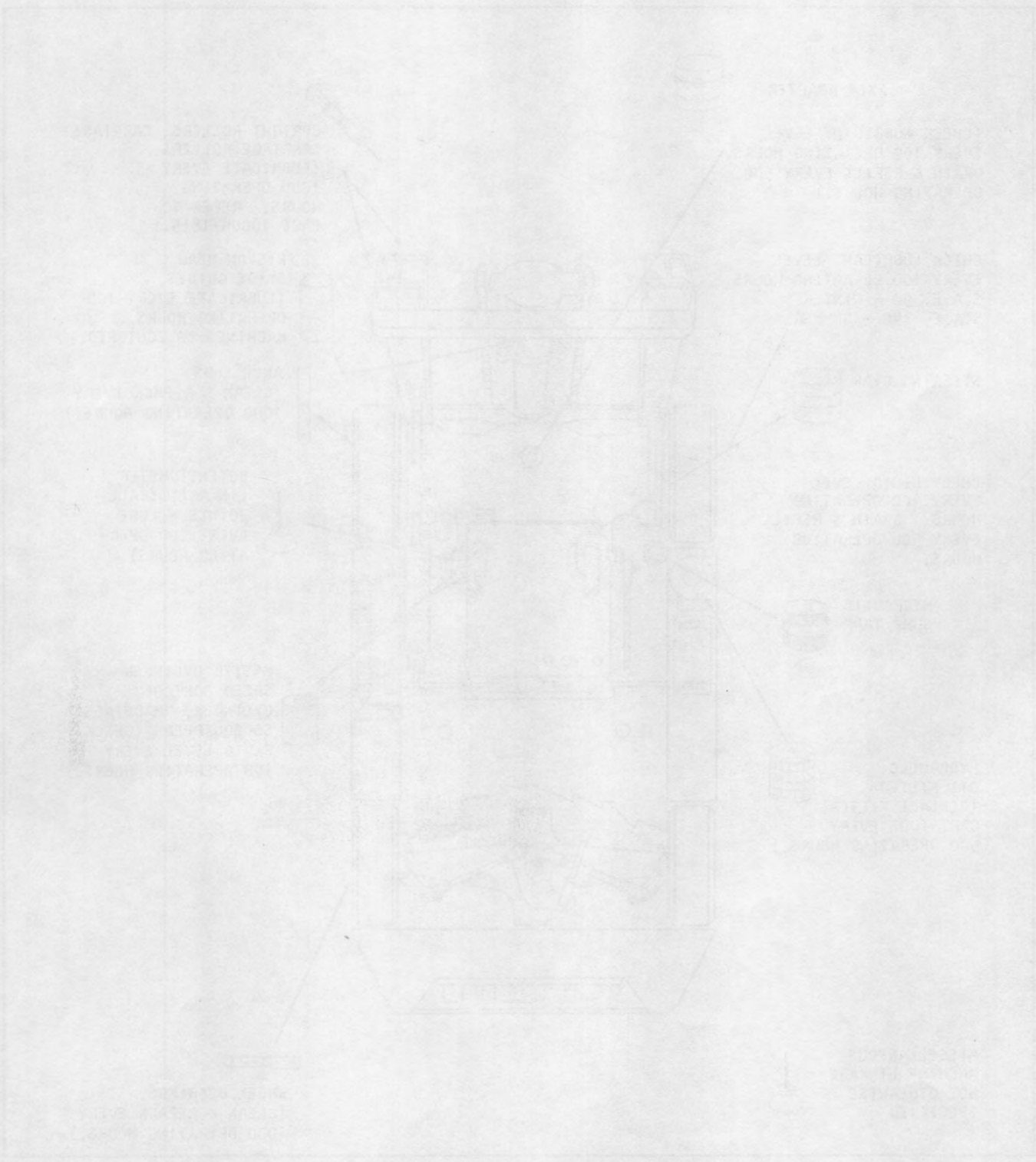
REFER TO PAGES 100H 073 AND 1000H 1303

SLIDING TANDEM LUBE CLARK NUMBER 886396.

NLGI #1 (Amolith grease EP #1 or its equivalent)

HYDRAULIC FLUID - CLARK SPEC. MS-68 885385


AXLE ADAPTER
E
P
(CHECK LUBRICANT LEVEL EVERY 100 OPERATING HOURS. DRAIN & REFILL EVERY 500 OPERATING HOURS.)
UPRIGHT ROLLERS, CARRIAGE CARRIAGE ROLLERS. (LUBRICATE EVERY 1000 OPERATING HOURS. REFER TO PAGE 1000H-18¹5.)
CHECK LUBRICANT LEVEL EVERY 100 OPERATING HOURS S.A.E. 90 - WINTER S.A.E. 140 - SUMMER
PISTON HEAD SLIDE GUIDES. (LUBRICATE EVERY 100 OPERATING HOURS. MACHINES SO EQUIPPED.)
STEERING GEAR
AXLE ENDS (CLEAN & REPACK EVERY 1000 OPERATING HOURS.)
CHECK FLUID LEVEL EVERY 100 OPERATING HOURS. DRAIN & REFILL EVERY 500 OPERATING HOURS.
POTENTIOMETER LINKAGE. (BALL JOINTS - LUBE EVERY 100 OPERATING HOURS)
HYDRAULIC SUMP TANK
MASTER CYLINDER SPEED CONTROL CYLINDER, "MACHINES SO EQUIPPED" (CHECK FLUID LEVEL EVERY 100 OPERATING HOURS.)
HYDRAULIC OIL FILTER (REPLACE FILTER CARTRIDGE EVERY 500 OPERATING HOURS.)
MISCELLANEOUS MACHINE LINKAGE NOT OTHERWISE SPECIFIED
WHEEL BEARINGS. (CLEAN & REPACK EVERY 1000 OPERATING HOURS.)



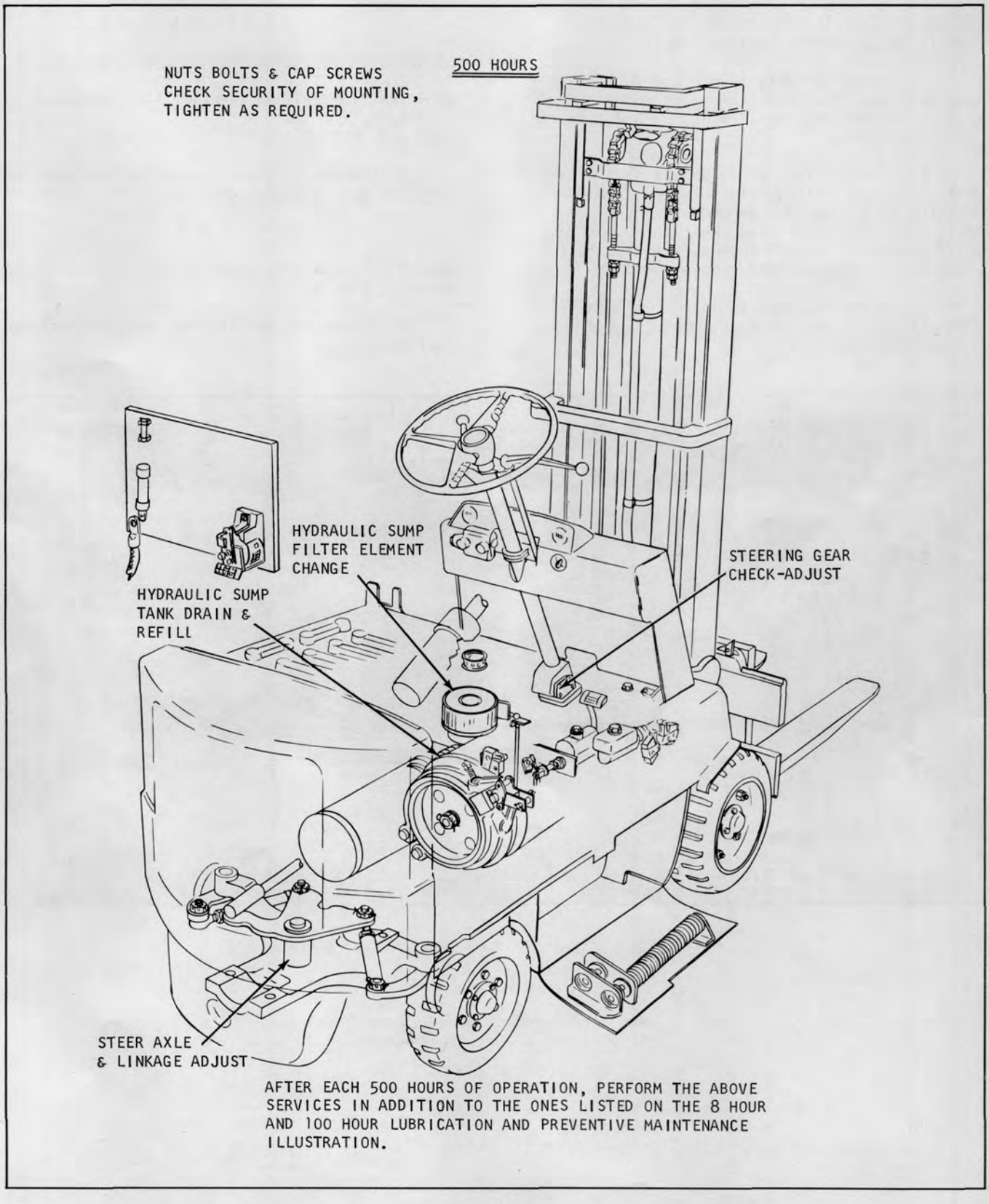


Plate 8927. Lubrication and Preventive Maintenance Illustration

HYDRAULIC SUMP TANK DRAIN AND FILTER CHANGE (SOLID STATE CONTROL EQUIPPED UNITS)

1. Lower upright, turn power switch off and open the left hand frame door to allow access to the sump tank drain plug and hydraulic filter.

2. Take a piece of cardboard or similar material about 6"X2', fold this in the middle vertically to form a V shaped trough, place this under the drain plug, rest the other end on a container large enough to hold the full capacity of the tank and remove the plug.

3. Allow the tank to drain completely. Then flush the tank with at least 2 quarts of clean hydraulic fluid.

C A U T I O N

DO NOT OPERATE THE HYDRAULIC PUMP WHILE THE SUMP TANK IS EMPTY AS DAMAGE TO THE HYDRAULIC PUMP WILL RESULT.

4. Remove filter assembly by disconnecting hose and removing retaining bolts.

N O T E

Remove any remaining gasket material from the mounting flanges.

5. Clean out any residue left in the sump cavity.*

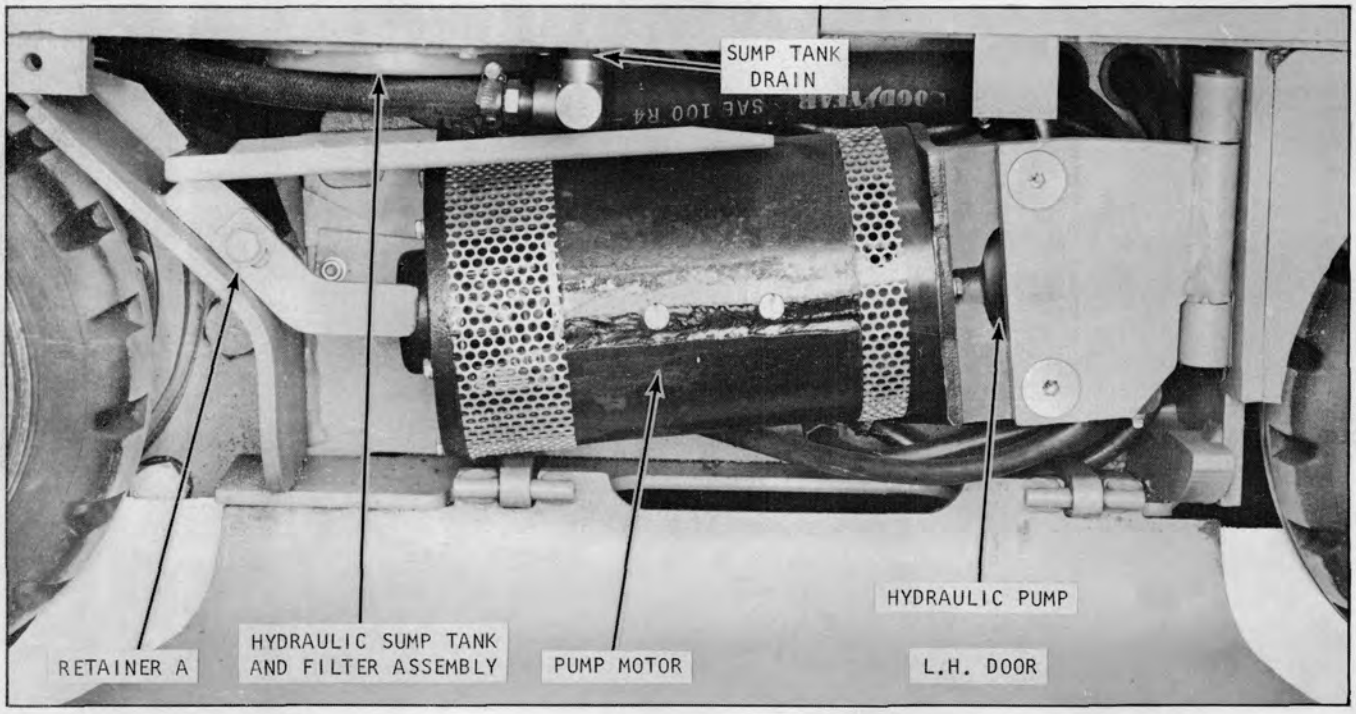


Plate 8930. "Typical" Sump Tank, Filter & Pump

N O T E

*Continue on page 500H-174 for remainder of draining and filling proceedure.

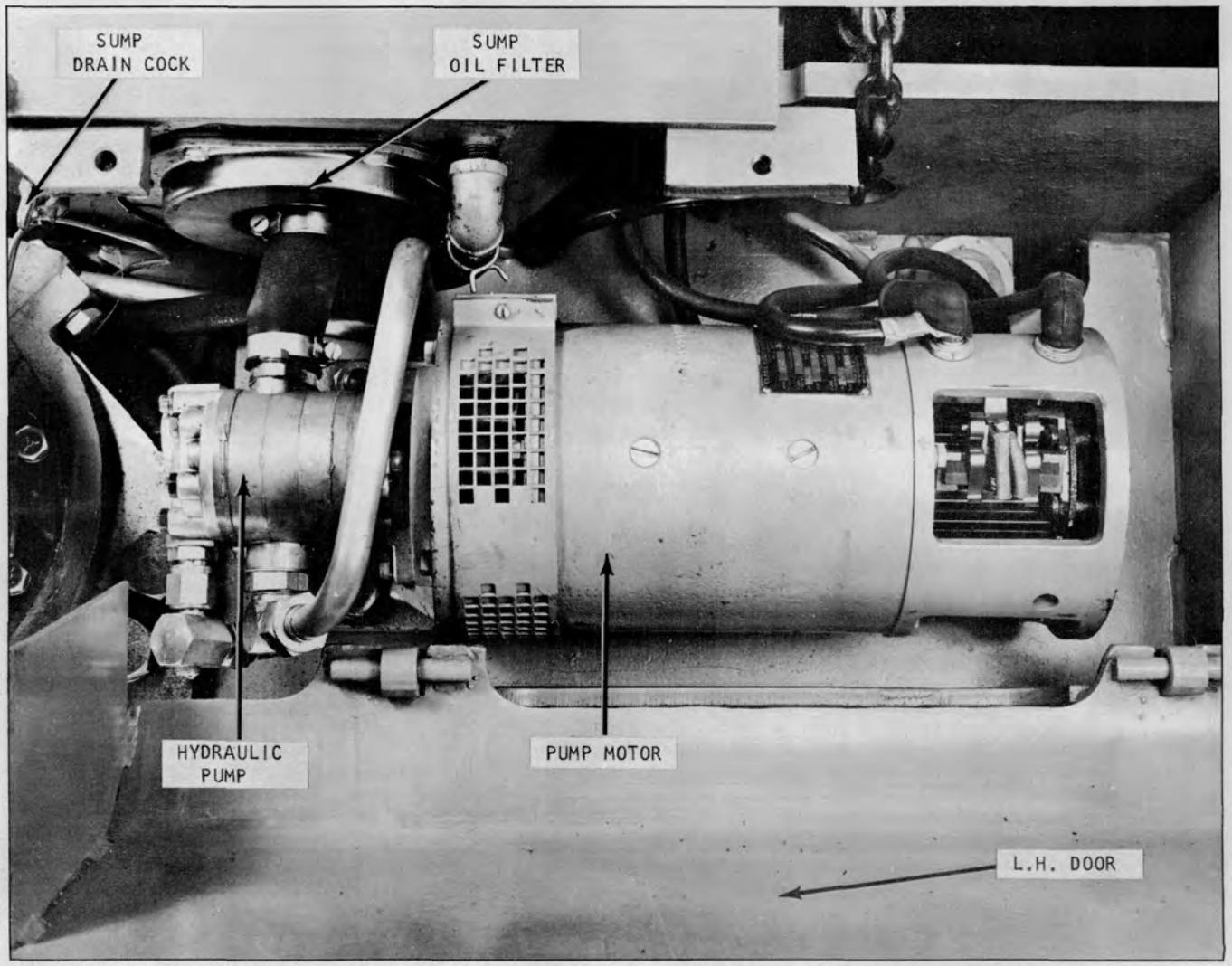


Plate 7067. Sump Tank, Filter and Pump

SUMP TANK DRAIN AND HYDRAULIC FILTER ELEMENT CHANGE

1. Lower upright. Turn power switch to the off position.

2. Open the L.H. frame door to allow access to the sump tank drain plug or drain cock and the hydraulic filter.

3. Remove sump fill plug from L.H. tank. Using a hose attached to a funnel, place unattached end of hose in a large container. Remove drain plug and allow tank to thoroughly drain.

4. Flush tank with about two quarts of clean hydraulic fluid.

C A U T I O N

DO NOT OPERATE HYDRAULIC PUMP WHILE SUMP TANK IS EMPTY AS DAMAGE TO THE HYDRAULIC PUMP WILL PROBABLY RESULT.

5. Disconnect the hose and remove the hydraulic filter retaining bolts.

6. Pull the filter assembly out of the sump tank and remove any remaining gasket material from mounting flanges.

7. Clean out any residue left in the sump cavity.

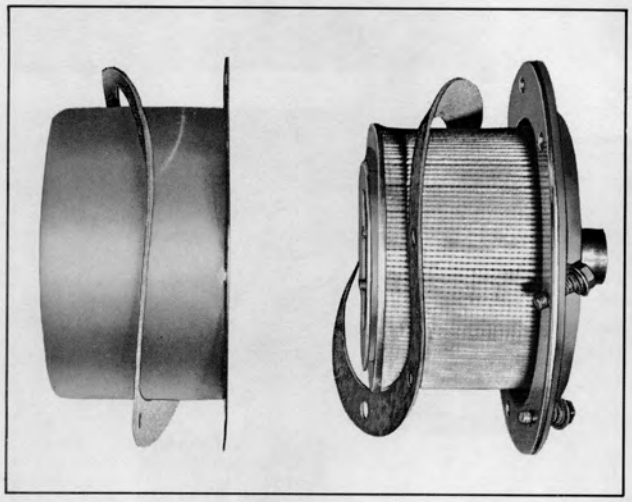


Plate 5274. Hydraulic Oil Filter

8. Install new filter element and gaskets to the filter housing and secure housing to the sump tank with the attaching capscrews.

N O T E

THE FILTER ATTACHING BOLTS SHOULD BE TIGHTENED TO 40-50 INCH POUNDS. IF THIS TORQUE IS EXCEEDED, DISTORTION OF THE HOUSING MAY OCCUR, CAUSING LEAKAGE.

9. Install pump hose to filter and tighten hose connections.

10. Replace drain plugs and fill sump tank to capacity (see specifications). Only use hydraulic fluid per Clark Specifications MS-68, Clark Part #885385. Operate hydraulic cylinders and recheck system for leaks. If there are no leaks present, close both the access frame doors and secure with fasteners provided. Replace fill plug and sump breather to their correct locations.

C A U T I O N

THE HYDRAULIC SYSTEM MUST BE KEPT CLEAN. IT MAY BE NECESSARY TO DRAIN, CLEAN AND REFILL THE SUMP TANK MORE OFTEN UNDER ADVERSE CONDITIONS. THIS IS BEST DETERMINED BY CHECKING HYDRAULIC FLUID FOR EVIDENCE OF DIRT, SLUDGE OR ANY FOREIGN MATTER AT PERIODIC INTERVALS. IF SUMP BREATHER BECOMES DIRTY REPLACEMENT IS NECESSARY.

STEERING GEAR

Steering gear adjustments must be made in the following manner (see Plates 6636 and 6637).

Always check worm bearing thrust adjustment, and adjust if necessary, before making sector gear lash adjustment.

Before making above adjustments, the following preliminary operations are necessary.

1. Disconnect steering drag link from pitman arm. Note relative position of drag link parts when disconnecting link so the parts may be re-assembled correctly.

2. Check lubricant level in steering gear housing. If low, add enough lubricant to bring level up to filler plug hole. (Use NLGI #1 Amolith grease EP #1 or its equivalent).

3. Tighten steering gear housing to frame side member bolts, see Plate 6636.

4. Determine straight-ahead position of steering mechanism by turning steering wheel to extreme right.

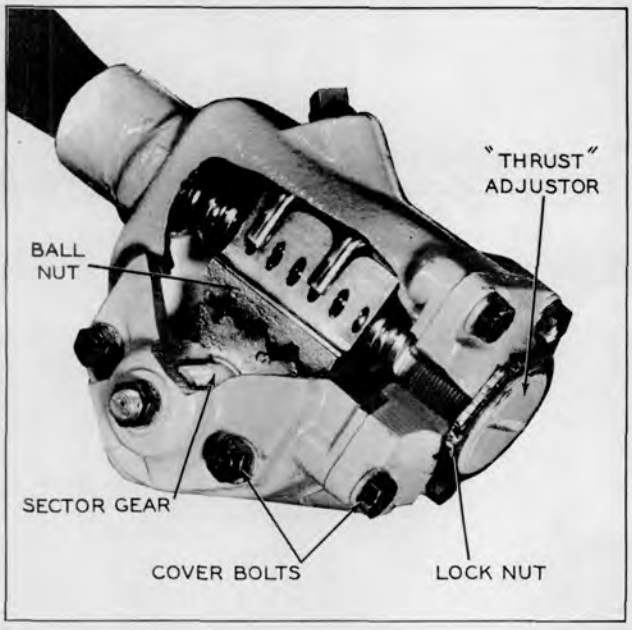


Plate 6636. Steering Gear Thrust Adjustment (Worm Bearings)

CAUTION

APPROACH EXTREME ENDS CAUTIOUSLY; WORM BALL NUT MUST NOT STRIKE ENDS WITH ANY DEGREE OF FORCE.

Then turn to extreme left, counting the exact number of turns from right to left end. Turn wheel back one-half number of wheel turns. Mark wheel with respect to steering column so center position may readily be found during adjustment procedures.

Worm Bearing THRUST Adjustment: Refer to Plate 6636 and proceed as follows:

1. Check tightness of cover bolts, see Plate 6636. Loosen lock nut and turn lash adjuster screw (Plate 6637) counterclockwise a few turns to provide clearance between sector gear and worm ball nut.

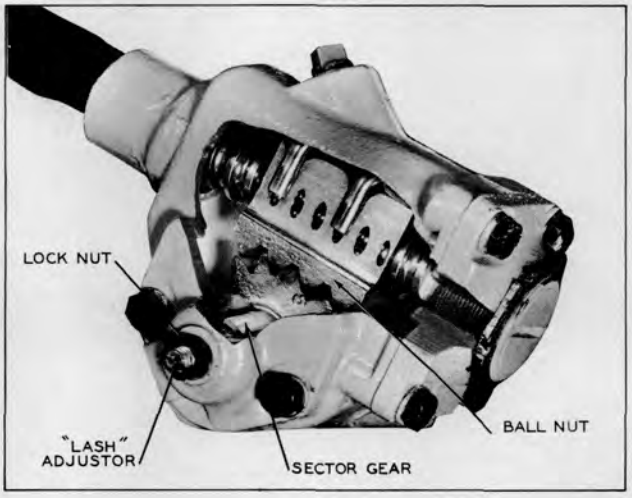


Plate 6637. Steering Gear Lash Adjustment (Sector Gear)

2. Turn steering wheel GENTLY to one extreme end. Turn wheel back one full turn. With spring scale on spoke of wheel, measure pull required to KEEP WHEEL MOVING. Pull on scale should be made at right angles to wheel spoke. If pull is within 1 1/2 to 2 pounds, proceed to lash adjustment in the following paragraphs. If pull is not within 1 1/2 to 2 pounds, adjust worm bearings. The pitman shaft adjustment must be made if worm bearing check is accomplished, or if the worm bearings are adjusted.

3. If it is necessary to adjust the worm bearings, loosen lock nut and then turn worm bearing adjuster nut clockwise until all end play is removed, see Plate 6636. Using

spring scale, as directed in Step 2, check pull and readjust as necessary; then tighten lock nut securely.

Sector Gear Lash Adjustment: Refer to Plate 6637 and proceed as follows:

1. Steering Gear Mechanism must be in straight ahead position as previously explained.

2. Turn lash adjuster screw clockwise to remove all lash between gear teeth. Tighten adjuster screw lock nut. Position spring scale on steering wheel so pull may be made at right angles to wheel spoke.

3. Measure pull while wheel is TURNED THROUGH CENTER POSITION. Readjust if reading is not within 2 1/2 to 3 pounds.

4. Tighten adjuster screw lock nut, check pull again.

5. After adjustments are made, install drag link on pitman arm.

N O T E

If steering linkage adjustment is necessary do not install drag link to pitman arm.

1. Steering gear mechanism must be in straight ahead position.

2. Turn lash adjuster screw clockwise to remove all lash between gear teeth. Tighten adjuster screw lock nut. Position spring scale on steering wheel so pull may be made at right angles to wheel spoke.

3. Measure pull while wheel is TURNED THROUGH CENTER POSITION. Readjust if reading is not within $2\frac{1}{2}$ to 3 pounds.

4. Tighten adjuster screw lock nut, check pull again.

5. After adjustments are made, install drag link on pitman arm.

N O T E

If steering linkage adjustment is necessary, do not install drag link to pitman arm.

STEER AXLE AND LINKAGE ADJUSTMENT

1. Connect front and rear tie rods at Points "A", "B" and "C".

2. Set steer tires parallel with sides of truck so that steer axle spider is centered.

3. Adjust rear tie rod so that idler arm center line between Points "B" & "D" are vertical.

4. Tighten lock nuts on rear tie rod.

5. Center steer wheel between full right and full left cramp.

6. Attach pitman arm so that centerline between Points "E" & "F" is approximately 9 deg from vertical in direction shown (this rotates pitman arm one seration towards front of truck.) Tighten nut holding pitman arm on steer gear.

7. Attach front tie rod to pitman arm ball and tighten lock nuts.

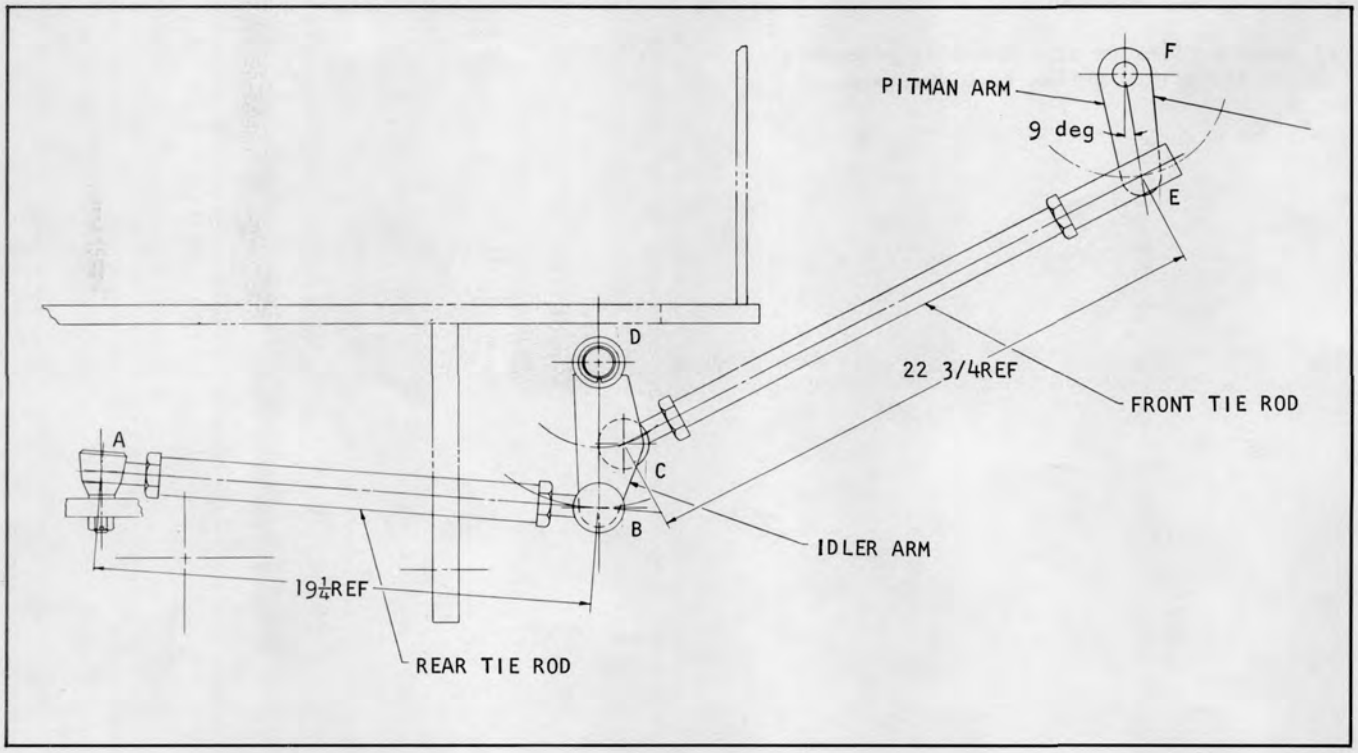


Plate 6585. Steer Axle and Linkage Adjustments

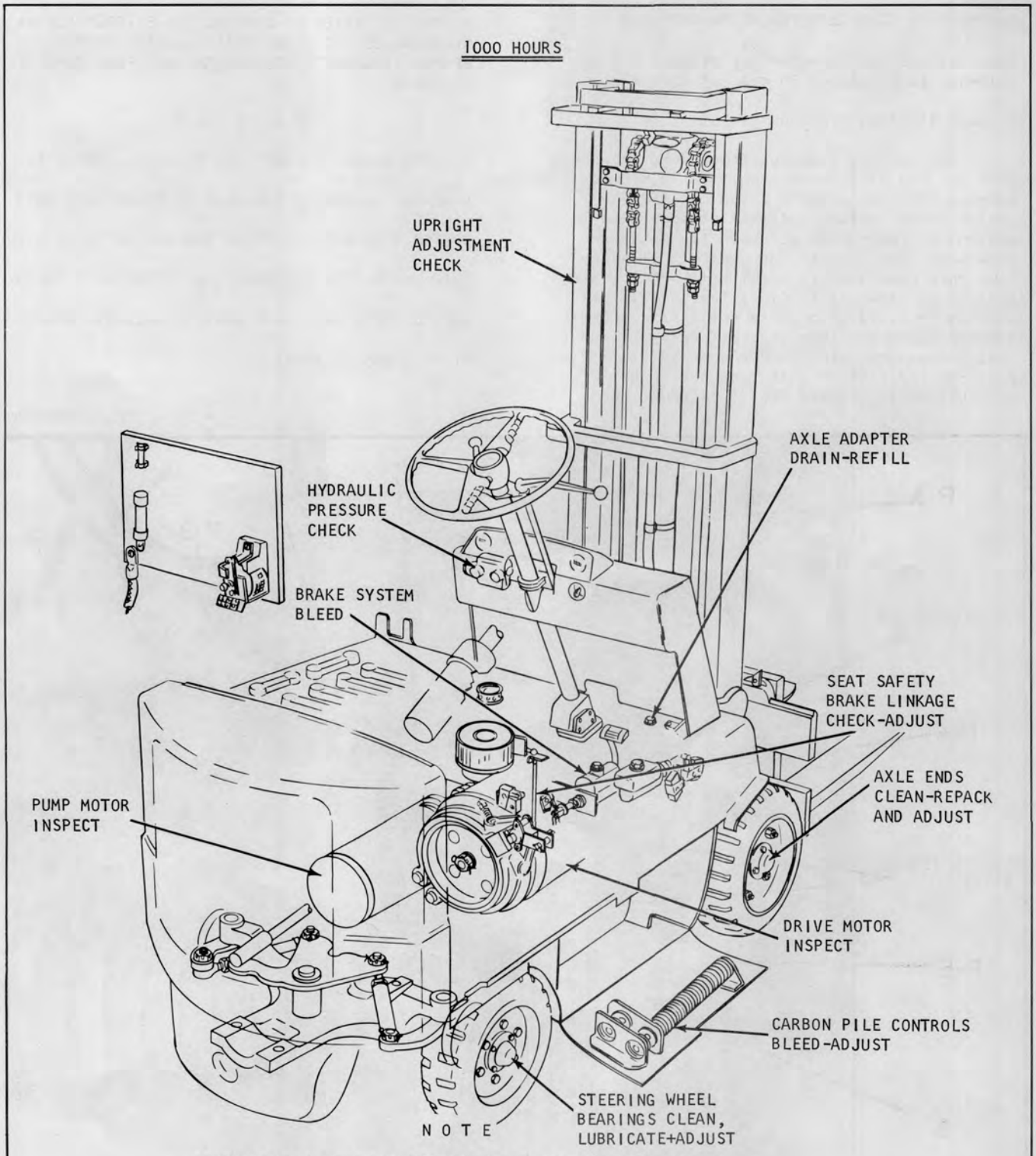


Plate 8928. Lubrication and Preventive Maintenance Illustration

CARBON PILE CONTROL BLEEDING PROCEEDURES

(Key letters on Plate 8941 or steps 7 & 8 on fold-out-page located in rear of this manual).

Primary Bleeding Proceedure

The primary bleeding proceedure incorporates the use of a bleeder unit (ball bleeder such as the type used to bleed air from hydraulic brake system). Attach bleeder unit to control cylinder open valve on the pressure unit hose that runs to the control cylinder. Now, open bleederscrew (item P-1). Allow air and oil to flow until oil is free of all air bubbles or fluid is a clean solid mass. Close bleeder screw and then shut off valve. Repeat this proceedure with bleeder screws (items P-2, P-3, P-4 and P-5) in this sequence. SHUT OFF PRESSURE UNIT. REMOVE EXCESS PRESSURE FROM HYDRAULIC SYSTEM BY OPENING ONE BLEEDER SCREW-ALLOWING OIL TO FLOW UNTIL "ALMOST" STOPPED BEFORE DISCONNECTING BLEEDER UNIT FROM CONTROL CYLINDER.

C A U T I O N

TIGHTEN VALVE "BEFORE" OIL FLOW HAS COMPLETELY STOPPED, OTHERWISE AIR WILL BE DRAWN BACK INTO SYSTEM THUS NECESSITATING THE SYSTEM TO BE BLED OVER AGAIN. DO NOT REMOVE OR DISCONNECT PRESSURE BLEEDER UNIT FROM CONTROL CYLINDER WHILE IT IS UNDER PRESSURE.

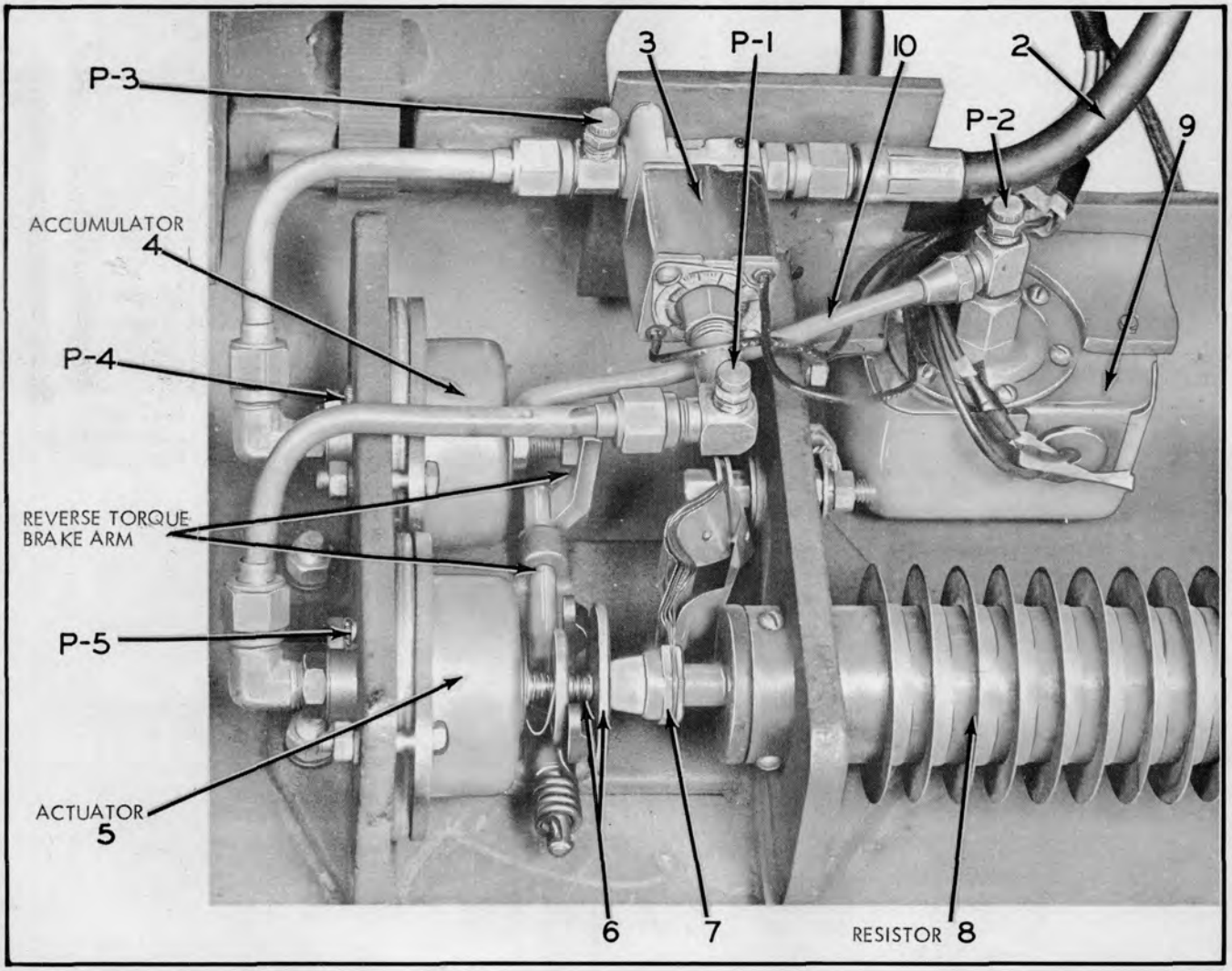


Plate 5994. Carbon Pile Bleeding Proceedure

Test System

If air is completely bled from system, the pressure switch (item Y) will make a "click" sound when the control cylinder push rod is mover 3/4 of an inch (or in effect, when the accelerator pedal is depressed, the control cylinder piston is depressed 3/4 of an inch the cylinder push rod is actuated - shoved inward). Repeat "bleeding" proceedure until "test" conditions are met. Then remove pressure unit. Be sure the unit is not under pressure before disconnecting unit from control cylinder. Please refer to the preceeding "Caution" listed under "Primary Bleeding Proceedure".

Alternate Bleeding Proceedure

Keep control cylinder "full" with heavy duty hydraulic brake fluid (SAE type 70 R3) during bleeding operation. Keep cylinder cap on cylinder during "bleeding" operation. Depress accelerator pedal and "hold" on down stroke. Open bleeder screw (item P-1) allowing air and brake fluid to flow until "almost" stopped, then close bleeder screw.

N O T E

Close bleeder screw while oil is still flowing to prevent air from being drawn back into system thus necessitating the system to be bled again.

Repeat this proceedure with bleeder screw (item P-2) and then bleeder screws (items P-3, P-4 and P-5) in this sequence. Wait one minute between accelerator pedal strokes to allow control cylinder to refill itself from it's "reservoir". Be sure reservoir is kept full during complete bleeding proceedure.

Repeat this "bleeding" proceedure until fluid is clear of all air bubbles, or fluid flow is a clean solid mass. It is a MUST to expell all air from the system.

Test system as previously explained under "Primary Bleeding Proceedure".

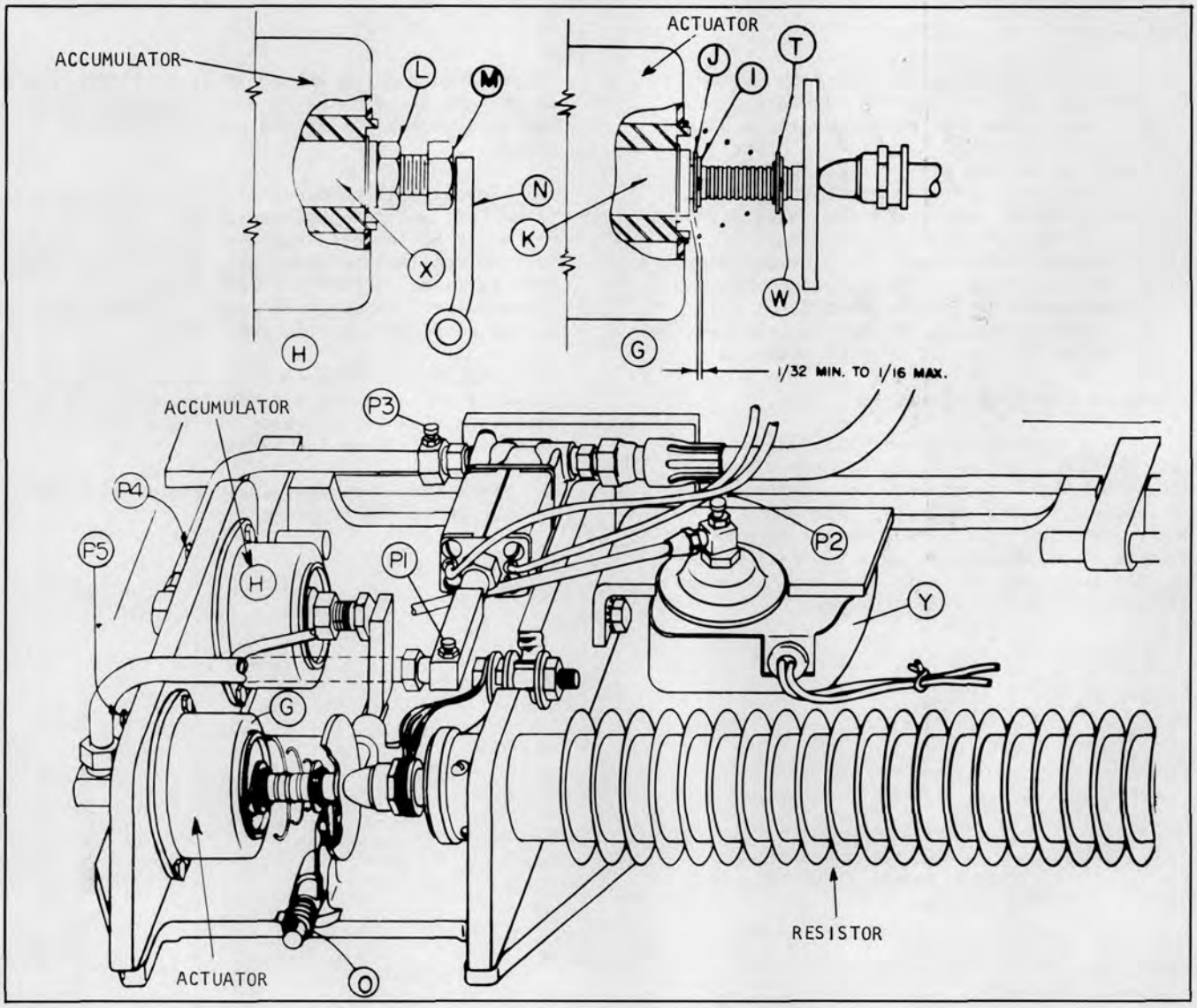


Plate 7411. Carbon Pile Resistor, Accumulator and Actuator

CARBON PILE ACCUMULATOR AND ACTUATOR ADJUSTMENTS. (Key letters on plate 7411).

ACCUMULATOR ADJUSTMENTS

Loosen nut "L". (During adjustment prevent piston rod "X" from turning more than necessary by placing wrench on screw "M" when loosening or tightening nut "L" or screw "M"). Adjust screw "M" to obtain 1/64 to 1/32 inch of free play between screw and arm "N". This adjustment must be made when the resistor is hot.

ACTUATOR CREEP SPEED ADJUSTMENT

Remove snap ring "W" from groove. Reinsert snap ring into groove closer to actuator by compressing spring to increase creep speed. Reinsert snap ring into groove farther away from actuator to decrease creep speed.

To check adjustment - with the key switch in the "on" position, driver's seat occupied and directional control in selected direction of travel, depress accelerator carefully to the position where the 1st point of power switch just actuates—— hold pedal at this level. (1st point of power switch operation is outlined on page 100H 475). As soon a this switch actuates the carbon pile control is in creep speed. If the creep speed adjustment is correct the truck should just move (when the resistor is cold) with no load on the forks. When the resistor is hot

the truck should just move with a rated load on forks.

C A U T I O N

A CORRECT CREEP SPEED ADJUSTMENT IS IMPORTANT TO MAINTAIN A MINIMUM FORCE OF 1/2 POUND AGAINST THE CARBON PILE PLUNGER TO PREVENT MOVEMENT OF THE CARBON DISCS RELATIVE TO EACH OTHER, AND THE ASSOCIATED ARCING WHICH DAMAGES THE DISCS. THIS MINIMUM SQUEEZE IS MAINTAINED BY THE CREEP SPEED SPRING.

ACTUATOR PLUNGER ADJUSTMENT

Adjust snap ring "I" on actuator shaft to maintain 1/32 to 1/16 inch clearance between washer "J" and end of piston rod "K".

N O T E

USE EXTRA WASHERS IF NECESSARY FOR ADJUSTMENT - KEEP WASHER "J" WHICH IS SUPPLIED WITH ACTUATOR - ADJACENT TO SNAP RING "I". MAKE THIS ADJUSTMENT WHEN RESISTOR IS HOT.

MOTOR INSPECTION AND CHECKS

Wiring: Inspect all connecting wires to be sure they are secure. Insulation should not be worn or damaged.

Commutator: If commutator is glazed or dirty clean with a strip of No. 00 sandpaper. Blow out all dirt and grit with compressed air.

C A U T I O N

DO NOT USE EMERY CLOTH TO CLEAN COMMUTATOR.

Brushes: The brushes should slide freely in their holders and make full contact on the commutator. Worn brushes (worn beyond half the original length) should be replaced. Badly chipped, broken or oil soaked brushes should also be replaced. Brushes may be wiped with a dry clean cloth to remove loose particles of dirt.

N O T E

DO NOT CLEAN THE BRUSHES IN ANY KIND OF SOLVENT OR ALLOW THEM TO COME IN CONTACT WITH GREASE OR OIL.

Check brush spring tension with a spring scale. To check reaction type brush springs, hook the scale under the brush spring near the brush and pull on a line parallel with the side of the brush. Take the reading just as the spring leaves the brush. To assist in telling the exact instant that the pressure is relieved, a small strip of paper can be placed under the brush. Pull slightly on the paper and the paper will slip out at the correct instant for reading the spring scale.

If the brush spring tension is too great, the commutator and brushes will wear excessively and result in short life. If the brush spring tension is too low, there will be a loss of efficiency due to poor brush contact.

To change brush spring tension, twist the spring at the holder with long nose pliers.

C A U T I O N

DO NOT ALLOW SPRING TO SNAP DOWN ON A BRUSH.

Refer to Specifications for correct brush spring tension.

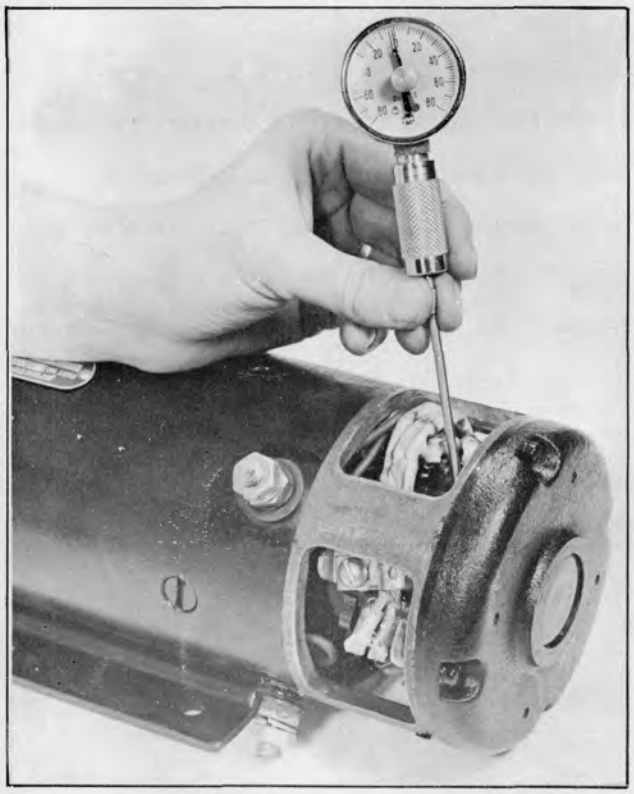


Plate 6560. Typical Method Checking Brush Spring Tension

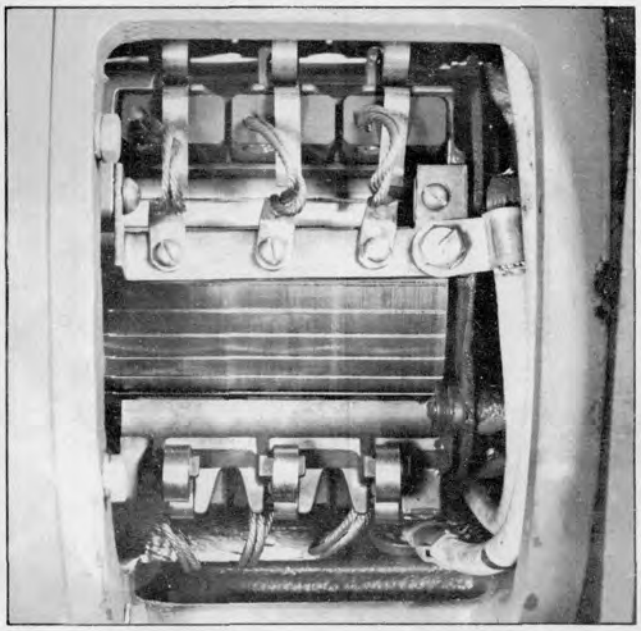


Plate 7564. Typical Motor Brushes

Plate 6640. Typical Wheel Bearings

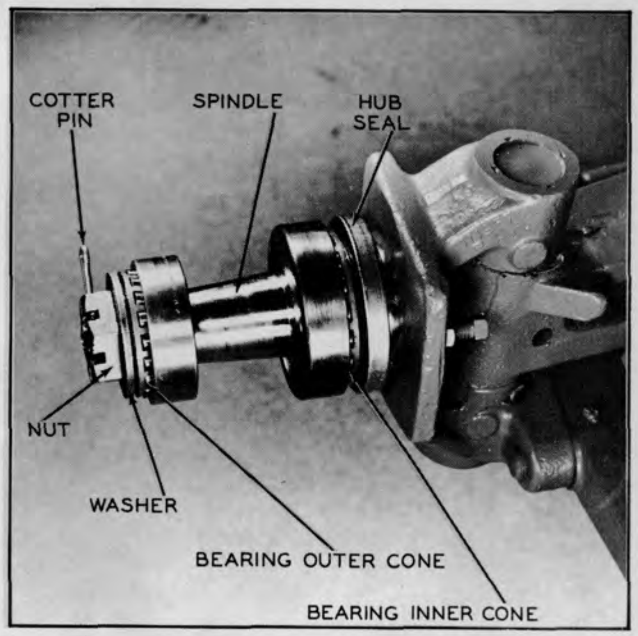


Plate 6703. Typical Wheel Bearings

STEERING WHEEL BEARINGS

Adjustment

1. Raise rear of machine so that tires clear floor.

WARNING

AFTER RAISING MACHINE AND BEFORE MAKING ANY ADJUSTMENTS OR ADJUSTMENT CHECKS, PLACE ADEQUATE (HEAVY) BLOCKING (SUFFICIENT TO SUPPORT THE WEIGHT OF THE MACHINE) UNDER THE FRAME TO PREVENT ACCIDENTAL LOWERING OR FALLING OF THE VEHICLE, THUS PREVENTING PERSONAL INJURY TO MECHANIC OR BYSTANDERS.

2. Inspect adjustment of bearings by gripping top and bottom of tire, chuck tire "in" and "out" to determine looseness or wobble.

NOTE

Before making wheel bearing adjustments, be sure play (looseness or wobble) is in the wheel bearings and not in the king pins.

NOTE

If wheel bearings need adjusting, clean and repack bearings before making adjustments. Refer to lubrication paragraph. Before repacking wheel bearings, check for any indication of leakage around hub seals. If such a condition exists, report to designated person in authority.

3. If looseness or wobble is in the wheel bearings, remove hub cap and spindle cotter pin, see (Plate 6640). Tighten nut with a 12" wrench, and at the same time rotate the wheel in one direction and then in the other until there is a slight bind to be sure all bearing surfaces are in contact. Then back off the nut 1/6 to 1/4 turn allowing the wheel to rotate freely. Secure nut at this position with a new cotter pin and replace hub cap.

Lubrication

1. Remove wheels after 1000 hours or every six months of operation. Clean bearings and repack with NLGI #1 (Amolith grease EP #1 or its equivalent.)

2. Install wheels and adjust wheel bearings as previously described.

CLEAN AND REPACK AXLE ENDS

Every 1000 operating hours remove and repack the axle ends with NLGI #1 (Amolith grease #1 or its equivalent).

1. Tilt upright back. Place solid heavy blocks under each upright rail. Tilt upright forward until vertical to the floor. This should allow the drive wheels to clean the floor. Remove drive wheels.

2. Remove hub cap, cotter pin, washer, spindle nut and pull hub assembly from spindle.

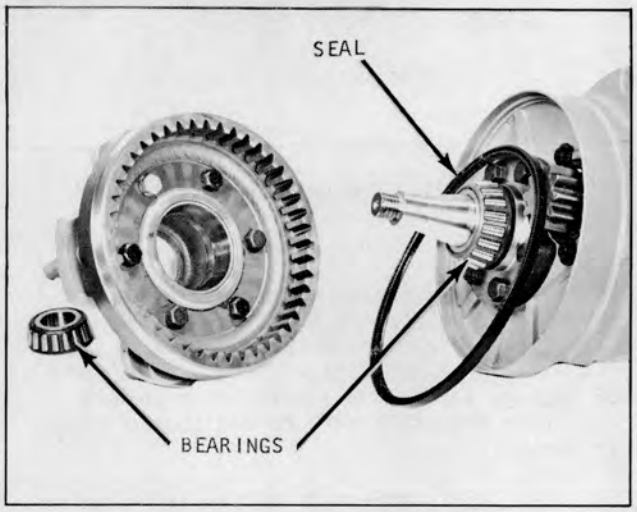


Plate 6892. Axle End Assembly

3. Remove bearings and clean in a Stoddard type cleaning solvent. Slosh bearings up and down in solvent. Remove and tap large side of bearing against a block of wood to dislodge solidified particles of lubricant. Repeat operation until bearings are thoroughly clean. Blow bearings dry with compressed air. Direct air stream across bearing to avoid spinning. Slowly rotate bearing by hand to facilitate drying. Dip bearings in gear oil and wrap in paper until they are to be reinstalled.

4. Clean ring gear, pinion drive shaft, hub assembly, spindle and spindle support.

5. Inspect seal for cuts, scratches and nicks. If is necessary to replace seal if such a condition is found.

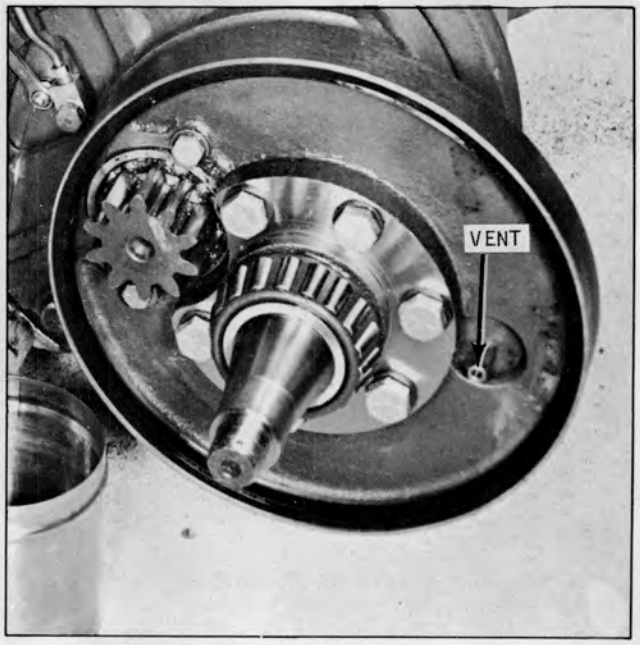


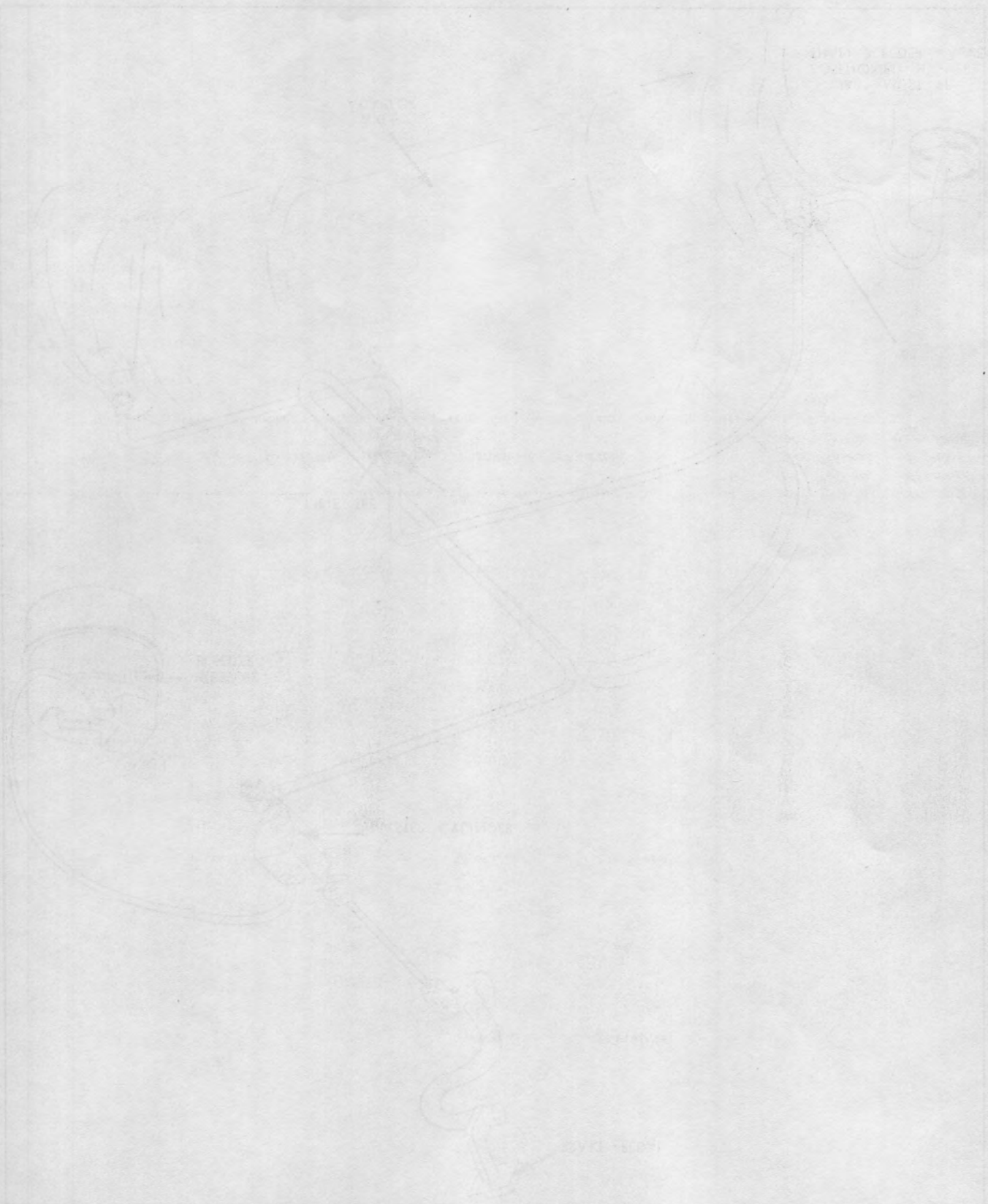
Plate 6893. Axle End Vent

6. Repack each axle end (bearings, spindle, ring gear and pinion) with one pound of NLGI #1 (Amolith grease #1 or its equivalent). Check the axle end vent for obstructions. the vent must be open.

7. Install bearings, seal and hub assembly.

8. Install washer, spindle nut and hub cap.

9. Tilt upright back and remove blocking.



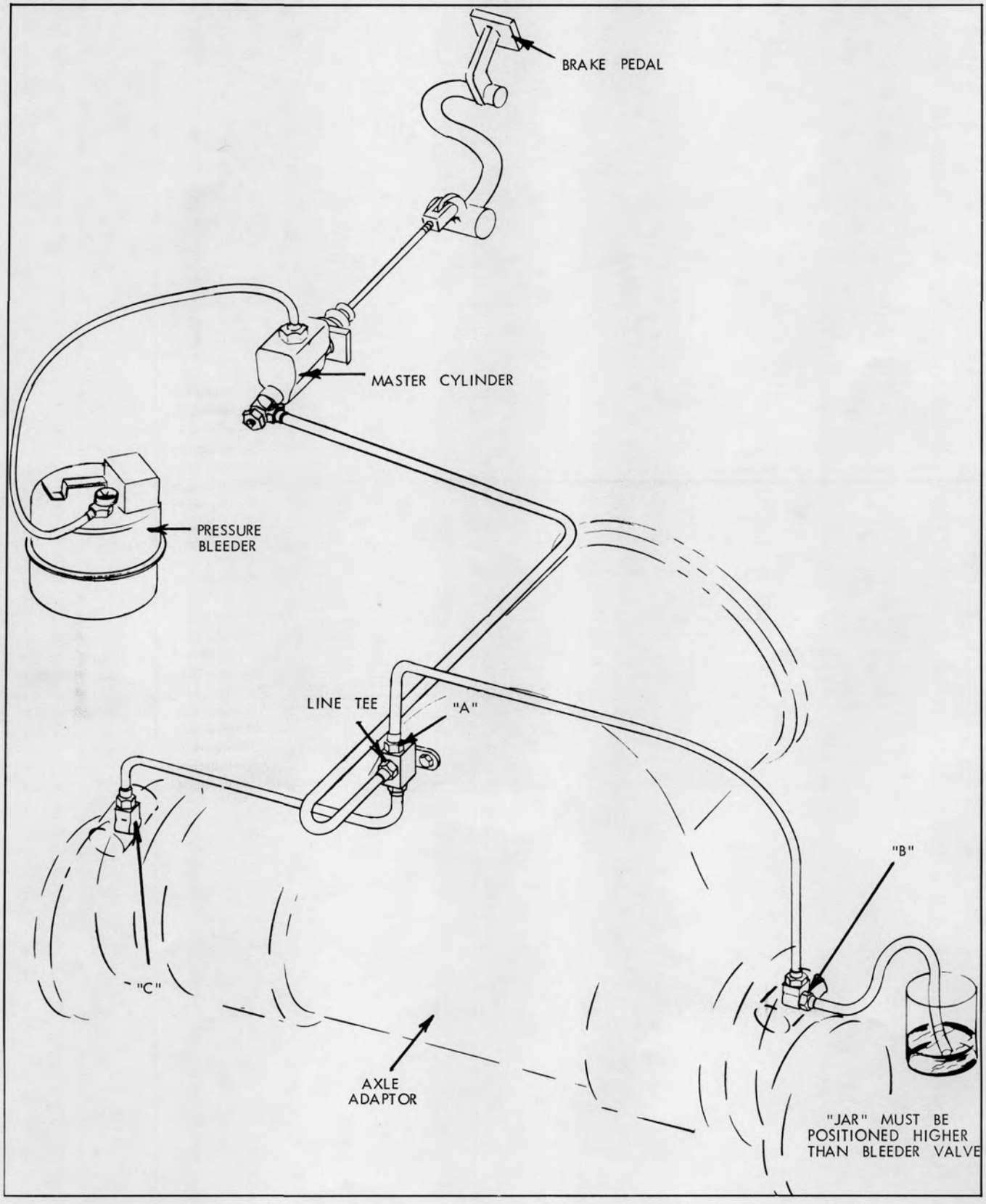


Plate 6883. Bleeding Brake System

BRAKE BLEEDING PROCEDURE

Proper operation of the hydraulic brake system requires a solid column of fluid without air bubbles at all points in the pressure system. Under certain conditions it becomes necessary to bleed fluid from the system in order to expel air bubbles which have become mixed with the fluid. The necessity of bleeding is indicated by a soft or spongy pedal, or at any time a brake line is removed (or broken) the system must be bled.

Step 1. Tilt upright back. Place solid heavy blocks under each upright rail. Tilt upright forward until vertical to the floor. This should allow the drive wheels to clear the floor. Remove drive wheels.

N O T E

MACHINES EQUIPPED WITH PNEUMATIC TIRES,

DEFLATE TIRES BEFORE REMOVING DRIVE WHEELS

FROM MACHINE.

Step 2. Check the brake pedal free travel (Refer to Specifications). Clean dirt from around the filler cap of the master cylinder reservoir. Brake fluid should be within 1/4" of the top. With filler cap off the master cylinder, depress and release brake pedal. A small displacement of fluid should be noticed in the cylinder reservoir. If this happens, the brake pedal (upon being released) is returning the master cylinder piston to its normal position to open a master cylinder port. This port must be open. If fluid does not return to the reservoir (when releasing brake pedal), this indicates improper pedal free travel and a pedal adjustment is required.

Step 3. To properly bleed the system it is recommended that a pressure bleeder filled with about two quarts of SAE 70R3 heavy duty brake fluid be connected to the master cylinder reservoir. Pressure bleeder should then be pressurized to approximately 30 P.S.I.

Step 4. Loosen line connection at highest position on "T" block point "A" (Plate 6883) and allow fluid and air to escape. Tighten fitting at this point when escaping fluid is free of air bubbles.

Step 5. Install a bleeder hose on one of the wheel cylinder bleeder screws and submerge the unattached end of the hose in a clean transparent jar containing several inches of brake fluid. NOTE: DURING BLEEDING OF THE WHEEL CYLINDERS THE JAR SHOULD BE ELEVATED TO A POSITION HIGHER THAN THE BLEEDER SCREWS MAKING SURE THAT THE END OF THE HOSE REMAINS SUBMERGED IN THE FLUID AT ALL TIMES. Loosen bleeder screw "B" (Plate 6883) enough to allow fluid and air to escape. Tighten bleeder screw at this point when escaping fluid is free of air bubbles.

Step 6. Install bleeder hose on the remaining bleeder screw and proceed as in step five. After all bleeding has been completed close the pressure bleeder shut-off cock and loosen hose connection at master cylinder to allow pressure to escape. Replace master cylinder cap.

Step 7. Replace drive wheels. (Inflate tires if they are of the pneumatic type).

Step 8. Tilt upright back and remove blocking from under each upright rail.

If a pressure bleeder is unavailable the system may be bled manually by following steps four thru eight. It must be remembered that the brake pedal should be depressed slowly and held to the floorboard until the line connections or bleeder screws are securely tightened. This prevents the possibility of air being drawn into the system during the bleeding operation. Check master cylinder reservoir level periodically during manual bleeding and fill to within 1/4 inch of the top as required.

BRAKE ADJUSTERS (2ND. DESIGN)

When the brake system is operating properly, the cam like action of the reaction arm allows self-adjustment for the total thickness of the brake linings, without any noticeable increase in brake pedal free travel. The self-adjustment feature eliminates the need for manual adjustment of the brakes.

When the brake linings become worn beyond their designed limits there will be a noticeable change in the brake pedal effort required to stop the machine or, brakes will become noisy during application. If either of these conditions exist the axle ends should be removed so an inspection of the brake linings can be made to determine their further serviceability.

Before installing new brake linings the adjuster arm mounting bolt torque should be checked with a torque wrench. The bolt should not turn in the backing plate until a minimum of 40 lb. inches or a maximum of 50 lb. inches is reached. See Plate 7198 for correct procedure.

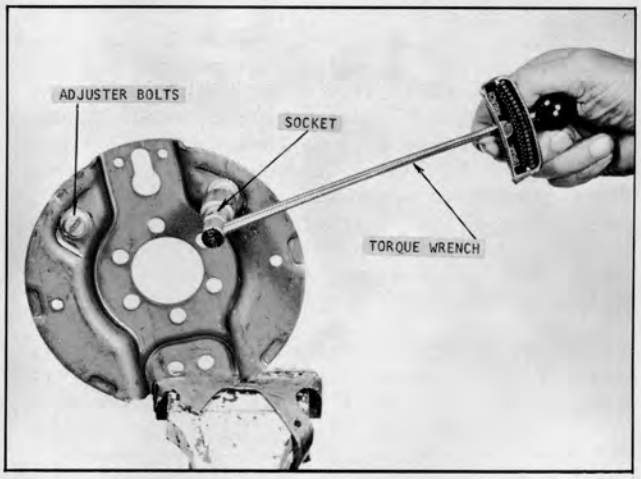


Plate 7198. Checking Adjuster Arm Torque

The backing plate and adjuster arm components must be clean, dry and free from rust when this torque test is made.

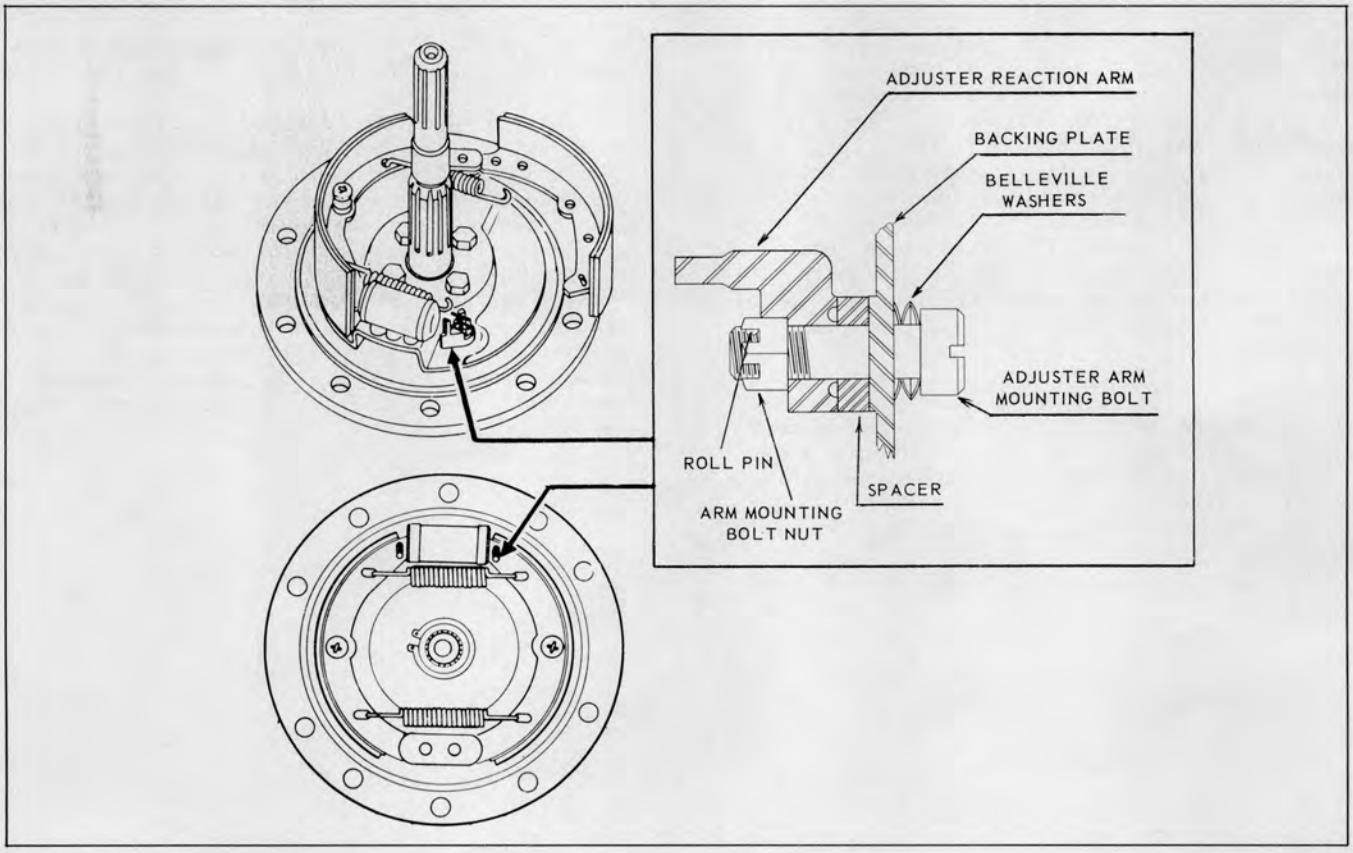


Plate 7494. Automatic Brake Adjusters

BRAKE ADJUSTERS (1ST DESIGN)

The mechanical brake adjusters maintain proper brake lining clearance until such time as the brake linings require replacement.

If it is found that during brake applications the brake pedal travel has gradually become excessive (and the system has been properly bled and pedal free travel is correctly adjusted) the brake linings are worm beyond their designed limits and the mechanical adjusters can no longer maintain proper brake lining clearance. If lining wear has reached this point and replacement of linings are necessary report to designated person in authority. When the Adjuster Reaction Arm INDEX WASHER "High Spot" rotates past the backing plate index washer "High Spot", excessive pedal travel will be noticed indicating that the brake linings have worn beyond their designed limits.

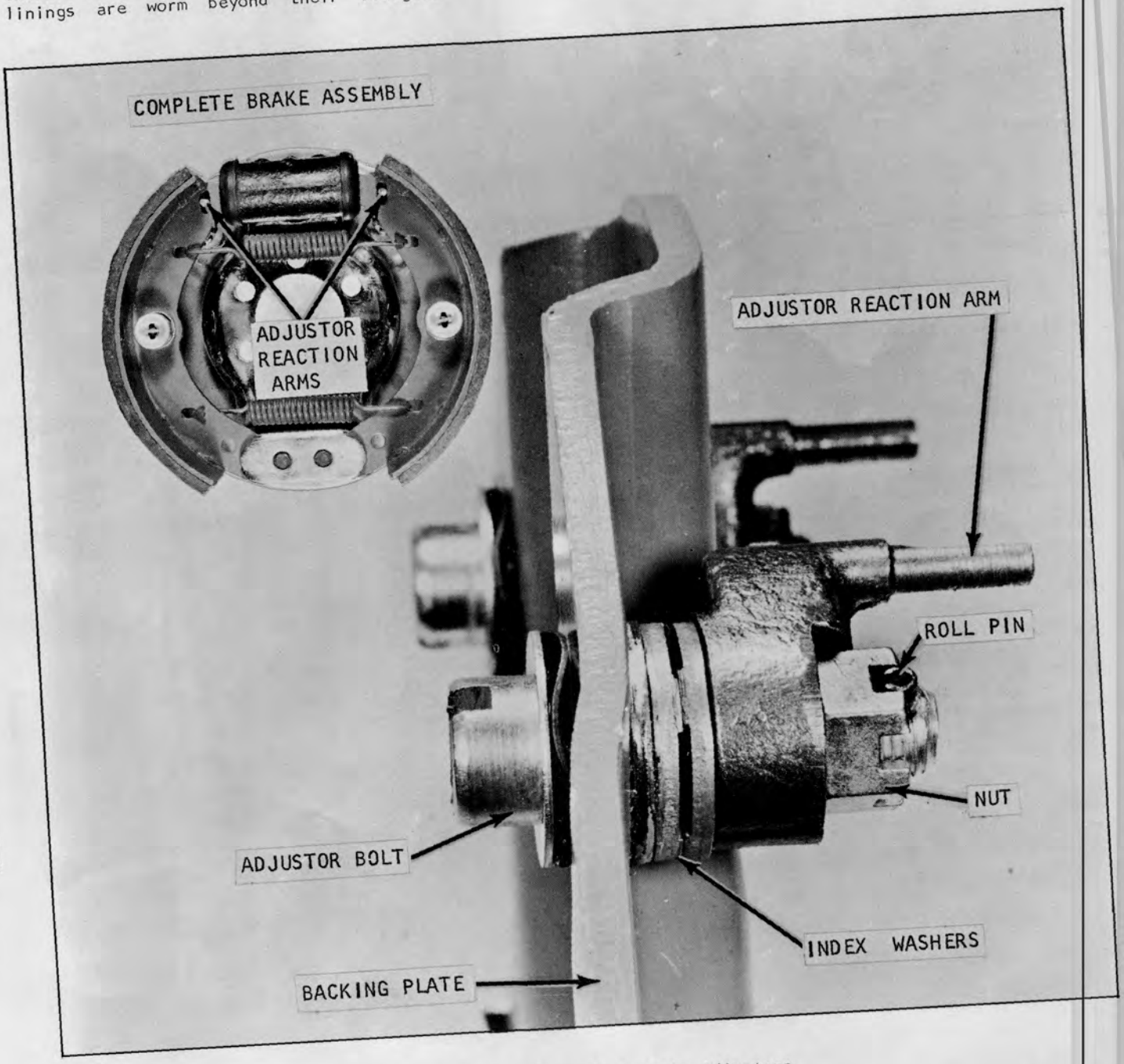


Plate 6890. Mechanical Brake Adjusters

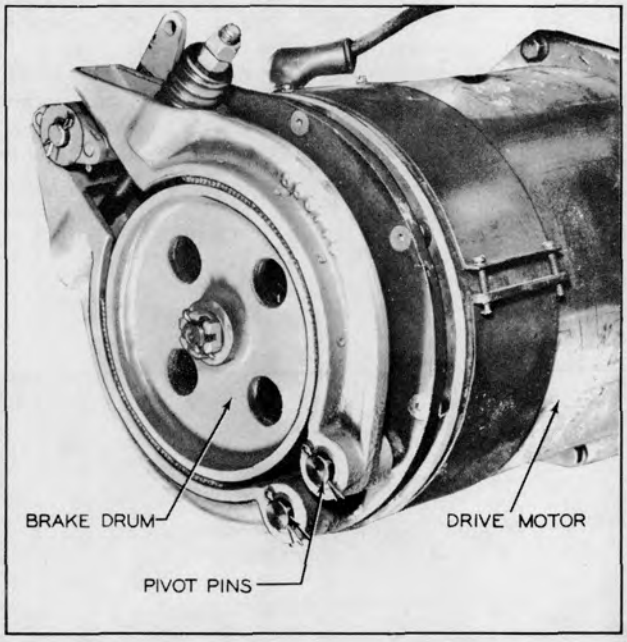


Plate 5031. Parking Brake

Plate 7410. Seat Linkage Disconnect Pin

SEAT SAFETY BRAKE (PARKING BRAKE)

1. The parking brake is mounted to the end of the drive motor and is operated by means of linkage attached to the driver's seat.

2. When properly adjusted, the brake cam will, with action of the seat linkage, raise new brake shoes off of the drum 1/8 inch at a point half way between the shoe pivot and the brake cam pivot. The gap will increase as the shoe lining wears.

3. Adjust seat return spring tension to allow the seat to raise as soon as the driver leaves the seat.

4. With the return spring installed the bottom of the seat plate should form an angle of 40 degrees with the top of the hood when brakes are applied.

5. The brake shoe return spring should be adjusted to a length of approximately 2 1/2 inches to enable the brake to meet the following specifications.

SEAT BRAKE EFFECTIVENESS

The brake must be capable of holding the truck with full rated load on a 15% grade. To Test: Disconnect seat linkage pin (Plate 7410). The driver should be seated on the truck with all power off.

AXLE ADAPTOR, DRAIN AND REFILL

Every 1000 operating hours drain and refill adaptor.

1. Clean dirt from around filler plug (D), and remove plug....remove level plug (E).

2. Remove drain plug (F).... llow assembly to completely drain.

3. Replace drain plug and fill the assembly until fluid reaches the height of the level plug opening. Replace plugs.

Do not overfill as the excessive quantity will serve no useful purpose. If the oil is too high, it will cause excessive oil churning and attendantly high oil temperature and possible leakage.

For LUBRICATION RECOMMENDATIONS....refer to the right hand column.

AXLE ADAPTOR VENT

Inspect axle vent (C) to be sure it is free of obstructions. If vent is not open, remove and clean in a Stoddard type cleaning solvent. Be sure vent is completely dry before replacing in the axle adaptor.

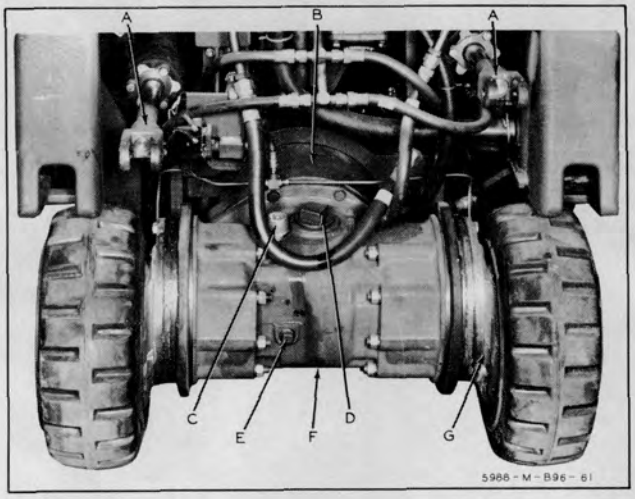


Plate 5988. Axle Adaptor

LUBRICATION RECOMMENDATIONS

Refer to your Machine Serial Number Plate....located on the instrument panel.

Machines built beginning with the following Machine Serial Numbers.....use Type "A", Suffix "A" Automatic Transmission Fluid. Fluid Containers must display a qualification number prefixed by AQ-ATF. Clark Part No. 879803.

EC20C & EC25C-1-763 and above
EC30B & EC40B-1-764 and above

EC30C & EC40C-1-919 and above

ECS50C-1-919 and above
EC50-60-70-1-831 and above

ECLS20B & ECLS25B-1-983 and above
ECLS30B & ECLS40B-1-984 and above

Machines built prior to the above Machine Serial Numbers.....use EPGL SAE #90 Gear Lubricant.

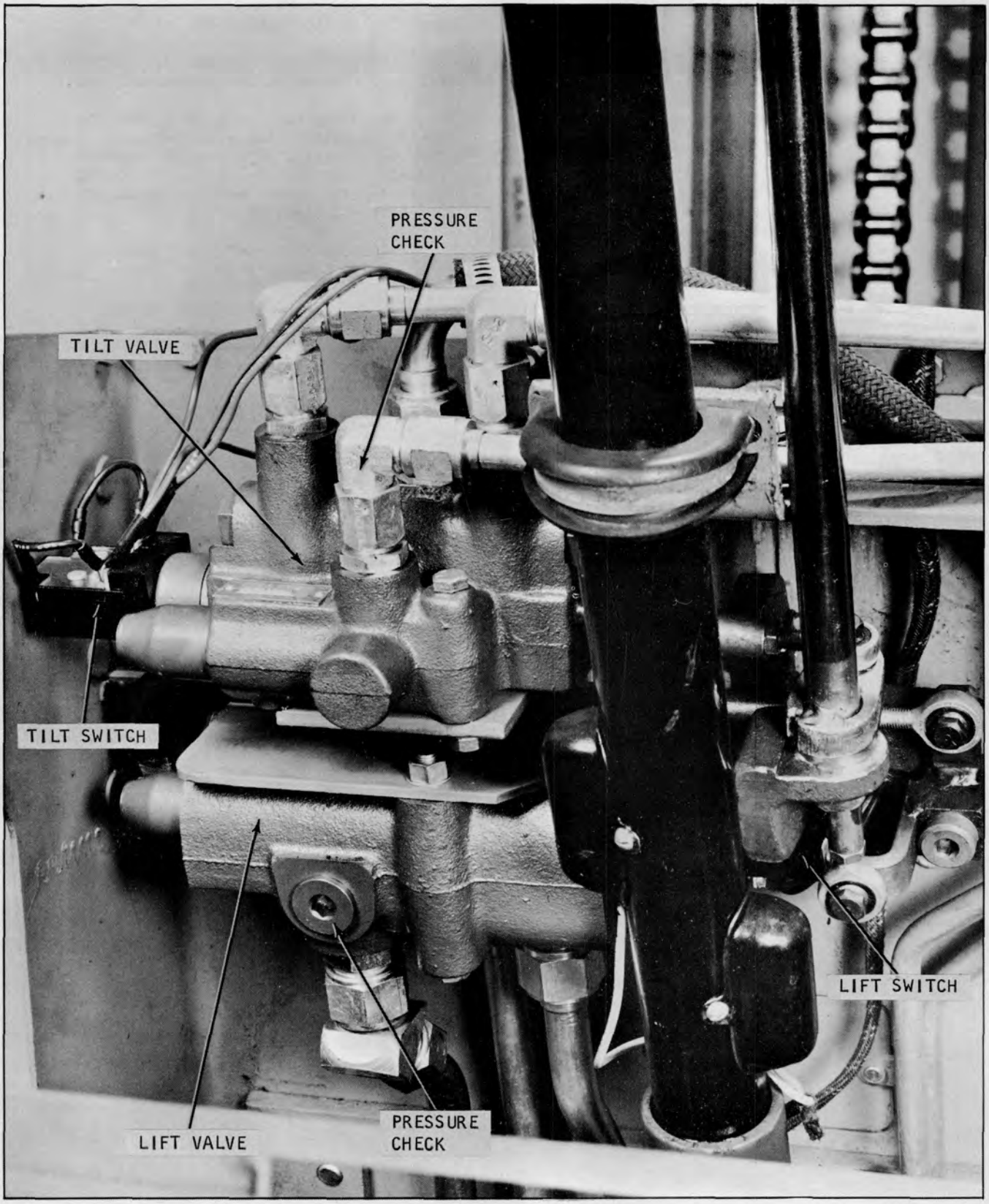


Plate 7224. Typical Control Valve

MAIN HYDRAULIC SYSTEM PRESSURE CHECK

1. Pressure check at lift valve.

a. Remove the pressure check plug from the lift valve (Plate 7224) and install a 0-4000 P.S.I. gauge at this location.

b. Turn key switch on and move hydraulic control lever to the "lift" position. When the upright has reached its maximum height the gauge should register 1750 to 1800 P.S.I. If pressure is not within this range report to designated person in authority.

N O T E

DO NOT HOLD LIFT LEVER IN "LIFT" POSITION FOR ANY PROLONGED PERIOD AFTER UPRIGHT HAS REACHED IT MAXIMUM HEIGHT. THIS WILL CAUSE HEATING OF THE HYDRAULIC OIL AND SHOULD BE AVOIDED.

c. If pressure readings are satisfactory remove pressure gauge and install plug securely.

N O T E

ONLY REPRESENTATIVES OF AN AUTHORIZED CLARK INDUSTRIAL TRUCK DEALER OR THE VENDOR SHOULD REPAIR OR ADJUST THE CONTROL VALVES.

2. Pressure Check at Tilt Valve.

a. Provide a means for connecting a 0-4000 P.S.I. pressure gauge at the inlet side of the valve (refer to Plate 7224). A tee at the inlet port may be used.

b. Turn key switch on and hold tilt lever back until upright reaches maximum back tilt. With the lever held momentarily in this position the pressure gauge should register 1750 to 1800 P.S.I. If pressure is not within this range report to designated person in authority.

c. If pressure readings are satisfactory remove pressure gauge and securely install inlet line in its original position.

LIFT CARRIAGE AND UPRIGHT ROLLER ADJUSTMENTS

To maintain top performance from the upright it may be necessary, from time to time, to adjust the rollers located on the Lift Carriage and Upright Assembly. These adjustments may be accomplished as follows:

Before checking for proper roller clearance, check to be sure the Inner Slide contacts with both Fabreeka (Stop) Pads at the same time when lowering the Inner Slide.

If adjustment is required, add or remove shims between Fabreeka (Stop) Pads located on the Outer Rail Tie Bar Assembly.

NOTE: More shims may be required on one side than the other in order to allow the Inner Slide to come in contact with both Fabreeka (Stop) Pads at the same time when lowering the Inner Slide.

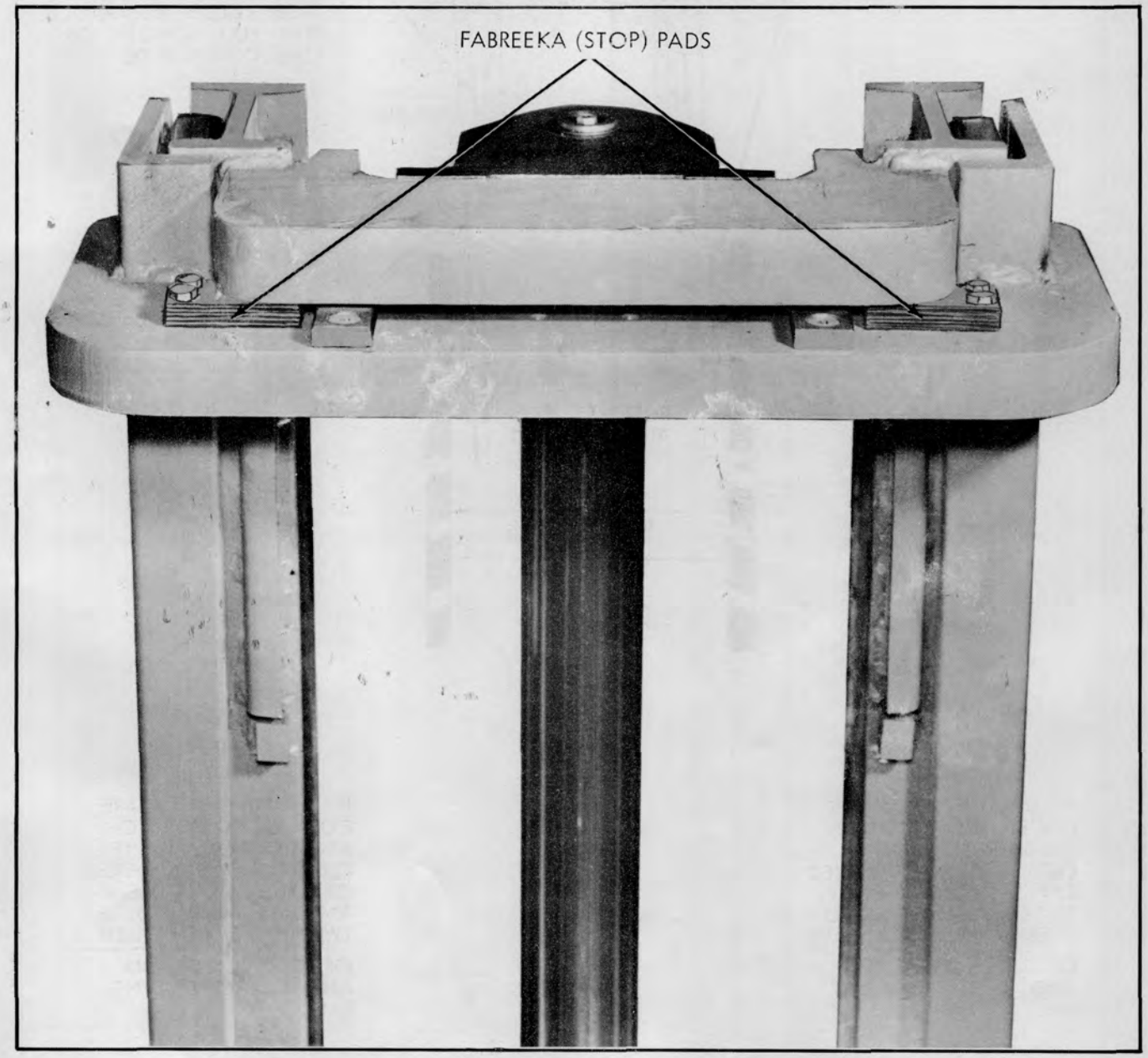
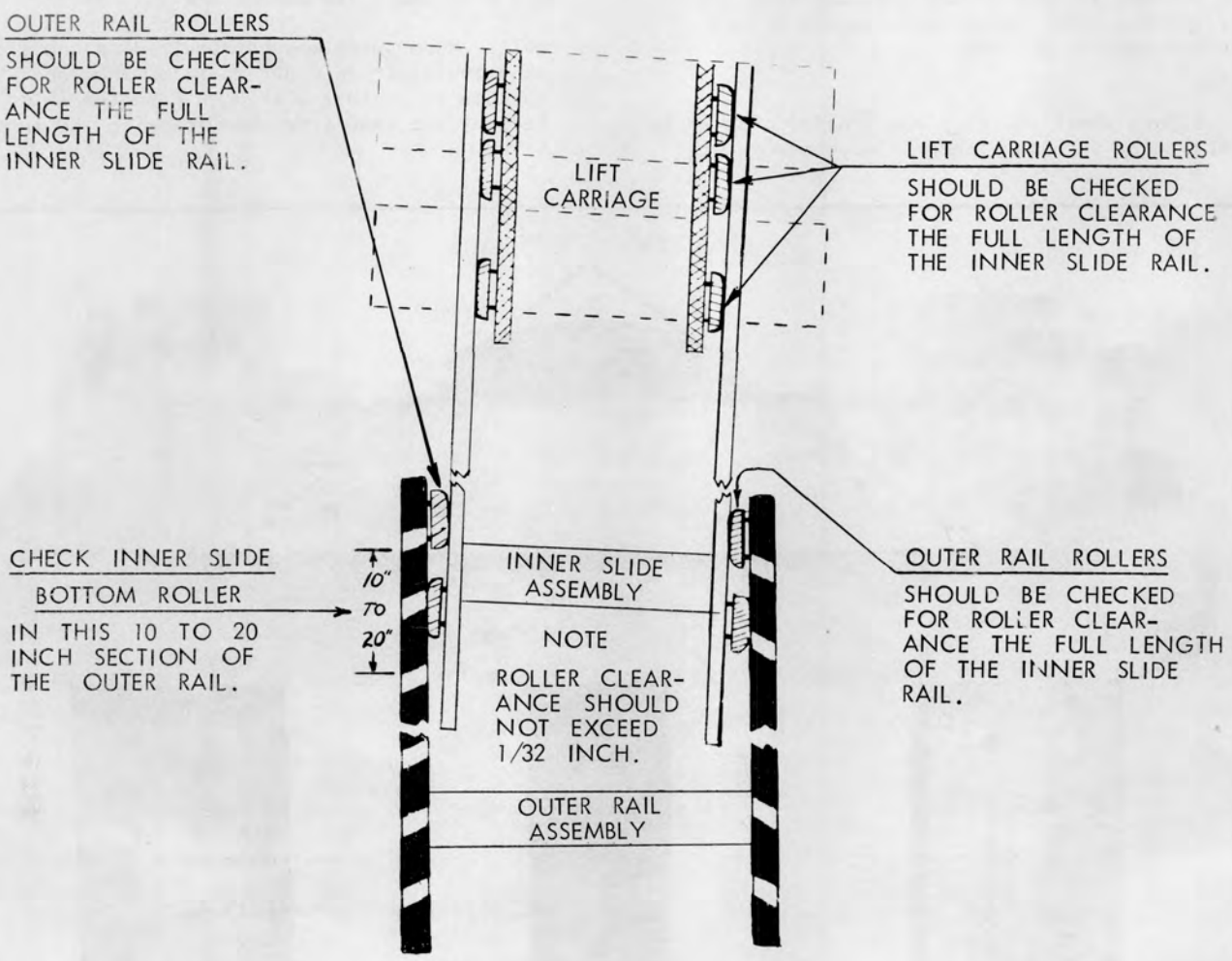


Plate 6619. Inner Slide Must Contact Both Fabreeka (Stop) Pads At The Same Time When Lowering Inner Slide



NOTE

IF UPRIGHT RAILS ARE COCKED IN POSITION AS SHOWN, AND IF CLEARANCE IS CHECKED ON THIS SIDE, CLEARANCE IS MEASURED BETWEEN THE UPPER EDGE OF THE ROLLER RIM AND CORRESPONDING RAIL.

NOTE

IF UPRIGHT RAILS ARE COCKED IN POSITION AS SHOWN, AND IF CLEARANCE IS CHECKED ON THIS SIDE, CLEARANCE IS MEASURED BETWEEN THE LOWER EDGE OF THE ROLLER RIM AND CORRESPONDING RAIL.

Plate 6891. Roller Adjustments

UPRIGHT ROLLER ADJUSTMENTS.

NOTE

THE UPRIGHT OUTER RAIL ASSEMBLY IS MANUFACTURED WITH A SLIGHT TAPER, THE BOTTOM BEING 1/16 INCH WIDER THAN THE TOP. EXTEND THE UPRIGHT TO THE UPPER LIMIT. CHECK TO BE SURE THERE IS NO BIND. LOWER UPRIGHT. IF THERE IS A BIND, THE INNER SLIDE WILL HESITATE OR REMAIN AT THE UPPER LIMIT. AS THE LIFT CYLINDER BEGINS TO RETRACT, THE INNER SLIDE WILL BREAK FREE AND THEN LOWER. THIS INDICATES IMPROPER ADJUSTMENT, OR THIS MAY INDICATE A DAMAGED ROLLER WHICH WILL NOT ROTATE. RAISE AND LOWER CARRIAGE AND CHECK TO BE SURE ALL ROLLERS ROTATE FREELY.

1. Because of the 1/16 inch taper in the Outer Rail Assembly, the rollers may bind when upright is extended if roller adjustment is made with the upright lowered; therefore, the upright must be extended to the upper limit (with no backward or forward tilt) before making any adjustments.

2. Insert pry bar between bottom end of either right or left Inner Slide (Rail), and Outer Rail, refer to Plate 6891.

3. Move Inner Slide sideways to remove all clearance at opposite rail.

4. When checking clearance on the side that pry bar was installed, there must be some clearance between the Outer Rail and the bottom roller at the lower edge of the Roller Rim. THIS CLEARANCE SHOULD NOT EXCEED 1/32 INCH. If clearance is checked on opposite side, clearance should be checked between Outer Rail and bottom roller at the upper edge of Roller Rim, refer to Plate 6891 and 6325.

NOTE

THE BOTTOM ROLLERS OF THE INNER SLIDE, MUST BE CHECKED FOR CLEARANCE IN A 10 TO 20 INCH SECTION STARTING AT TOP OF OUTER RAIL ASSEMBLY, SEE Plate 6572.

5. Check clearance between Outer Rail Upper Rollers and Inner Slide. ROLLER CLEARANCE SHOULD BE CHECKED THE FULL LENGTH OF THE INNER SLIDE ASSEMBLY. Refer to Step 4 for Roller Clearance Specifications.

6. If adjustment is required, proceed as follows:

7. Disassemble upright.

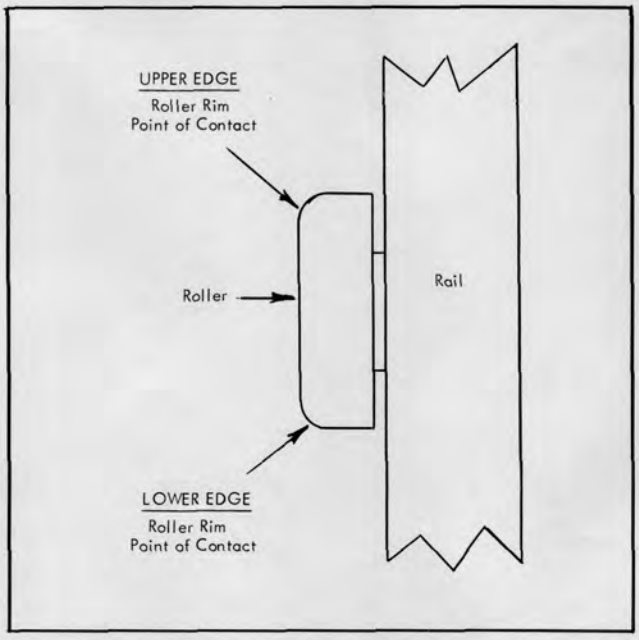


Plate 6325. Upright Roller

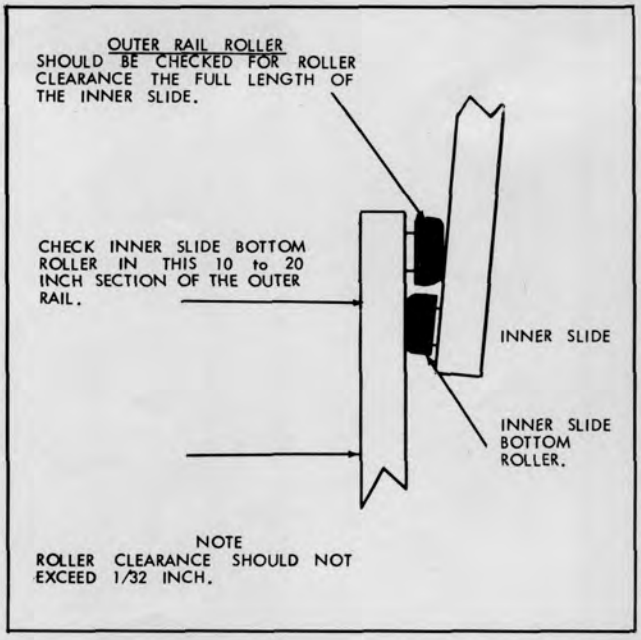


Plate 6572. Outer Rail Roller Clearance Check

8. Remove rollers from shafts and add or remove shims to acquire the clearance previously stated.

N O T E

THE ROLLER SHAFTS ARE WELDED TO THE RAIL ASSEMBLIES. TO REMOVE ROLLERS, MERELY PULL ROLLERS FREE OF ROLLER SHAFTS.

9. Reassembly upright.

10. Follow Steps 1 thru 5 and recheck clearance.

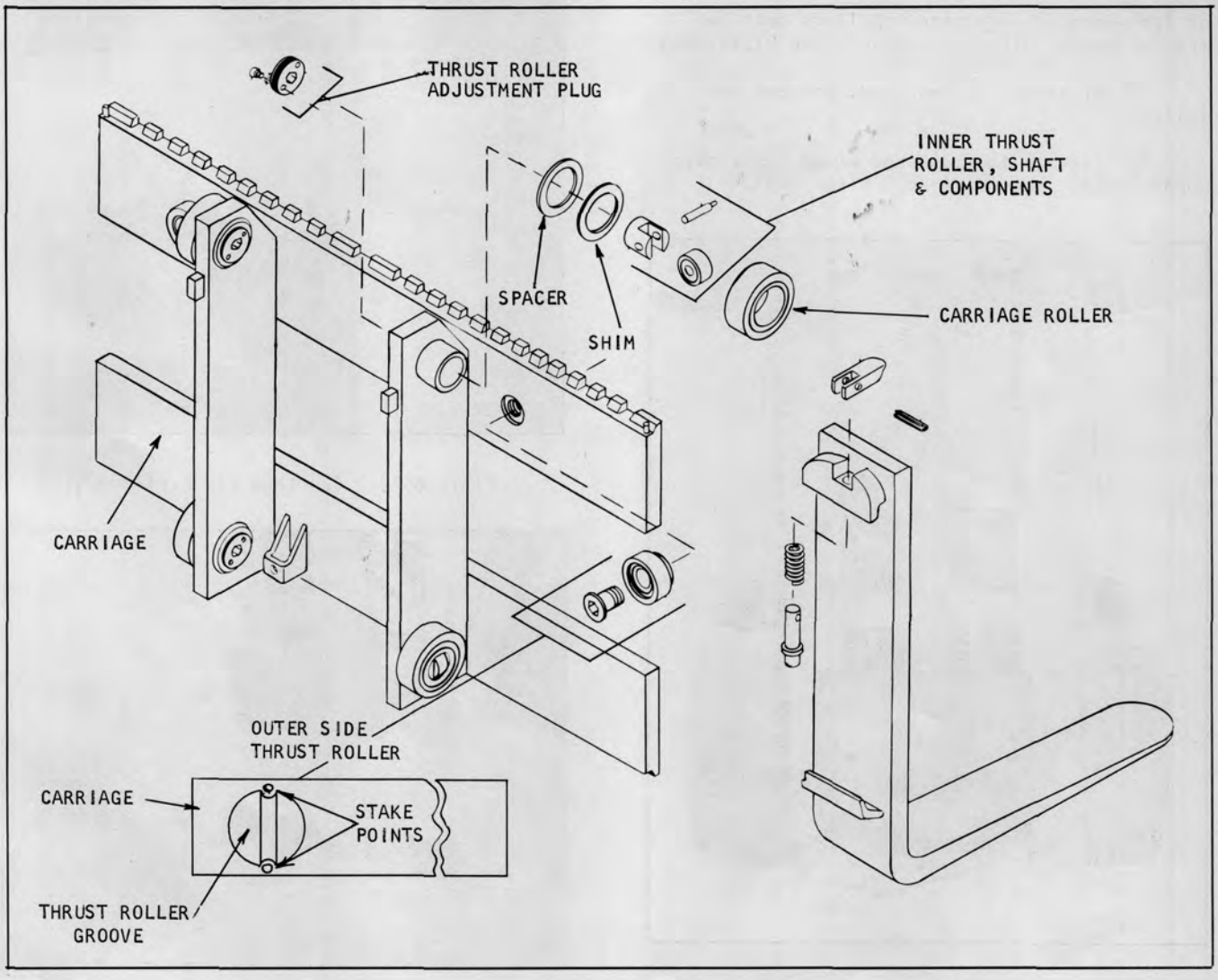


Plate 7238. Lift Carriage

LIFT CARRIAGE ROLLER ADJUSTMENTS

CARRIAGE MUST BE ADJUSTED SO IT IS HORIZONTAL AND CENTERED IN THE UPRIGHT FRAME. ROLLER CLEARANCE SHOULD BE CHECKED THE FULL LENGTH OF THE RAILS. ROLLERS SHOULD HAVE CLEARANCE OF NOT MORE THAN 1/32 INCH AT EACH SIDE

Outer Side Thrust Rollers

The Outer Side Thrust Rollers do not require adjustment. These should be replaced in the event of wear or damage. The maximum clearance is 1/16 inch at each side.

Tighten the Outer Side Thrust Roller Shafts to 150 pound feet torque. The end of these shafts have a machined groove. Stake with a punch at each end of groove as shown in (Plate 7238.) This will secure shaft to lift carriage.

Inner Side Thrust Rollers

1. Check the clearance between the Inner Side Thrust Rollers and Inner Rails. Maximum allowable clearance is 1/32 inch or 1/64 inch at each side. Rollers must be free to rotate without binding. See Plate 7238.

or 1/64 inch at each side. Rollers must be free to rotate without binding. See Plate 7000.

If adjustment is required, proceed as follows:

2. Elevate carriage and place a suitable support under the carriage. Plate 8623.

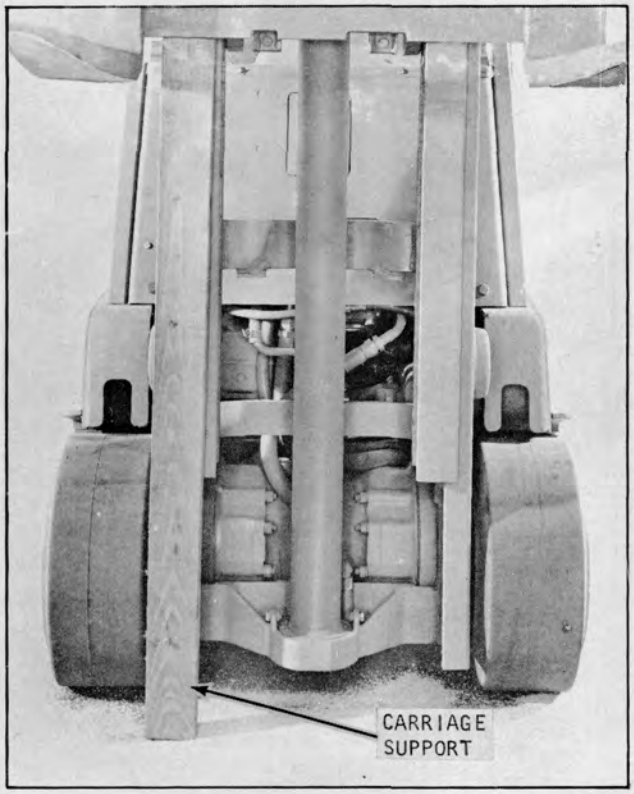


Plate 8623. Carriage Support

3. Remove carriage lift chain pins & replace with similar sized bolts. Plate 8599.

4. Remove carriage support, lower carriage to bottom, and tilt upright a little forward of vertical till carriage rests on the floor.

5. Remove bolts, raise channel, and back away from carriage. Plate 8922.

6. Add or remove shims as required to obtain correct clearance. Plate 8923.

7. Reinstall carriage by reversing steps 2-5.

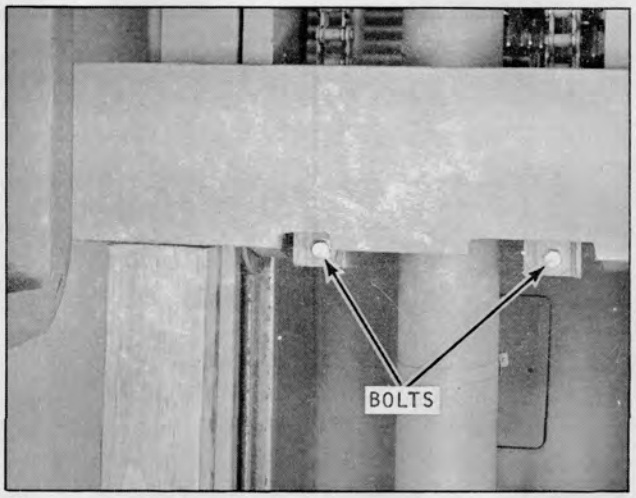


Plate 8599. Carriage Pin Replacement

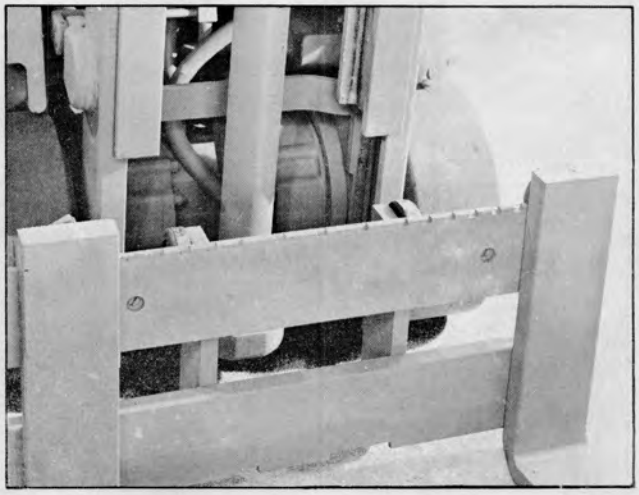


Plate 8922. Carriage Removed

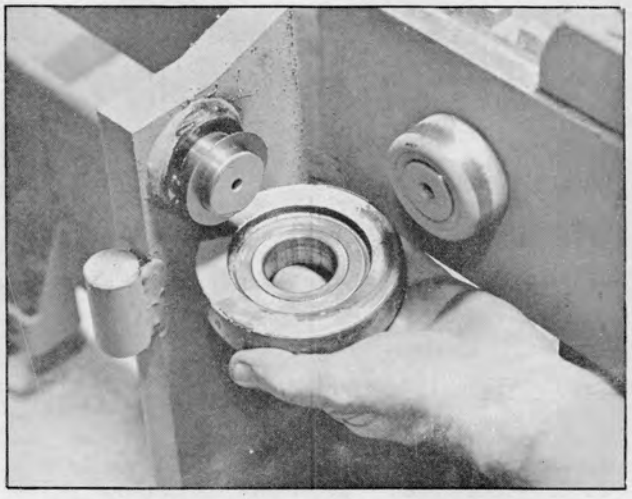


Plate 8923. Shim Adjustment

DRIVE AXLE

TROUBLE	PROBABLE CAUSE	REMEDY
Continuous Axle Noise.	Badly worn parts.	Replace worn parts with new.
	Unevenly worn tires.	Replace tires.
	Improperly adjusted wheel bearing.	Adjust correctly.
	Lack of lubricant.	Add sufficient lubricant of correct grade.
Axle Noise on Drive or on Coast Only.	Differential pinion gear and ring gear out of adjustment or worn excessively.	Adjust, repair or replace entire unit if conditions warrants.
Excessive Backlash in Axle Driving.	Loose axle shaft drive flange cap screws.	Tighten cap screws.
	Flange loose on axle shaft.	Reweld flange to shaft.
	Worn splines on axle shaft at differential end.	Replace drive flange and shaft assembly.
	Differential drive pinion gear and ring gear out of adjustment or worn excessively.	Adjust or replace as condition warrants.
Complete Failure to Function.	Broken axle shaft.	Replace axle shaft.
	Broken teeth on ring gear or pinion gear.	Replace ring gear and pinion and other parts of differential necessary. Adjust ring gear and pinion gear correctly.

STEERING AXLE

TROUBLE	PROBABLE CAUSE	REMEDY
Trouble.	Damaged axle.	Replace axle.
	Lubrication leaks.	Replace oil seals. (Refer to Lubrication Section). Report to designated individual in authority.
	Incorrect caster or camber.	Report to designated individual in authority.
	Uneven tire wear.	Inflate tires properly. Check wheel alignment.

BRAKES

TROUBLE	PROBABLE CAUSE	REMEDY
Brakes drag.	Improper pedal adjustment.	Adjust brake pedal free travel.
	Brake pedal return spring broken or weak.	Replace spring.
	Brakes improperly adjusted.	Adjust brakes.
	Brake shoe anchor pin tight in shoe.	Free-up pin and lubricate lightly.
	Brake shoe return spring broken or weak.	Replace spring.
	Loose or damaged wheel bearings.	Adjust or replace wheel bearings.
	Insufficient brake shoe clearance, or improper brake anchor pin adjustment.	Adjust brakes.
	Brake backing plate loose.	Tighten plate.
	Grease on linings.	Correct grease leakage; clean or install new shoes and lining assemblies.
	Dirt imbedded in lining.	Clean lining with wire brush.
	Drums scored or rough.	Replace drum and brake shoe and lining assemblies.
Severe brake action on light pedal pressure.	Brake shoes improperly adjusted.	Adjust brakes.
	Grease on linings.	Correct grease leakage; clean or install new shoes and lining assemblies.
	Loose brake shoe anchor.	Adjust and tighten.
Brake locked.	Brake pedal lacks free travel.	Adjust pedal free travel.
	Brakes frozen to drums (cold weather).	Break loose by driving vehicle.
Brake noisy or chatters.	Brake lining worn.	Replace shoe and lining assemblies.
	Grease on linings.	Correct leakage; clean or replace shoe and lining assemblies.
	Dirt embedded in linings.	Clean lining with wire brush.
	Improper or loose linings.	Replace shoe and lining assemblies.
	Brake shoe or drum distorted.	Straighten or replace.

BRAKES (Continued)

TROUBLE	PROBABLE CAUSE	REMEDY
Excessive pedal travel.	Lining worn.	Adjust or replace shoe and lining assemblies.
	Brake improperly adjusted.	Adjust brake.
	Scored brake drums.	Repair or replace drums.
Excessive pedal pressure.	Grease on linings; worn or glazed lining.	Correct grease leakage; clean up and replace shoe and lining assemblies.
	Warped brake shoes, or defective brake linings.	Replace shoe and lining assemblies.
	Shoes improperly adjusted.	Adjust brakes.
	Brake drum scored or distorted.	Repair or replace drums.
	Shoes improperly adjusted.	Adjust brakes.
	Insufficient fluid in master cylinder.	Fill master cylinder to within 1/4 inch of the top.
Wheel troubles.	Wheel wobbles; bent.	Inspect mounting on hub, spindles, and drive axle; replace defective wheel or mounting.
	Wheel loose on hub.	Tighten.
	Wheel out of balance.	Balance wheel.
	Wheel bearings run hot.	Adjust, lubricate wheel bearings.

INDUSTRIAL TRUCK DIVISION

TROUBLE SHOOTING GUIDE

HYDRAULIC SYSTEM

TROUBLE	PROBABLE CAUSE	REMEDY
Pump not delivering oil.	Wrong direction of rotation.	Must be reversed immediately to prevent seizure and breakage of parts due to lack of oil.
	Tank oil level low.	Add recommended oil.
	Oil intake pipe or suction filter plugged.	Replace filter cartridge, clean strainer if so equipped.
	Air leak in suction line.	Will prevent priming, or cause noise and irregular action of control circuit.
	Oil viscosity too heavy to pick up prime.	Thinner oil should be used, per recommendations for given perature and service.
	Broken pump shaft or gear.	Report to designated individual in authority.
Pump not developing pressure.	Pump not delivering oil for any of the above reasons.	Check oil circulation by watching oil in tank.
	Relief valve setting not high enough.	Refer to relief valve instructions.
	Relief valve sticking open.	Dirt under pressure adjustment valve. Refer relief valve instructions.
	Leak in hydraulic control system (cylinders or valves).	Find leak and correct.
	Partially clogged intake line, intake filter or restricted intake pipe.	Pump must receive intake oil freely or cavitation will take place.
Pump making noise.	Small air leak at pump intake piping joints.	Test by pouring oil on joints while listening for change in operation. Tighten as required.
	Air leak at pump shaft packing.	Repair or replace.
	Tank air vent plugged.	Must be open thru breather opening or air filter.
	Too high oil viscosity.	Use recommended oils.
	Shaft packing worn.	Replace shaft packing per preceding instructions.
	Oil filter dirty.	Replace filter element.
Forks do not lift to maximum height.	Hydraulic Oil level low.	Fill sump tank.

HYDRAULIC SYSTEM CONTINUED

TROUBLE	PROBABLE CAUSE	REMEDY
Lift or tilt action fails.	Loss of oil pressure.	Report to designated individual in authority.
Oil leak at top of lift cylinder assembly.	Worn or damaged lift piston seal.	Replace seal.
	Scored cylinder wall.	Replace cylinder.
	Plugged vent line.	Clean out vent line. Replace if collapsed.
Oil leak around piston rod at tilt cylinder.	Worn seal.	Replace seal.
	Scored piston rod.	Replace rod and eliminate cause of scoring which may be caused by misalignment, worn bearing or foreign matter.
With load centered on lift forks load is lifted unevenly.	Lift chains out of adjustment.	Adjust chains.

EC30BSG, EC40BSG, EC20CSG, EC25CSG,
EC30CSG, EC40CSG, EC50CSG

CIRCUIT OPERATION

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 semiconductor rectifier used as a latching switch; i.e., it may assume either a conducting or non-conducting state (On or Off).

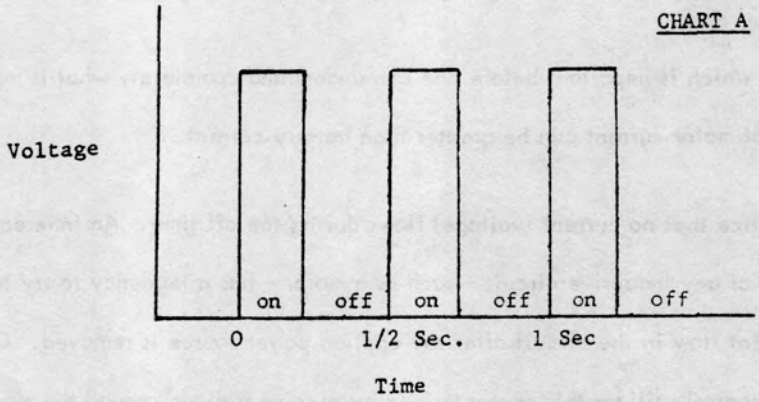
The SCR can be turned on by a momentary application of control current to the gate. To turn it off, it is necessary in addition to removing the turn-on signal from the gate, either to remove all power from the SCR or to apply momentary reverse voltage between cathode and anode.

An SCR is a very fast switch. It can be turned off or on at will up to several thousand times per second depending on how its controlling circuitry is arranged. Its conduction or non-conduction is merely a rearrangement of electrons within itself; therefore an SCR has no known limit of life expectancy. To put it conservatively one could say an SCR has a minimum life expectancy of several billion operations when operated within its ratings.

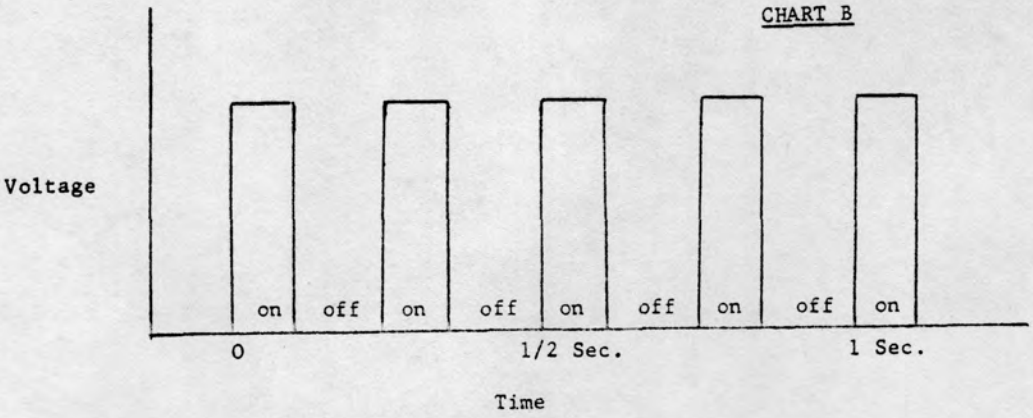
Fine - now we have a switch that we can operate very fast and it never wears out - now what? Suppose we connect this SCR between the battery and a d-c series motor. Then suppose we arrange the SCR so that we can operate it several times per second. Better still, let's arrange it so we can vary the number of times per second that we switch it off and on. These operations occur so rapidly we cannot observe them on a recording ammeter. Therefore, if we want to see them we need something that

has a faster response time. Fortunately, we have such an instrument and it is called an oscilloscope.

Now let us see how we can apply this new tool to speed control of a d-c motor. By varying the voltage applied to a d-c series motor we can control its speed. Up to now we have controlled this voltage by using resistors to vary this voltage. If we look at the operations of the SCR or pulses as we call them we can expect to see something like this.



The voltage is available for brief intervals of time as shown in Chart A as the SCR is switched off and on. Now if we double the number of times per second that we switch the SCR off and on, the results are seen in Chart B.



Another way of looking at these two charts is that when we went from Chart A to Chart B we doubled the frequency, that is we doubled the number of pulses per second.

It should now be obvious that the average voltage is higher on Chart B than on Chart A since more voltage is present in any given second of time.

Now let us look at the oscilloscope. If we set 6 volts and double the number of pulses we get 12 volts. Therefore, by pulsing the SCR off and on and smoothly controlling the number of pulses per second, we get speed control for a fork truck.

The next item which is important before one can understand completely what is happening here is that motor current can be greater than battery current.

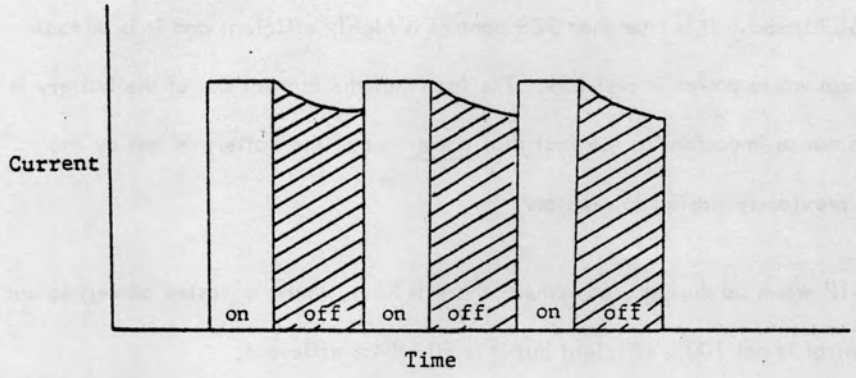
In Chart A notice that no current (voltage) flows during the off time. An inherent characteristic of any inductive circuit - such as a motor - has a tendency to try to maintain current flow in the circuit after the applied power source is removed. General Electric SCR control utilizes this characteristic by placing a diode* around the motor. This allows the current resulting from the inductive properties of the motor to circulate through the motor during the off time (refer to circuit diagram).

*(3 REC - FLY BACK DIODE)

Three REC is a silicon diode which is nothing more than a highly reliable, high current, small size recitifer which passes current easily in one direction but not in the other. The current which flows during the off time as a result of motor inductance is called fly-back current. Hence, this is called the fly-back diode.

Now, if we want to show motor current, instead of looking like Chart A, it will look like Chart C.

CHART C



The shaded areas are the resultant of the addition of the fly-back current and as is easily seen, raises the average current to a much higher level.

Thus, motor current can be greater than battery current. However, don't be fooled, we are not getting something for nothing.

Power is equal to volts times amps and for example if 100A is flowing out of the battery and 200A is flowing into the motor, the battery is at 36V and the motor is at 18V. Thus, the power is equal so we have not really saved any power.

The saving results as follows: The chunk of power that used to be dissipated in the resistor to get the motor down to 18V is now saved. It never comes out of the battery because SCR control utilizes only as much power as the motor needs for any reduced speed condition and does not waste it in resistors.

Since the power always has to be the same, in the battery and the motor, then at high speeds when motor voltage (CEMF) and battery voltage approach each other, then the current multiplier becomes smaller and smaller until it approaches 1 to 1 at top SCR speed. It is true that SCR control is highly efficient and it is because it does not waste power in resistors. The fact that the current out of the battery is lower is not as important as the fact that power out of the battery is less by the amount previously wasted in resistors.

SCR's will warm up during use. Where there is heat, there is wasted power; so our SCR control is not 100% efficient but it is 90 - 94% efficient.

The power out of the battery does not quite equal the power into the motor. It is 6 to 10% more out of the battery than into the motor which are the 6 to 10% losses in the SCR. The pulses per second or frequency of General Electric SCR control varies to cause the motor voltage to vary over a range which will operate the truck from creep speed to approximately 70% of full speed. This frequency varies from 45 pulses per second at creep speed to 300 pulses per second at 70% speed. The average voltage at the motor - thus the speed of the vehicle - is a function of the number of pulses per second. The number of pulses per second is infinitely variable by operation of the accelerator pedal which operates a variable resistor or potentiometer in the accelerator master switch.

We have one more point to understand and then we can try to determine how the circuit works. The SCR unit has four leads, two of which are power and two of which are control.

By applying a small amount of control power to the control leads (about 50 milliamps - .05 amps and 10 volts) we can cause the SCR to conduct power in the range of up to 200 amperes. However, if the control signal is removed, the SCR continues to conduct. An alternate means must be used to turn it off. The way we accomplish this is to pass current backward through it for a given period of time - four millionths of a second - and this turns the SCR off.

Let us now look at a block diagram of the circuit.

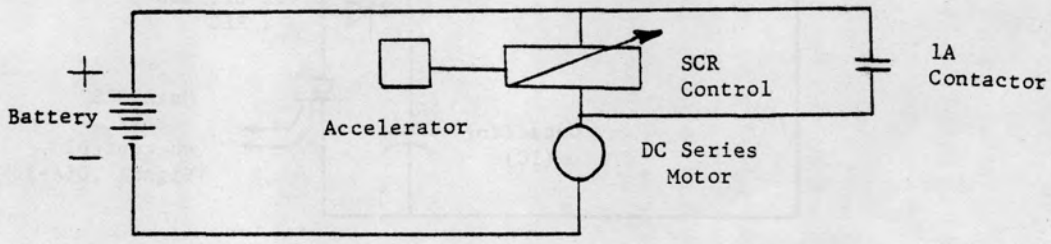


FIG. 2

The SCR is merely a device inserted in series with the motor to control it's speed by varying the voltage to the motor. The speed is controlled by varying the potentiometer in the accelerator master switch.

For the top speed and efficiency as well as to assure that the motor torque is not limited on a ramp, bypass contactor (1A) is provided. This places the motor directly across the battery.

Now we are prepared to look at the circuit in detail.

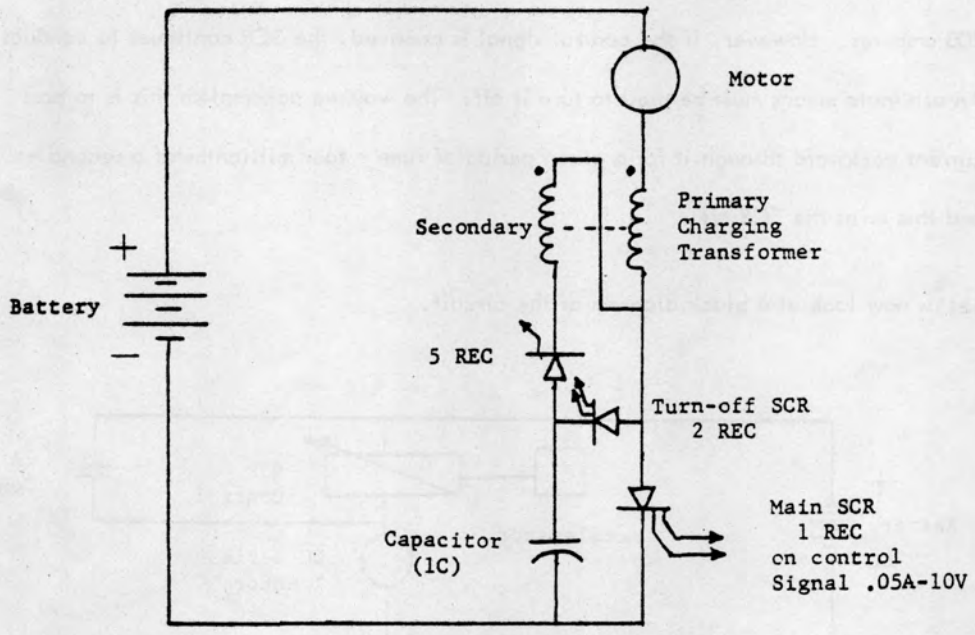


FIG. 3

The first thing that is obvious is that there are only two control items in the power circuit; the main SCR and the primary of the charging transformer. There is considerably less than 1 volt drop across the two of these items in total at rated current. Thus, you can see why the efficiency of this scheme is so high. The "turn-off" SCR, the capacitor, 5 REC, and the secondary of the charging transformer are low current control items used to reverse

the current in the main SCR and turn it off. When a pulse of current flows through the primary of the charging transformer, a high voltage (approximately 100 volts) is produced by the secondary of the charging transformer and it charges the capacitor through 5 REC, which turns on at this time. The capacitor is now charged minus on top and plus on bottom. 2 REC and 5 REC block this voltage and store it on the capacitor until it is time to stop any given pulse. Then 2 REC receives a small signal which causes it to conduct and discharge the capacitor backward through the main SCR, forward through the "turn-off" SCR, and back to itself. Thus, the main SCR is turned off and is ready for the next "on" pulse after the proper laspe of time.

We have now turned the SCR on and off but how did we generate the control signals that were the initiators of the action?

In order to proceed along this line it is necessary to understand how a Resistive-Capacitive (R-C) circuit works since it is the heart of the control system.

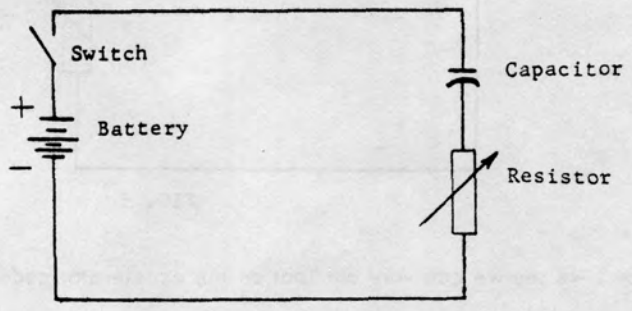


FIG. 4

If the switch in figure 4 is closed, current flows through the resistor and into the capacitor. The charge on a capacitor is measured in ampere-seconds. In other words, for any given size of capacitor, it takes a definite time to reach its full charge with a specified amount of current flowing into it. Therefore, if we select a given capacitor and a given resistor, we get a fixed amount of time to charge the capacitor. Thus, we have a very reliable, static, and repetitively accurate timer which has been used for timing and electronics for many years. Now, if we vary the value of the resistor, we vary the current which would vary the time to charge the capacitor. To do this, we put a variable resistor or potentiometer in the accelerator master switch which changes resistance as a function of foot position on the accelerator pedal. Thus we have varied time. The signal from the capacitor is fed to the control leads on the main SCR. Whenever, the capacitor charges, a signal is fed to the main SCR and turns it on and pulses it.

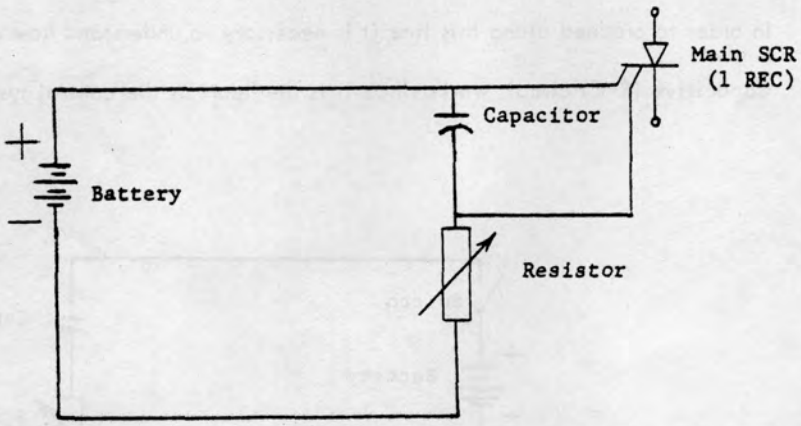


FIG. 5

Now, we see we can vary our foot on the accelerator pedal and vary the frequency of the pulses of the main SCR. High resistance in the accelerator pedal potentiometer

gives low current flow into the capacitor. Since it takes a long time to charge the capacitor, there is a long time delay between pulses and the main SCR is fixed only a few times per second, resulting in slow speed. Conversely, if the foot pedal is fully depressed, resistance is lowered, time is short, frequency is high and truck runs at 70 per cent (top SCR) speed. We have now figured out how to generate variable frequency "on" pulses for the main SCR.

As far as 2 REC (turn off SCR) goes, this is a slave to the main SCR and always fires after a given amount of time. This means the on time of the main SCR is constant.

AUXILIARY FUNCTIONS

The first auxiliary function that we shall look at is the current limit circuit. The function of this circuit is to limit the maximum amount of current that the battery can ever deliver under any conditions while on SCR control, to 200 amperes average. This function is accomplished by pulse width modulation. That is, the width of the pulses is narrowed as is necessary to hold the average current down to 200 amperes. See figure 6. Details on checking and adjusting the current limit function are found in Operating and Maintenance Instructions.

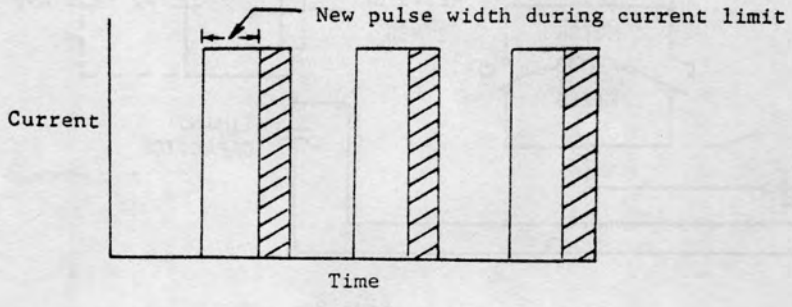


FIG. 6

Next, let's take a look at the plugging function. The first thing that must be done is to sense that a plug is taking place. This is done as shown in figure 7 by placing a diode around the armature in the reverse direction so that it normally blocks the

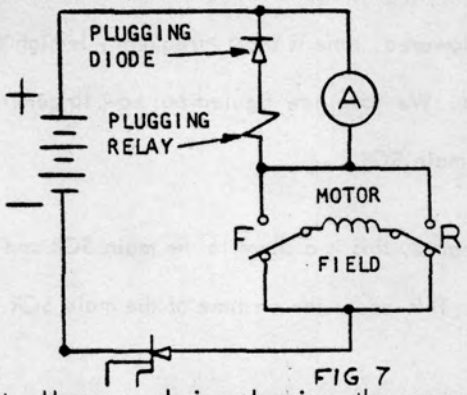


FIG 7

flow of current. However, during plugging, the current in the armature reverses, thus, current will flow through the plugging diode. Therefore, if we add a plugging relay, with a current coil in series with the plugging diode, we can operate a relay every time we plug.

If we use a normally closed set of contacts on the relay (see figure 8), the plugging

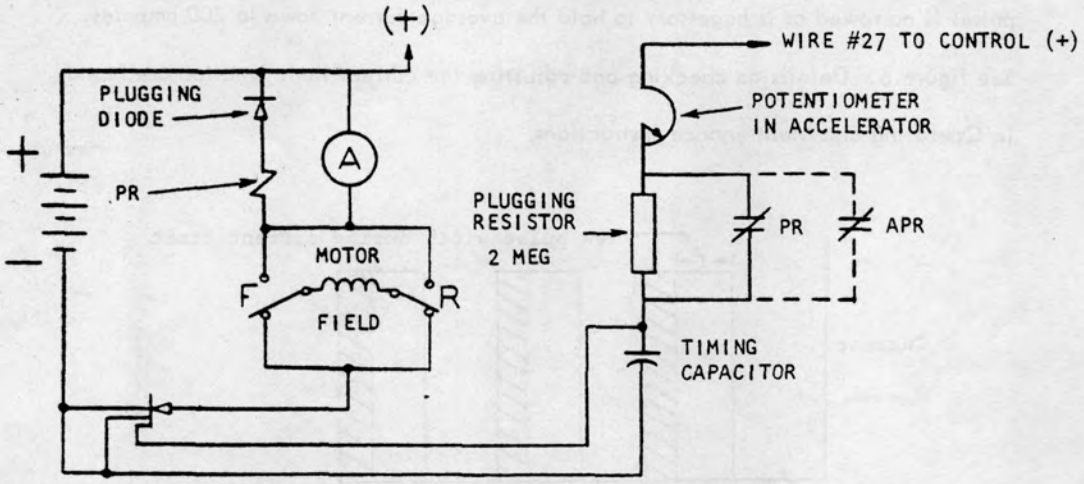


FIG. 8

relay operates, the normally closed PR contacts open and a large volume of resistance is inserted in the R-C timing circuit for the "on" oscillator. This increases the time between pulses and reduces the pulse frequency to a very low value - 1 to 5 pulses per second. Thus, with a very low average current during plugging, a controlled plug is possible. Next, the plugging resistor is made in the form of a potentiometer so that plugging can be adjusted for various weights of trucks so that each truck can be adjusted for the right degree of deceleration during plugging.

The next part of the circuit to be discussed is the auxiliary plugging relay as shown in figure 9.

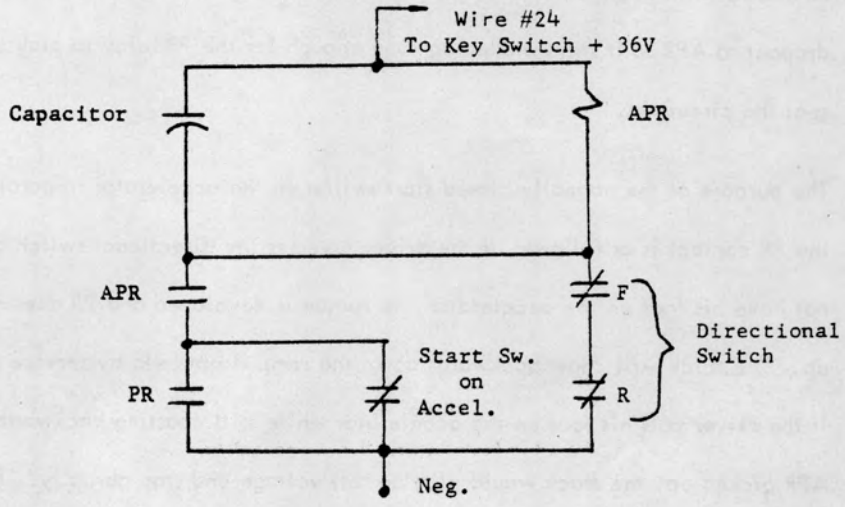


FIG. 9

This circuit is designed to allow starting on steep ramps. Without it, if you try to start on a steep ramp, when you take your foot off the brake and transfer it to the accelerator, during this time even though brief, the truck coasts backward, the generated current flows through the plugging relay (refer figure 7); the plugging

relay picks up and reduces the pulses to 1-5 per second. Thus, the truck "locks in" and coasts slowly backward to the bottom of the ramp. To prevent this, the APR relay is used with its normally closed contact in parallel with the PR contact as shown by the dotted portion of figure 8.

The APR relay operates only as a function of the directional switch. The F & R contacts shown in figure 9 are closed only in the neutral position of the direction selector switch. Thus, whenever the directional switch is moved from forward to reverse, APR picks up and, if the truck is being plugged, PR also picks up. Thus, APR seals in through the APR and the PR contacts. The capacitor gives time delay dropout to APR so it stays picked up long enough for the PR relay to pick up and seal the circuit in.

The purpose of the normally closed start switch on the accelerator in parallel with the PR contact is as follows: If the driver reverses the directional switch but does not have his foot on the accelerator, no torque is developed and PR does not pick up. The truck will coast backwards down the ramp if not held by service brakes. If the driver puts his foot on the accelerator while still coasting backwards without APR picked up, the truck would plug on full voltage and stop abruptly. This normally closed accelerator contact keeps APR picked up during the coast so that when the accelerator is depressed, PR picks up, and a normal controlled plug results.

The following items can be found in the circuit diagram.

The next auxiliary item to be considered is 14 REC. This is a blocking diode in the

negative line feeding all the control. This is to prevent burning up the control components which are sensitive to voltage polarity. If when the control is being installed in the truck, the plus and minus leads are mixed up, this diode will block current flow and no damage to the control will result and the control is rendered completely inoperative.

The next group of items are diodes 7 REC, 8 REC, and 9 REC. These are suppressors of induced voltage caused by contactor being energized and de-energized.

The next items to be considered are (* Read note & continue) feed 36 volts to the "on" R-C circuit and start the pulsing. The control power is fed in this manner so that the main SCR will always stop conducting before F or R open, thus limiting the role of F and R to carrying current rather than breaking current. This means greatly extended tip life.

The next item to be considered is Card 3. This is an adjustable static timer which utilizes a small SCR and 3 transistors to give adjustable time delay for the 1A contactor. The timing of the 1A contactor can be adjusted from instantaneous to about 2 seconds. Thus, the truck can be adjusted to have any degree of acceleration desired since the time spent on SCR control is adjustable.

*the normally open contacts of the F & R interlocks. These contacts are in series between the control (+) and wire # 27 to

COMPLETE CYCLE OF OPERATION

Referring back to the circuit diagram..... mentally close the key switch with the seat switch closed, take your foot off the brake and step lightly on the accelerator pedal. This closes the start switch in the accelerator and if the directional switch is closed to FWD the F contactor closes and pulsing begins at low frequency and you are in creep speed. Then as you depress the accelerator more and more the truck accelerates due to increased pulse frequency and finally if the accelerator is fully depressed the 1A switch closes in the accelerator and after the set time delay the 1A contactor closes and bypasses the SCR. Now, the truck accelerates to top speed.

Now plug the truck from top speed by throwing the directional selector switch from forward to reverse and keeping the accelerator fully depressed.

F drops out and R picks up, APR picks up since the directional switch passed through the neutral position, PR picks up since plugging current is flowing and drops out the 1A contactor. The truck decelerates smoothly since pulsing has been drastically reduced. When the truck approaches 0 speed, no additional plugging current is flowing, PR drops out which drops out APR, and full SCR pulsing begins accelerating the truck in the opposite direction. Since the accelerator pedal is still fully depressed after the set time delay, 1A picks up, and the truck accelerates to full speed reverse.

Now that you have completed one cycle of operation (that is, starting from a stop, accelerating to full speed, plugging to a stop, and then accelerating to full speed in reverse) it is suggested you try some mental gymnastics to ascertain that you understand

how each function operates.

Think in terms of normal electric lift truck operation - A typical maneuver would be as follows - Pick up a load - haul it in a forward direction at top (1A) speed, reduce speed and place the load in a stall at right angles from direction of travel, stopping by use of brakes. Reverse direction backing up a short distance, plugging to a stop, and reversing to a forward direction to pick up another load. Stop with brakes. Reverse direction to clear stall area plugging to a stop and proceed in the forward direction to haul new load to its destination.

If you were able to run thru this exercise, without referring to the detailed sequence as given above, then you are ready to understand the trouble-shooting instructions as detailed in the Operation and Maintenance Instructions.

CLARK EQUIPMENT

INDUSTRIAL TRUCK DIVISION

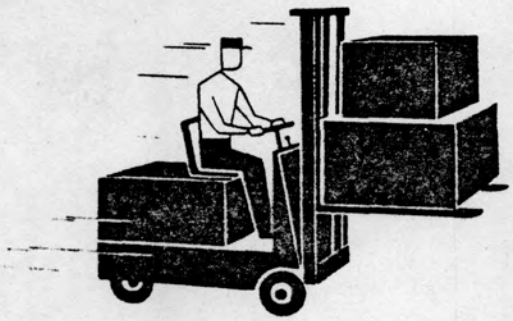
TROUBLE SHOOTING

CLARK EQUIPMENT

OPERATING & MAINTENANCE

INSTRUCTIONS

SCR CONTROL for ELECTRIC VEHICLES



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 semiconductor rectifier used as a latching switch; i.e., it may assume either a conducting or nonconducting state (On or Off).

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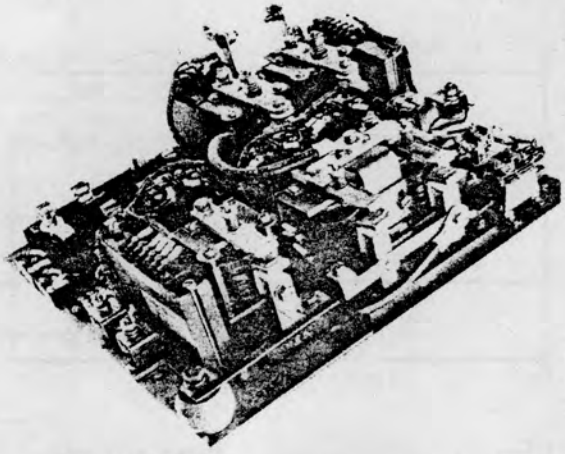


Plate 8931.
Typical contactor panel consisting of forward, reverse pump and bypassing contactors; static timing module, and plugging relays.

PHOTOS OF CONTROL

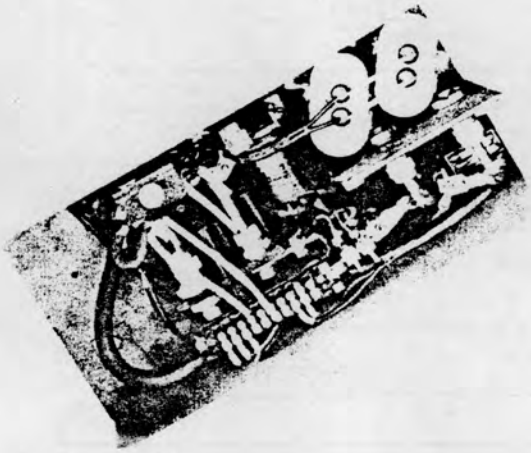


Plate 8933.
Typical SCR panel containing all SCR's, amplifiers, and capacitors.

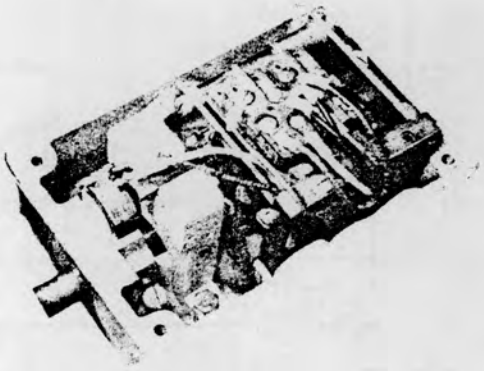
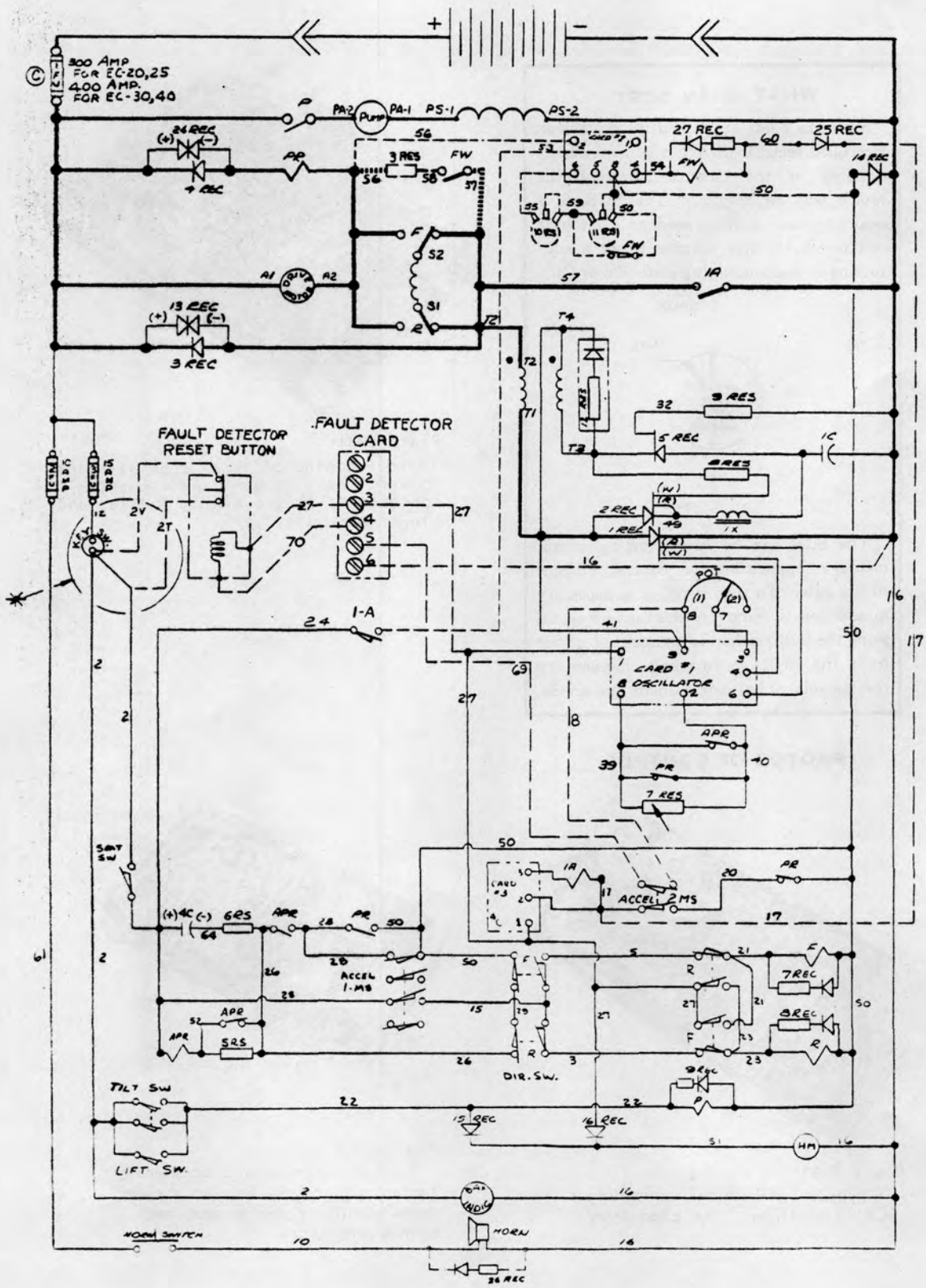


Plate 8932.
Typical foot-operated accelerator switch with cover removed showing speed control potentiometer and control interlocks.


300 AMP FOR EC-20,25
400 AMP. FOR EC-30,40
FAULT DETECTOR RESET BUTTON
FAULT DETECTOR CARD
CARD #1 OSCILLATOR
CARD #3
ACCEL 2 MS
ACCEL 1 MS
DIR. SW.
TILT SW
LIFT SW.
HORN SWITCH
HORN
24 REC
4 REC
3 REC
13 REC
27 REC
25 REC
14 REC
10 RES
11 RES
3 RES
5 REC
8 RES
2 REC
1 REC
7 RES
6 RES
5 RES
7 REC
8 REC
9 REC
15 REC
16 REC
26 REC
FW
R
F
PA-1
PA-2
PS-1
PS-2
S1
S2
T1
T2
T4
1A
1C
1-A
1X
2V
2T
SEAT SW
TILT SW
HM

CIRCUIT OPERATION

(Wiring diagram)

The circuit is energized by closing the key switch, the seat switch, and moving the F or R lever to either position and then depressing the accelerator. The F or R contactor coil is now energized applying power to the drive motor circuit. Control power is fed through the contactor interlocks to Card 1. Card 1 contains two basic circuits: an oscillator and a current limit circuit.

The *Oscillator Section* of Card 1 will oscillate when positive control power is applied and a synchronizing control signal is applied from the anode of 1REC. The oscillator output is fed to the gate of 1REC, the main SCR. This is the gate signal which will switch 1REC to the conducting state. When 1REC is conducting, current flow is from battery positive through 1FU, drive motor, T2-T1, 1REC and back to battery negative. The initial rising d-c current through T2-T1 induces a voltage from T4 to T3, drives T3 below battery negative, causes current to flow through 9RS to the gate of 5REC, turning 5REC on. The current flowing through 5REC and T4 to T3 charges 1C (wire 34) negative until the transformer saturates, reducing this current flow to zero, turning off 5REC. The voltage of T3 then swings from negative to positive, causes current to flow through 8RS to the gate of 2REC, turning 2REC on. 2 REC conducts, capacitor 1C discharges around the circuit composed of 1C, 1REC, 2REC, and 1X. This discharge current flows through 1REC in the reverse direction, thus turning off the main SCR.

This explanation has been for one complete cycle of circuit operation. 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. Figure 6 shows the nature of the motor current. It should be noted that the average current measured at the motor will be greater than the average current measured at the battery. 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 cycle to start is determined by the time that the oscillator section takes to oscillate. This frequency of oscillation is controlled by the

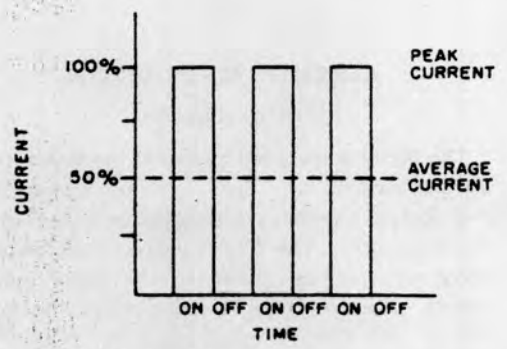


Figure 5—Battery Current

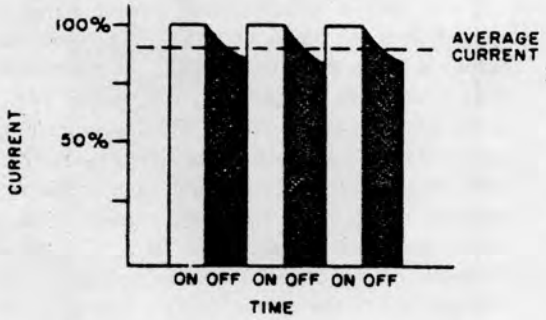


Figure 6—Motor Current

pot on the accelerator. Slow speed is obtained by having maximum ohms in the potentiometer, as the resistance in the pot *decreases*, the speed of the motor *increases*. With level operation, the SCR circuit is capable of delivering approximately 70% speed. For full speed operation 1A contactor is closed to apply full battery voltage to the motor. 1A coil is energized by closing 1A switch on accelerator.

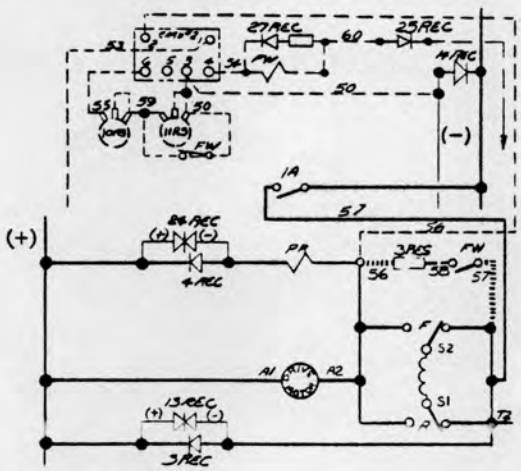
The *Current Limit Section* of Card 1 provides protection to motor and control by limiting currents during acceleration and stall. This circuit is sensitive to load current and overrides the oscillator under heavy loads so as to limit the pulse frequency (thus the average current) to a safe value. The current limit is adjusted to give 175-200 amperes SCR current (400 to 500 amperes motor current) at locked rotor.

Time delay acceleration is provided by a static timing circuit (Card 3). This circuit delays the closing of the 1A contactor following the closing of the 1A contact in the acceleration switch. This time delay is adjustable by means of a screwdriver adjustment on Card 3 from .3 to 3 seconds.

Some truck applications require more speed than normally available with the motor connected directly across the battery (with 1A closed). After 1A is closed, Card 2 senses truck speed (by measuring voltage across the series field). After a suitable speed has been attained on full field, FW contactor is energized to insert a field-weakening resistor (3RS) in parallel with the drive motor field. If speed should drop (as when going up a grade) Card 2 drops out FW contactor, reapplying full field to the motor. Refer to Figure 7 for a partial elementary showing the field weakening circuit.

Smooth slow down is provided while reversing by providing a small amount of retarding torque for deceleration. This is accomplished by means of a plugging relay (PR) with its coil in series with 4 REC connected across the drive motor armature.

During normal motor operation the current through the PR coil is not great enough to pick up the relay. Now if the drive motor is reversed under load, it then becomes a generator being driven by the inertia of the truck. The output of the generator is across the armature; therefore, the generated current flows through PR and 4



*Furnished by Truck Mfr.

Figure 7 – Partial diagram showing field-weakening circuit.

REC, and PR picks up. One PR interlock prevents closing 1A. 1A will also prevent closing FW if field weakening is used (See Figure 7). The other interlock (disregard APR interlock for the moment) inserts an additional value of resistance in the oscillator circuit, greatly reducing the pulse frequency. This is necessary since a short-circuited generator requires very little field current (excitation) for large armature current output. Therefore, battery current (SCR current) during plugging is very low. 4 REC which short circuits the armature during plugging also provides the auxiliary function of a clamp circuit to prevent the generator from building up high voltages during plugging. In summary, a very small amount of battery current is all that is required for a soft smooth deceleration of a truck. The softness of deceleration can be adjusted by means of potentiometer (7RS). At the end of the plug the current through PR coil will drop, the plugging relay will open, and the drive circuit is returned to normal operation.

The control is arranged to differentiate between a normal reversal (directional switch is thrown forward to reverse or reverse to forward) and coasting backward on a ramp where the directional switch is not thrown but where sufficient current may be present to pick up PR. This feature is obtained through the APR circuit. This relay picks up only when the directional switch passes through neutral. If PR and APR are picked up, indicating actual reversing, not merely roll-back, then the low deceleration torque described above is applied. If APR is not picked up, indicating roll-back, full torque will be available for restarting on the ramp.

GENERAL MAINTENANCE INSTRUCTIONS

The SCR control, like all electrical apparatus, does have some thermal losses. The semi-conductor junctions have finite temperature limits above which these devices may fail. 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 altitudes of 5000 feet or over and in ambients of 100 degrees F or over should be brought to the attention of the truck manufacturer.
- The stall current should not be maintained for longer than 30 seconds.
- The control should not be steam cleaned. Blowing off with a low-pressure air hose is the preferred method.
- The heat sinks on the SCR's and diodes are painted black to help dissipate heat. Painting these heat sinks any other color will limit the ability of the sinks to dissipate heat.
- Terminal boards and other exposed SCR control parts should be kept free of dirt and paint which might change the effective resistance between points.
- The truck should not be plugged when the truck has been jacked up and the drive wheels are in a free wheeling position. This can create excessive voltages that can be harmful to the control.

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.

The SCR control can have only two types of failure. They are either no power (Table 1) on 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 wiring diagram for your specific truck.

Before proceeding, visually check for loose wiring, maladjusted linkage to accelerator switch, signs of overheating of components, etc. Before touching electrical components, disconnect the battery and discharge capacitor 1C. Reconnect the battery as needed for the specific check.

Tools and test equipment required are torque wrench, 36-volt test battery, 220-ohm 2-watt resistor, clip leads, volt/ohmmeter (20,000 ohms per volt) and general hand tools.

TABLE 1

FAILURES WHICH CAUSE NO MOTOR TORQUE WITH SCR CONTROL

	SYMPTOMS	WHAT TO DO
1A.	Zero volts from control positive to control negative.	• Check 1 FU and 3 FU to see if they are blown. • Check the key switch for misoperation. • Check 14 REC (See Table 4-G). • Check battery for low specific gravity and connections for looseness or broken fittings.
1B.	Contactors (F or R) do not pick up. Battery volts from control positive to control negative.	• The problem may be an open circuit from control positive to F and R coils, including misoperation of the seat switch, start switch, directional switch or normally-closed F and R interlocks. • Check 7 and 8 REC for short circuits (See Table 4-G).
1C.	Contactors close (F or R). No power and no SCR hum with accelerator in SCR range.	• With the accelerator in operating range, 1A blocked open, and contactors F or R picked up, check for control volts between terminal 1 Card 1 and negative. If there is zero volts at this point, check wire #27 for open circuit. • Check for battery volts between terminals 9 and 6 on card 1. If voltage is not present, check the power contact tips of F and R and the continuity of wires from 1 REC anode to Card 1 and from Card 1 through red lead of 1 REC to battery negative. • Check for about one third of control volts between Card 1 terminals 3 and 6 (except near high-speed position of accelerator). If near zero or about half or more of control volts (except near high-speed position of accelerator when the volts will rise to control volts), the potentiometer (and/or contacts) in the accelerator may be defective (See Table 4-J) or Card 1 may be defective (See Table 4-A). • Check for open circuit from Card 1 terminal 4 through 1 REC gate (white lead). (See Table 4-H). • Check 1REC for open gate (See Table 4-H). • Check oscillator section of Card 1 (See Table 4-A).

	SYMPTOMS	WHAT TO DO
1D.	Contactors close (F or R). Very little power and high-pitch SCR hum.	• Check 2 REC for a short in the conducting direction (See Table 4-H).
1E.	Contactors close (F or R). Very little or no power and a very low-frequency hum in the SCR (4-10 cycles per second).	• Check normally closed tips of PR and APR across terminal 2 and 8 of Card 1 to see that they are both properly closed (See Table 4-F). • Check PR for being stuck open. If relay binds, replace. If normally open tips are welded, check 6 RS in series with 4 C (wiring diagram.) Recommended ohms for 6 RS is 3 ohms.
1F.	Contactors close (F or R). Normal hum but little or no torque. Plugging relay may chatter.	• Check for short in 3 and 4 REC (See Table 4-G). • If replacing 3 REC or 4 REC, check that Thyrector 13 REC and 24 REC are functioning (20 to 70 ohms conducting) from negative to positive. • If 4 REC is defective and Thyrector is functioning, check for an application with considerable plugging, particularly from high speeds and down ramps.

TABLE 2

FAILURES WHICH CAUSE FULL MOTOR TORQUE WITH SCR CONTROL

	SYMPTOMS	WHAT TO DO
2A.	Contactors close (F or R). Full SCR speed immediately. Audible hum.	• Check for short from positive to terminal 3 of Card 1. • Check potentiometer for proper resistance (See Table 4-J).
2B.	Contactors close (F or R). Full speed immediately. No audible hum.	• Check for welded power tips on 1A contactor, or short in truck wiring or malfunction of Card 3 causing 1A to pick up immediately. (See Table 4-B). • If 1A power tips weld, check that tip gap is near maximum and armature spring is near maximum.
2C.	Contactors close (F. or R). Full speed immediately. No audible hum. Capacitor 1C not charged when measured within 30 minutes after operation of truck.	• Check 1 REC for a short (See Table 4-H). • Check for open in 5 REC gate circuit from negative through 9RS to 5 REC. • Check 9RS (See Table 4-I). • Check 5 REC for open gate (See Table 4-H). • Check continuity of wires from 1C to 5 REC and from 5 REC through T3, T4 to T1 at the 1 REC anode. • Check for shorts in capacitor 1C (See Table 4-D).
2D.	Contactors close (F or R). No audible hum. Full speed immediately, but this condition seems to be sporadic. Capacitor 1C not charged within 30 minutes after operation of truck.	• Check 7 REC, 8 REC, and 9 REC. (See Table 4-G.) • Failure of the main SCR to turn off may occur if the junction exceeds rated temperature. (See Table 7A.)

	SYMPTOMS	WHAT TO DO
2E.	Contactors close (F or R). Full speed immediately. No audible hum. Capacitor 1C charged, i. e., volts from battery negative (positive on voltmeter) to 5 REC anode is more than 30 volts.	• Check for open in 2 REC gate circuit from T3 through 8RS to 2 REC. • Check 8RS (See Table 4-I). • Check 2 REC (See Table 4-H).

TABLE 3

MISOPERATION OF SPECIAL FEATURES

	SYMPTOMS	WHAT TO DO
3A.	Failure of 1A contactor to operate.	• Check voltage between terminals 1 and 2 of Card 3 (when F contactor is closed) to be control volts. If voltage is not present check for open in wiring from positive to Card 3 terminal 1. Also check for open from terminal 2—Card 3 through 1A switch on accelerator, normally closed PR interlock to control negative. • Check voltage between terminals 3 and 2 of Card 3 to be battery volts after time delay. If voltage is present, check for open circuit in the 1A coil (See Table 4-E). • Check Card 3 (See Table 4-B).
3B.	Failure of FW contactor to operate. (Refer to Figure 7).	• Check for control volts from Card 2 terminal 1 to terminal 3 when 1A is closed. If not, check 1A interlock and wiring from terminal 1 to positive control and terminal 3 to negative control. • Jumper terminals 1 and 4 of Card 2. If FW contactors does not pick up, check contactor coil and wiring (See Table 4-E). • Check 1A contactor to see that it causes an increase in truck speed. If not check 1A power tips. • Check wiring from Card 2 terminal 2 to A2. • Check that Card 2 will operate. (See Table 4-C). • Check that jumpers or potentiometer setting is low enough to correspond to motor used (See Table 6).
3C.	FW contactor operates, but no increase in truck speed is observed.	• Check 3 RS for open circuit.

	SYMPTOMS	WHAT TO DO
3D.	FW contactor operates, but truck speed varies.	• Check for truck grounds around 3 RS.
3E.	FW contactor operates, but at incorrect speeds and or currents.	• (See Table 6).
3F.	Severe reversal. (Reversal satisfactory if APR's normally closed tips across 7 RS are blocked open with thin insulation and 7 RS is above about 1 megohm.)	• With accelerator in the off position, APR should pick up and seal in when the directional switch is passed through neutral. If not, check the normally closed interlock in the accelerator, the truck wiring, and check for shorted 4C capacitor. • With the accelerator depressed, APR should pick up and hold in for about ¼ second when directional switch is passed through neutral. If relay drops out quickly, check capacitor 4C.
3G.	Severe reversal. (Reversal severe with APR blocked open as above.)	• Check 4 REC and PR coil for open circuit (See Table 4-G). • Check PR (See Table 4-F). • Check current limit (See Table 5). • Check if PR drops out before vehicle comes to zero speed (See Table 4-F).
3H.	Severe reversal. (Deceleration smooth but severe as vehicle changes direction).	• Check adjustment and operation of timer card. (See Table 4B).
3I.	Reversal too soft or somewhat severe.	• Check adjustment of 7 RS. SCR should pulse about 4 to 20 times per second.

After determining the inoperative function from the preceding tables, the next step will be to check the individual component. The following tables will aid in trouble shooting each component.

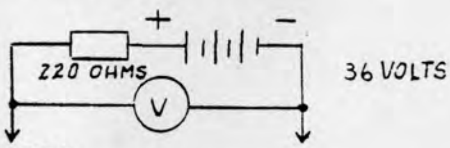
4G. RECTIFIERS

When checking diodes. disconnect battery and discharge capacitor 1C to prevent burning out the ohmmeter. When reassembling hardware on rectifiers, refer to Table 5 for proper torque settings.

a) To check 3, 4, 14, 15, 16 and 25 REC, disconnect one side of the rectifier. 3 REC and 4 REC are diodes with about 7 to 12 ohms in the conducting direction (+ ▶ -) measured with scale RX1, and infinite resistance in the non-conducting direction (- ▶ +) measured with scale RX10,000. (On some meters about 75 to 160 ohms are obtained in the conducting direction.)

b) 7, 8, 9, 26 and 27 REC's consists of a diode in series with a 220 ohm resistor. All should read under 1000 ohms in the conducting direction and infinite resistance in the non-conducting direction. It is good practice to recheck these blocks after performing any service work on the control.

To check, disconnect leads from one terminal of the diode block. Connect a 220-ohm 2-watt resistor in series with a 36-volt test battery and a voltmeter (50 volt scale). Connect the voltmeter across the diode block. The voltmeter should read about 17 volts when the diode is in the conducting direction and battery volts in the non-conducting direction.



4H. SCR's (1 REC, 2 REC and 5 REC)

These are Silicon Controlled Rectifiers. Before checking, disconnect battery and discharge capacitor 1 C to prevent burning out the ohmmeter.

a) 1 REC - To check 1 REC, disconnect the heavy pigtail lead, the small white lead, and the small red lead. Measure resistance from stud to heavy lead then reverse polarity of the meter and repeat above step. The resistance in both directions should be infinite (RX10,000 scale). Replace 1 REC if the resistance is below 100,000 ohms. Measure resistance between the heavy pigtail lead (Anode) and the small white lead (gate). With ohmmeter positive on the white lead, 1 REC should measure 15 to about 30 ohms on the RX1 scale. Now reverse the ohmmeter leads; resistance should be 70 ohms to 2000 ohms on the RX1 scale.

b) 2 REC - To check 2 REC, disconnect heavy pigtail lead and small white lead (also disconnect small red lead, if present). Measure resistance from stud to heavy lead, and then reverse polarity on the ohmmeter and repeat above step. Resistance should be infinite in both directions (RX10,000 scale). Replace 2 REC if resistance is below 100,000 ohms. Measure resistance between the heavy lead (Ancde) and the small white lead (gate). With ohmmeter positive on the white lead, 2 REC should measure 30 to about 50 ohms on the RX1 scale. Now reverse the ohmmeter leads; resistance should be 100 ohms to 2000 ohms on the RX1 scale.

c) 5REC - To check 5REC, disconnect wires to heat sink and gate wire to 9RES. Measure resistances from stud to anode lead and then reverse leads from the ohmmeter and repeat above step. Resistance should be infinite in both directions (RX10,000 scale). Measure resistance between the anode lead and the gate lead. With ohmmeter positive on the gate, 5REC should measure 18 to about 40 ohms on the RX1 scale. Now reverse the ohmmeter leads, resistance should be 800 ohms to 2000 ohms on the RX1 scale.

TABLE 4
CHECKING COMPONENTS

4A. CARD 1 Oscillator Section - Disconnect the gate lead from terminal 4 of the card. Clip a low impedance earphone from terminal 4 to terminal 6. Apply power to the truck, throw the directional switch, and press the accelerator while listening to the earphone. A tone should be heard going from a low frequency buzz to a medium frequency hum as the accelerator is pressed. If no hum is heard, disconnect the card from the Panel. Short terminals 1, 3, and 9 together, and short terminal 2 to 8. (on 24 volt cards short terminals 1 and 3 together, and short terminal 2 to terminal 5). Apply the positive of a 36 volt test battery to terminal 1 and negative to terminal 6. (on 24 volt cards use a 18 volt test battery). Connect a voltmeter (scale 2.5 volts d-c) across terminal 4 (pos) and terminal 6 (neg) and read .5 to 1 volt d-c. Replace card 1 if this voltage reading is not obtained. If it is obtained, replace voltmeter leads with earphone leads from terminal 4 to terminal 6. A medium pitch oscillation should be heard, if not replace Card.

4B. CARD 3

Disconnect leads to Card 3. Connect a voltmeter (50 v scale) from terminal 3 to 2. Apply battery volts negative to terminal 2 and positive to terminal 1. The voltmeter should read about one volt and then raise to battery volts at the end of the timer interval .3 to 3 seconds on 36-volt cards and .5 to 1.5 seconds on 18 and 24 volts. Turning trim pot should adjust time (CW to increase). Remove battery volts and voltmeter should drop to zero. Repeat check with battery positive to terminal 4 on cards with dual positive input.

4C. CARD 2

Disconnect leads to Card 2 terminals 1 and 2. Block FW from closing with a piece of insulation between power tips. Adjust 10 RS to give at least 10 ohms resistance between terminal 6 and terminal 3. Apply positive control volts to terminal 1, FW contactor should not pick up. Short terminals 2 and 3, FW contactor should pick up. If the Card does not operate as described, replace the card.

4D. CAPACITOR 1C

Disconnect battery and discharge capacitor. Measure ohms through the capacitor using the RX10,000 scale. Meter should read zero ohms and then swing to above 100,000 ohms. If not, disconnect jumpers between capacitors, and apply the same test to each capacitor. Replace capacitors if needed.

4E. CONTACTORS (F, R, 1A, FW, and P)

a) 100-ampere contactors. (See instructions GEH-3086.)
b) 200-ampere contactors. (See instructions GEH-3074.)

4F. RELAYS (PR AND APR)

a) PR--If the plug is rough, disconnect the battery and visually check current coil for signs of being overheated (this could be an indication of shorted turns). If coil is burned, replace PR. Check contact tips on PR. Both normally-closed tips should open at the same time when the armature is manually closed. Note carefully that one tip does not open before the other when the slack movement in the armature is gradually removed. If the tips are not operating together adjust for proper operation by carefully bending stationary contact supports.

b) APR If the plug is rough, disconnect battery and check contact tips on APR. Both normally-closed tips should open at the same time when the armature is manually closed. Note carefully that one tip does not open before the other when the slack movement in the armature is gradually removed. If the tips are not operating together, adjust for proper operation by carefully bending stationary contact supports.

4-I. GATE CONTROL (8RES, 9RES AND 12 RES)

8 and 9 RES act like a diode with high resistance in the conducting direction.

To check, disconnect the lead from terminal 2 to the gate. Using a test battery, 220-ohm resistor and voltmeter as in 4G, the voltmeter should read about 22 volts when the voltmeter is connected to terminal 1 (positive) and terminal 2 (negative). Reverse voltmeter leads (terminal 2 negative), voltmeter should read battery volts.

12 RES checked in the conducting direction should read 31 volts, and battery voltage in the nonconducting direction.

4J. POTENTIOMETER IN ACCELERATOR

To check the operation of the potentiometer, disconnect battery and disconnect wire from accelerator pot to Card 1 terminal 3. Also disconnect wire from Card 1 terminal 9 to pot. Place an ohmmeter (RX10,000 scale) across wires to pot and read from 180,000 to 250,000 down to less than 300 ohms as the accelerator is advanced from low-speed to high-speed position. If these readings are not obtained, loosen pinion gear clamp and adjust rotation of pot shaft relative to accelerator shaft or replace potentiometer.

With the wires disconnected as above and with the accelerator switch in any position, read resistance of 1 megohm or higher from the wires to the potentiometer to the truck frame. If lower readings are obtained check for truck grounds.

Refer to page TS-858-1 for maintenance instructions of the accelerator.

TABLE 5

CHECKING CURRENT-LIMIT

5A. The current-limit circuit has been preset at the factory and should not be adjusted. However, if truck operation appears sluggish or if control appears to be overheated, the following check should be made.

Material required to check current limit:

300 ampere 50 millivolt d-c shunt*

50 millivolt d-c meter (d'Arsonval movement)*

50 volt d-c meter (d'Arsonval movement)

Battery with equal or greater ampere-hour capacity used on truck, charged to 1250 or higher specific gravity.

*Or equivalent equipment to measure 200 amperes average current at or above ½-scale deflection.

Check that ohms in accelerator potentiometer are under 300 ohms in high speed (See Table 4-J).

Connect the shunt and millivolt meter between battery negative and 1REC. Connect the voltmeter between battery positive and T2 on the SCR panel. Disconnect the positive lead of 1A contactor coil. Jack the wheels of the truck off the floor.

Connect battery and depress the accelerator slightly to assure that a positive deflection of the meters are obtained.

Check max. speed adjustment first by moving the accelerator to the full-power position and applying the brakes until battery current is 60 amperes (or about 70 percent of the loaded level

amperes with motor directly across the battery and motor fields connected the same as are used in SCR control). Voltmeter should read between the following:

Battery Volts	*Motor Volts*
36	22-26

Now, check current limit by moving the accelerator to the full-power position and applying the brakes until the wheels come to a standstill or until the meter reads between 180 and 210 amperes (full scale is 500 amperes). If the wheels reach standstill and the meter reads between 180 and 210 amperes the current limit is set correctly.

NOTE: Do not stall the motor for more than 30 seconds at a time. Allow time for motor cooling between stalls. Do not operate motor at high speeds or reverse motor with wheels jacked up.

5B. If the current limit is not properly set, refer to the CLARK dealer.

If either adjustment has to be altered, recheck max. speed and current limit until both limits are met. The max.-speed adjustment has a large effect on current limit. The current-limit adjustment has a smaller effect on high speed. Both adjustments are CW to increase.

If the end of the adjustment of the current-limit trimpot is reached without setting current limit (a slight clicking sound occurs at each revolution of the trimpot at the end of travel) the max.-speed adjustment may be turned, CCW to reduce current.

5C. Torques for Rectifiers

a)	1 REC (C80)	300 inch-pounds, or	24 foot-pounds
b)	2 REC (C50)	150 inch-pounds, or	12 foot-pounds
c)	3 and 4 REC(4JA90DX99)	300 inch-pounds, or	24 foot-pounds
d)	5 REC (C35)	30 inch-pounds, or	2½ foot-pounds
e)	14 REC (4JA40M)	30 inch-pounds, or	2½ foot-pounds

NOTE: Silicon grease (DOW-CORNING DC-5 or EQUIVALENT) should always be applied between rectifier and heatsink before tightening rectifier hardware.

TABLE 6

CHECKING FIELD - WEAKENING

To check field weakening connect ammeter and shunt as in Table 5.

Accelerate a loaded truck on the level. FW contactor should close about 1 second after 1A closes when current reduces to about 125 to 150 percent of loaded-level motor current.

Decelerate a loaded truck by going up a ramp or applying brake.
FW contactor should drop out when current increases to about 300 amperes.

The current at pick up can be reduced by reducing the ohms in 10RS, or reconnecting the pot to terminal 6 instead of 5. The amperes at drop out will be reduced by the same ratio.

The ratio between the current when FW will pick up and drop out as tested above is fixed by the size of 3RS (or top truck speed). Increasing the ohms in 3RS will reduce top speed and also reduce the current at drop out for a given setting of Card 2.

TABLE 7

GENERAL TROUBLE SHOOTING

	SYMPTOMS	WHAT TO DO
7A.	Excessive temperature.	● Check that control is in a ventilated area. ● Check that stall current is not maintained for long periods (30 seconds is a conservative limit).
7B.	Different performance after changing Card 1 or SCR panel.	● Controls are set at the factory for use with a given motor and battery voltage. Current at stall can be quite different if used on a different combination. Whenever installing card, always check the current limit and top speed adjustment. (See Table 5.)
7C.	Burning of 1A, F, R or P power tips.	● Excessive burning of power tips and welding of 1A may be caused by the use of a diode only as a voltage filter for the coils. If there is evidence of this problem: Check 7, 8, or 9 REC

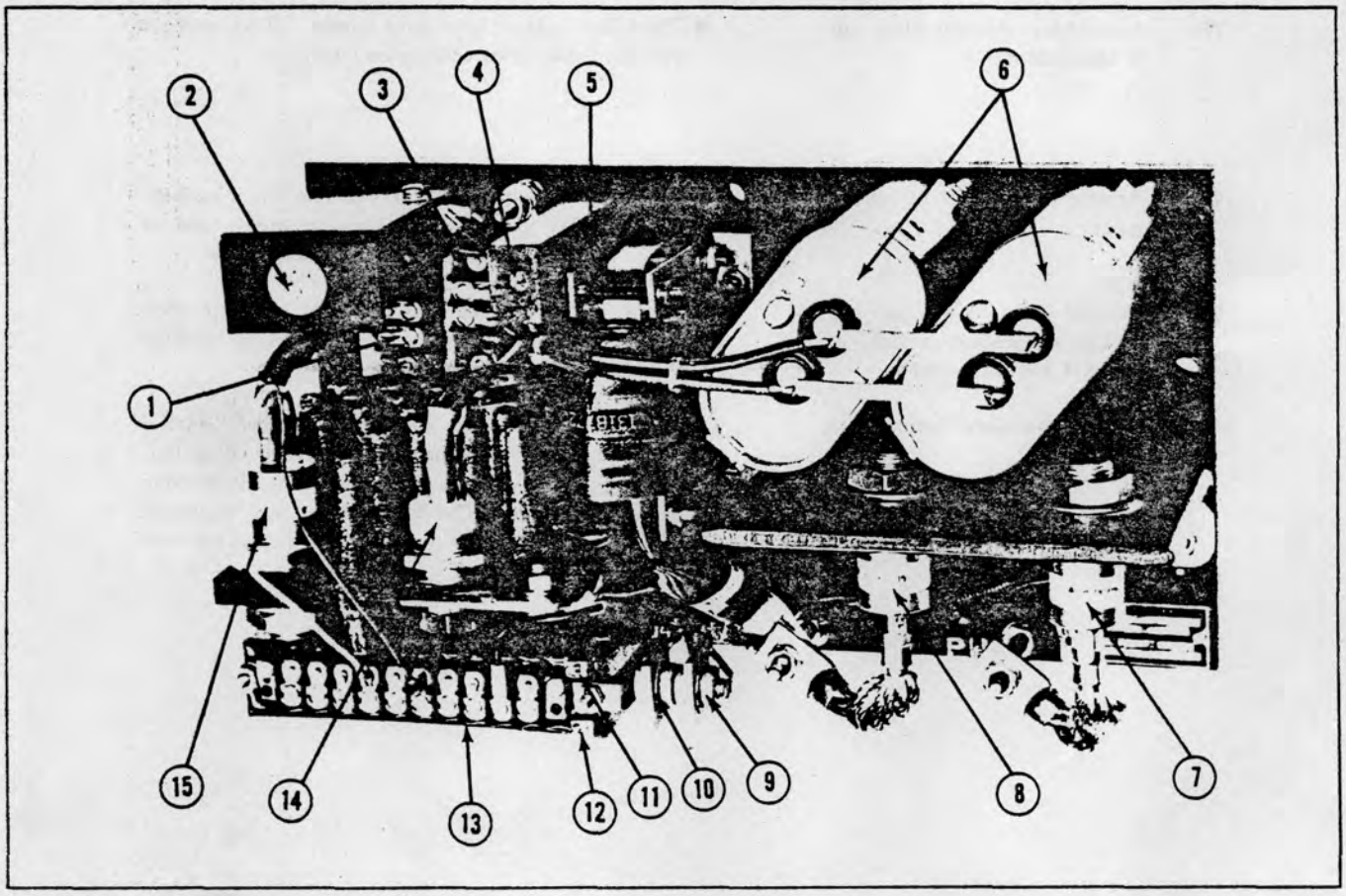
REC	Max. Amps.	Series Res.
7, 8, or 9	1	220 Ohms

7D.	Misoperation of switchette.	● Check that switch adjustment screw has been adjusted to give overtravel after switchette snaps. (Be sure also that plunger does not bottom--1/32-inch free motion of plunger is good.) Unless a normally closed circuit is being used on the positive side of the 1A switch in the accelerator, wire the two normally open circuits in parallel.
7E.	Burning of normally closed F and R circuits of accelerator.	● Check to see if 6 RS resistor in series with 4C capacitor is open. If so, replace 6 RS resistor (3 ohms).

	SYMPTOMS	WHAT TO DO
7F.	Accelerator internal stop out of adjustment.	● Check for loose or bent stop screws. If so, replace with hardened screw with nylon insert.
7G.	Accelerator pot out of adjustment.	● Check pot for slipping. Use a double nut if needed. Check pinion for slipping. Move clamp to end of pinion and replace screws with allen-head screw.
7H.	Control fuse blown; or key switch, directional switch, or lift-tilt switch burned.	● Check 7 REC, 8 REC, 9 REC for short or open circuit. These diodes will sometimes fail by shorting and then burn clear.
7I.	Shorts between connection terminals.	● The clearances between terminals and other electrical parts are close. When making connections check that no terminals have been twisted or bent closer than ⅛-inch clearance. The terminal for the Thyrector wire to T2 on the SCR panel has shorted to the heat sink of 3 and 4 REC.

TYPICAL PHYSICAL ARRANGEMENT AND IDENTIFICATION OF COMPONENTS

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



(1) GATE CONTROL FOR BLOCKING SCR (9 RES)
(2) BLOCKING SCR (5 REC)
(3) GATE CONTROL FOR TURN-OFF SCR (8 RES)
(4) CURRENT-LIMITING REACTOR (1X)
(5) PULSE TRANSFORMER (1T)
(6) COMMUTATING CAPACITOR (1C)
(7) PLUGGING DIODE (4 REC)
(8) FLY-BACK DIODE (3 REC)
(9) PLUGGING DIODE FILTER (24 REC)
(10) FLY-BACK DIODE FILTER (13 REC)
(11) MAX. SPEED ADJUSTMENT
(12) CURRENT LIMIT ADJUSTMENT
(13) OSCILLATOR CARD (CARD 1)
(14) TURN-OFF SCR (2 REC)
(15) MAIN SCR (1 REC)

Figure 10 - SCR panel

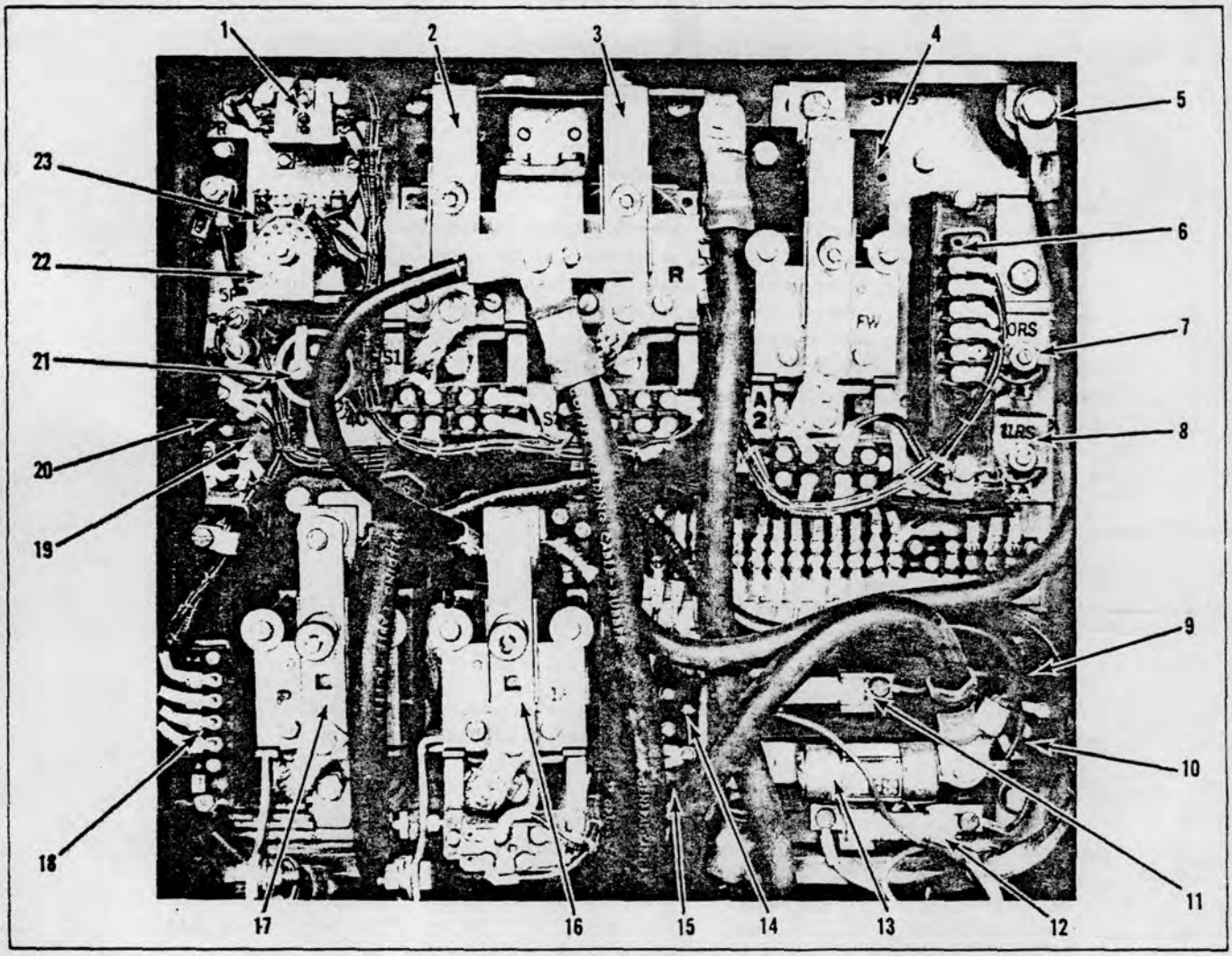


Figure 11. Contactor Panel

1-AUXILIARY PLUGGING RELAY
2-FORWARD CONTACTOR
3-REVERSE CONTACTOR
4-FIELD WEAKENING CONTACTOR
5-56
6-CARD 2
7-10 RS
8-11 RS
9-15 REC
10-16 REC
11-10 AMP FUSE

OPTIONAL EQUIPMENT

12-15 AMP FUSE
13-400 AMP FUSE (EC 30-40) 300 AMP FUSE (EC20)
14-27 REC
15-9 REC
16-BY-PASS CONTACTOR (1A)
17-PUMP CONTACTOR
18-CARD 3
19-8 REC
20-7 REC
21-TIMING CAPACITOR FOR APR
22-PLUGGING POTENTIOMETER
23-PLUGGING RELAY

ACCELERATOR SWITCH

IC3012BH600

DESCRIPTION

The accelerator master switch is foot-operated through a pedal and linkage system, its purpose is to provide speed control for a truck traction motor by varying the resistance in an SCR control system. It consists of a switch shaft that is attached to the foot-pedal linkage.

As the switch shaft is rotated, a segment gear mounted on the shaft drives a pinion gear, which in turn rotates a carbon-type potentiometer. By utilizing a potentiometer which has a high initial ohmic value and essentially a logarithmic taper, it is possible to get good initial "creep" speed. As the pot is further rotated, the log taper cuts resistance out very rapidly, which provides smooth stepless acceleration. This switch also contains two switchette units that are operated by cams mounted on the main switch shaft. These cams are cut to a contour to provide a predetermined control sequencing arrangement for the contactors, relays and electronic components of the SCR control system.

The enclosure provided is for general heavy-industrial duty or for sparkproof applications.

INSTALLATION

The switch is arranged for bringing a conduit to a hole provided in the center of one side.

An adjustable mechanical stop is located under the footpedal, so that it will terminate the travel of the pedal and linkage system rather than have this force transmitted to the internal stops of the accelerator switch.

MAINTENANCE

Oil-less bearings are used at each end of the main operating shaft. These bearings provide their own lubrication and require no attention. Apply some "Gredag"—type grease periodically to the pinion and segment gear teeth. It should not be necessary to lubricate any other parts. In the event the carbon potentiometer become inoperative, it is easily removed by loosening its locknut, removing the two screws holding the potentiometer mounting bracket to the top of the bearing block, and loosening the clamp which secures the pinion gear to the potentiometer shaft.

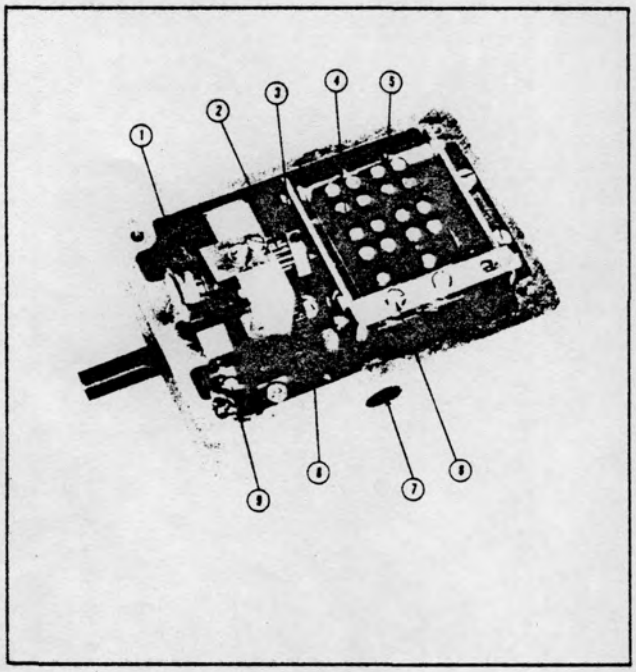
When assembling a new potentiometer reverse the procedure, however check to insure that the potentiometer shaft is running freely in its bearing block after tightening the mounting bracket. Before putting the pinion gear on the pot shaft and meshing its teeth with those of the segment gear, it is necessary to orient the pot electrically with respect to the main switch shaft. Turn the pot shaft until it is against its own mechanical stop, then back off the stop about two degrees. This should be done with the switch shaft in the off position. The pot resistance should be at its maximum rated value in this position.

Then the pinion gear can be slipped on the pot shaft and meshed with the segment gear. The pinion clamp can now be tightened securely (See Table 4J).

The first switchette should be adjusted by its raise or lower mechanism to operate at approximately 7 degrees rotation of the main shaft (resistance per Table 4-J). Upon adjusting the switchette trip points at the required main shaft angles, be sure that the plunger does not bottom. Some over-travel should be provided. Also upon checking the reset point of the switchettes, be sure that this has

occurred before the cam-follower roller reaches the high-land area of the cam. The second switchette which picks up contactor 1A should be adjusted to operate at approximately 27 degrees rotation of the main shaft (Resistance below 300 ohms). Switchettes are easily replaced by removing their two mounting screws.

Although it is unlikely that an operating cam would ever have to be replaced, this can readily be done by removing the four mounting bolts holding the entire switchette adjusting assembly to the switch box. This exposes the main cam shaft. Then the screw holding the cam to the shaft can be removed.



(1) POTENTIOMETER
(2) PINION GEAR
(3) PINION GEAR CLAMP
(4) SWITCHETTE, AS-START, AS-OFF
(5) SWITCHETTE, AS-1A
(6) SWITCH ADJUSTMENT AND LOCKNUT
(7) CONDUIT ENTRANCE
(8) SEGMENT GEAR
(9) CW INTERNAL STOP

Figure 11. Accelerator Switch

HARTMAN CONTACTOR PANEL

Travel Motion

See Plate 9219

The contactor panel with the key switch and seat switch closed, sets up circuits through the pressure switch or 2MS contacts and the normally closed contact of CR1 to pickup Relay CR1. Relay CR2 is also energized through the NC contacts of the 1st point of power switch. CR1's NC contacts open the 1A contactor circuit. With the Forward and Reverse Switch selection made, as soon as the foot accelerator pedal is depressed to the 1st point of power, the N.O. contacts of CR1 and CR2 complete the circuit to the selected Forward or Reverse Contactor. Its N.C. auxiliary contact locks out the opposite directional contactor and its N.O. auxiliary contact sets up a holding circuit around the contacts of CR2, 1A and CR1. The truck starts up slowly in the selected direction with full series field and the carbon pile resistor at full resistance.

As the accelerator pedal is depressed, corresponding hydraulic pressure is applied to the carbon pile and its resistance diminishes and the motor speeds up. When the accelerator pedal is fully depressed the second point of power 2MS opens to release CR1 but not until .6 second delay to make sure the motor has had time to accelerate. After this time delay, the N.C. contacts of CR1 energize 1A. Closing of 1A shorts out the carbon pile resistor and speeds up the motor still further by cutting out part of the series field to weaken the field.

Letting up on the accelerator again picks up CR1 to open the accelerator contactor 1A and backs off pressure of the carbon pile. When 1st point of power resets, the directional contactor opens, and the motor coasts under control of the foot brake.

Reversing the motor to plug to stop is possible but only after the foot pedal has been brought back to the off position in order to reset the CR2 Relay and then redepressed to the 1st point of power in order to pick up the opposite directional contactor. As long as the counter EMF of the armature keeps the By Pass Solenoid Valve energized, the carbon pile is retained at full resistance and the Pressure Switch prevents CR1 from dropping out and energizing the accelerating contactor 1A.

After the CEMF releases the solenoid valve, automatic acceleration can take place in the opposite direction.

Reversing the Directional Switch while the accelerator pedal is depressed will disconnect the motor until pedal is returned to the off position and then depressed again.

Applying the foot brake will also de-energize the motor by the brake switch opening the directional contactor. The accelerator pedal must be returned to off position to reset CR2 and then depressed again to pick up the selected directional contactor and speed.

Hydraulic Pump

See Plate 9219

With the Key Switch closed, closing either the Tilt Switch or Lift Switch will energize the Pump Starter Contactor and start up the hydraulic pump motor. It will stop as soon as tilt or lift switch is opened.

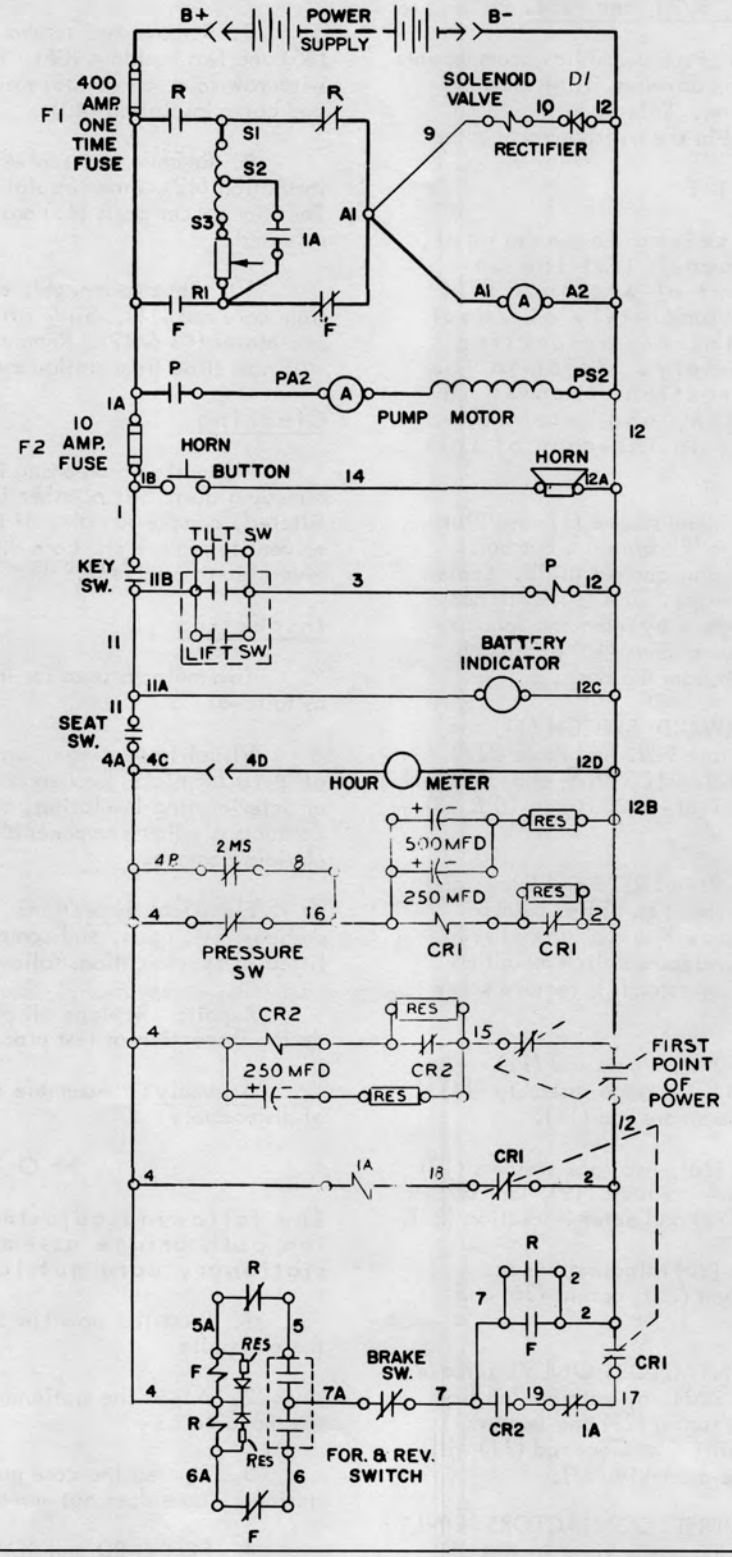


Plate 9219. Wiring Schematic

HARTMAN CONTACTOR PANEL

Disassembly, See Plates 9222, 9223, and 9224.

1. Each panel consists of subassemblies, components and their attaching parts. The drawings illustrate the parts and their relative position. Reference should be made to these drawings to aid in the overhaul procedure.

N O T E

When equipment is received for overhaul, visually inspect and bench test the unit to determine the extent of overhaul that is required. Do not completely overhaul the panel unless preliminary inspection indicates this is necessary. Refer to the Trouble Shooting Instructions located in the front of this section, and refer to Specifications located in the rear of this section.

2. Remove twelve hex head screws (1), see Plate 9222, and twelve lock washers (2) releasing bus bars (3,4,5,6, & 7). Remove bus bars and set aside. Loosen nut (8) and swing bus bar (9) aside. The four switches (10,11,12, & 13) can be removed by removing four hex head screws (14) and four lock washers (15) from each switch and lifting each switch from the base.

3. Disassembly of FORWARD SWITCH (11) and REVERSE SWITCH (12), see Plate 9222 and Plate 9223. Disassembly of SWITCH (CONTACTOR) 1A and SWITCH P (PUMP CONTACTOR), see Plate 9222 (items 10 & 13) and see Plate 9224.

Remove screws (1), see Plates 9223 and 9224, and lock washers (2) releasing switch (3). The pump contactor is not equipped with a switch. Remove screws (4 & 5) which releases switch mounting plate (6). To remove switch operator (7), remove screw (8) and lock washers (9).

4. Remove lock nut (10) from core rod (11). Remove bushing (12), spring (13), bridge assembly (14) and bushing (15) by sliding from core rod (11).

5. Remove two screws (16), two lock washers (17) and two bushings (18). Remove contacts (19), four screws (20) which releases bus bars (21) and outer insulation (22).

6. Remove four screws (23) releasing bus bar insulation (24), inner insulation (25), detent (26) and spacers (27).

7. 1A and PUMP CONTACTORS ONLY: remove movable core (28), see Plate 9224, by unthreading from core rod (11). Slide off core spring (29) and two end plates (30 & 31). Remove coil (32). Core rod (11) will now slide from stationary core assembly (33).

7. FORWARD and REVERSE CONTACTORS ONLY: Remove lock nut (28) by placing screwdriver in slot of core rod (11), see Plate 9223, and turning nut (28) with nut driver. Slide bushing (30), spring (31), bridge assembly (32), and bushing (33) from core rod (11), see Plate 9223.

8. Remove two screws (34), two lock washers (35) and two bushings (36). Remove contacts (37) and withdraw four screws (38) which releases bus bars (39) and outer insulation (40).

9. Remove four screws (41) releasing bus bar insulation (42), inner insulation (43) and spacers (44). The four spacer posts (45) around the coil will not be released.

10. Remove movable core (46) by unthreading from core rod (11). Slide off core spring (47) and two end plates (48 & 49). Remove coil (50). Core rod (11) will now slide from stationary core assembly (51).

Cleaning

Normally no cleaning is necessary other than removing dust, dirt or other foreign matter with dry filtered, compressed air. If it is necessary to use a solvent to remove stubborn dirt, then use a Stoddard type cleaning solvent.

Inspection

Two methods used for inspection of the panel are as follows:

Visual Inspection: under a strong light, inspect all parts for nicks, broken or damaged leads, cracked or deteriorating insulation, broken terminals, burned contacts or other components and all threaded parts for obvious damage.

Electrical Inspection: using suitable metering devices, test coils, and components for rated values listed in Specifications following this section.

Repair: Replace all parts found to be defective during inspection or test procedures.

Assembly: Assemble in the reverse procedure of disassembly.

N O T E

The following adjustments are made leaving **both bridge assemblies off** and the **stationary core nut loose.**

1. Press the movable core in until it is against the end plate.

2. Adjust the stationary core until it just touches the movable core.

3. Tighten the core nut making sure that the stationary core does not move.

4. FORWARD and REVERSE CONTACTORS ONLY: assemble the N.C. bridge assembly (32) to the core rod (11) by first running a 10-32 S.S. nut (29)

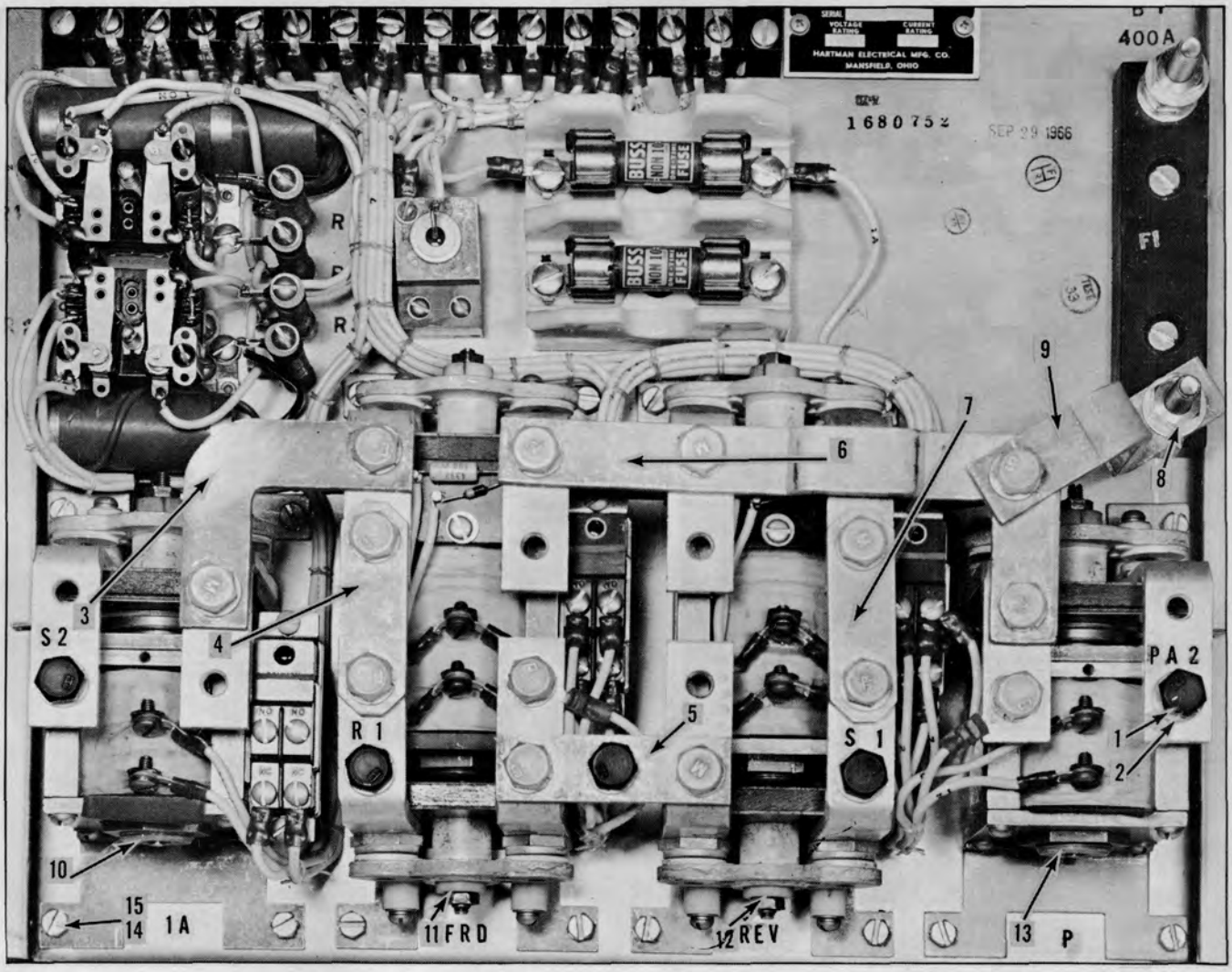


Plate 9222. Hartman Panel (Disassembly and Reassembly)

1. Hex Head Cap Screw
2. Lock Washers
3. Bus Bar
4. Bus Bar
5. Bus Bar
6. Bus Bar
7. Bus Bar
8. Nut
9. Bus Bar
10. (1A) Contactor
11. (FRD) Forward Contactor
12. (REV) Reverse Contactor
13. (P) Pump Contactor
14. Hex Head Cap Screw
15. Lock Washer

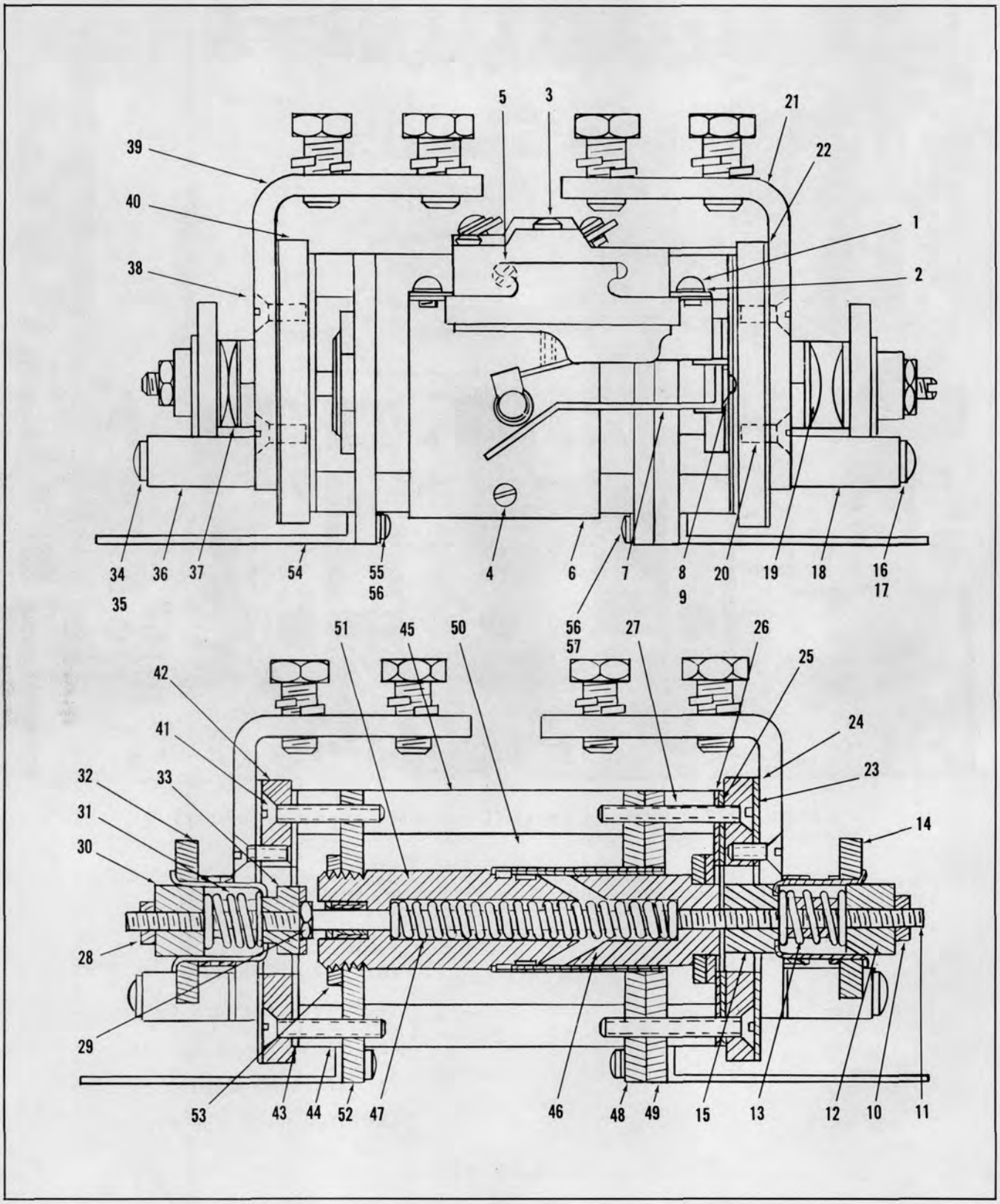


Plate 9223. Hartman Panel (Forward and Reverse Contactors)

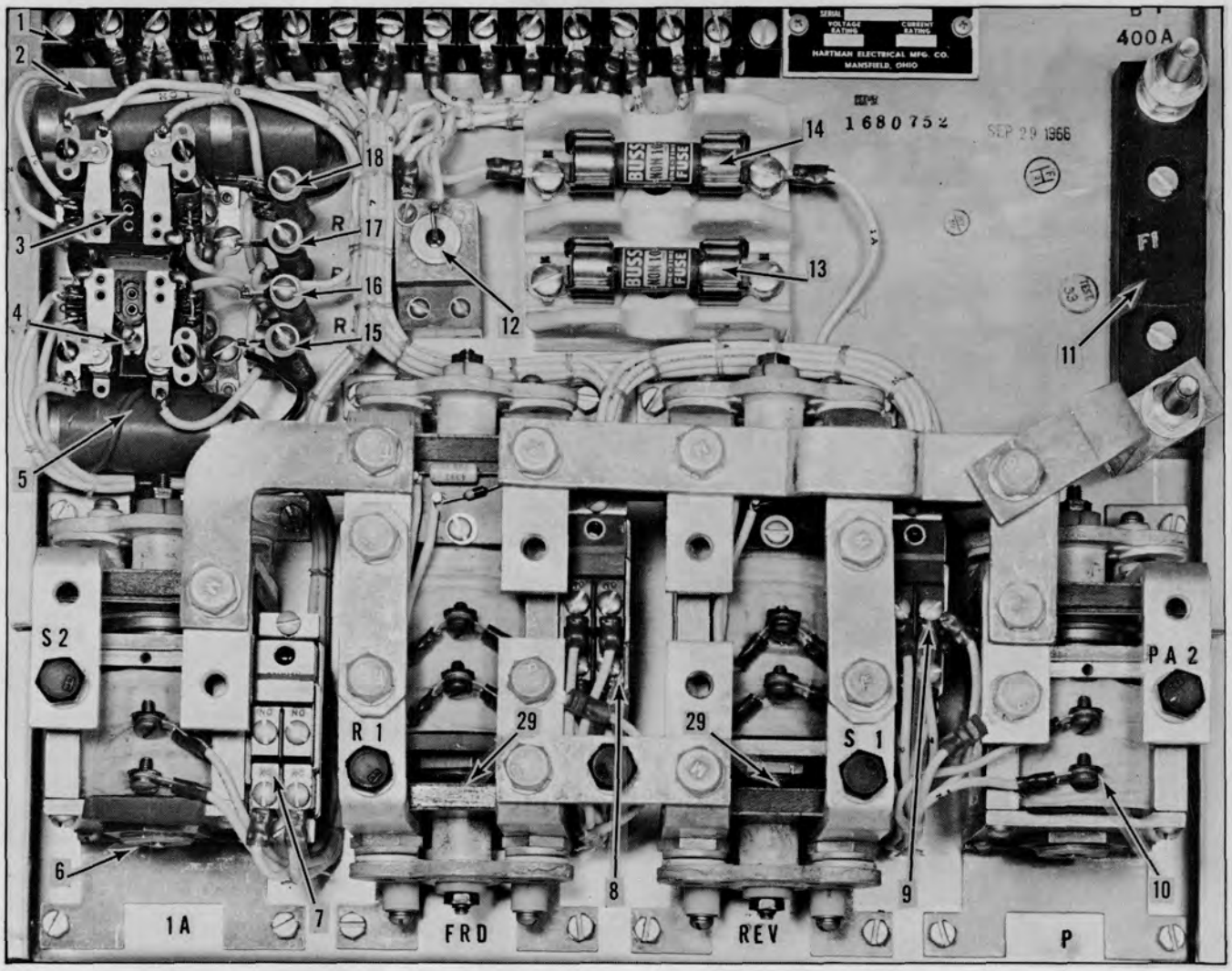
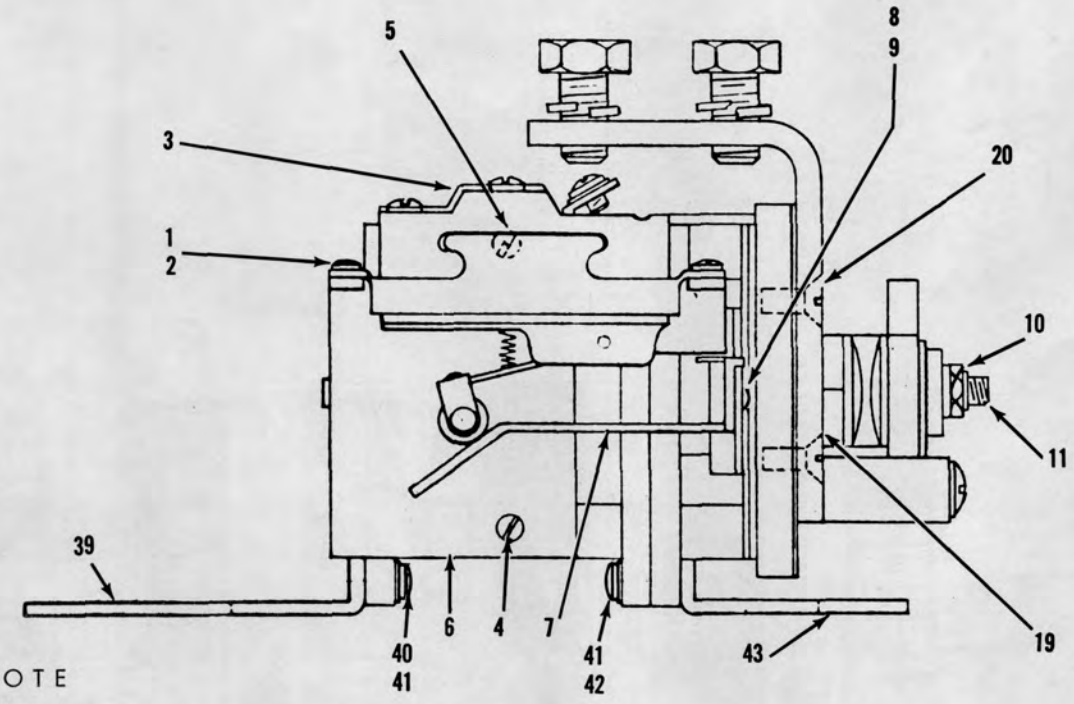


Plate 9220. Hartman Contactor Panel (Front View)

1. Terminal Strip (36S)
2. Capacitor, CR1 Relay (C1)
3. CR1 Relay (CR1)
4. CR2 Relay (CR2)
5. Capacitor, CR2 Relay (C2)
6. (1A) Contactor 1A
7. Switchette, 1A Contactor
8. Switchette, Forward Contactor (FRD) Forward Contactor
9. Switchette, Reverse Contactor (REV) Reverse Contactor
10. (P) Pump Contactor
11. 400 Amp (Main) Fuse
12. Diode Rectifier (D1)
13. Spare Fuse (10 Amp)
14. 10 Amp Fuse (F2)
15. 10 ohm Resistor, 12 watt (R4)
16. 125 ohm Resistor, 12 watt (R3)
17. 125 ohm Resistor, 12 watt (R2)
18. 10 ohm Resistor, 12 watt (R1)

ITEM 29: Forward and Reverse Adjusting Nuts



NOTE

ALSO, REFER TO TS 872 & TS 873 FOLLOWING.

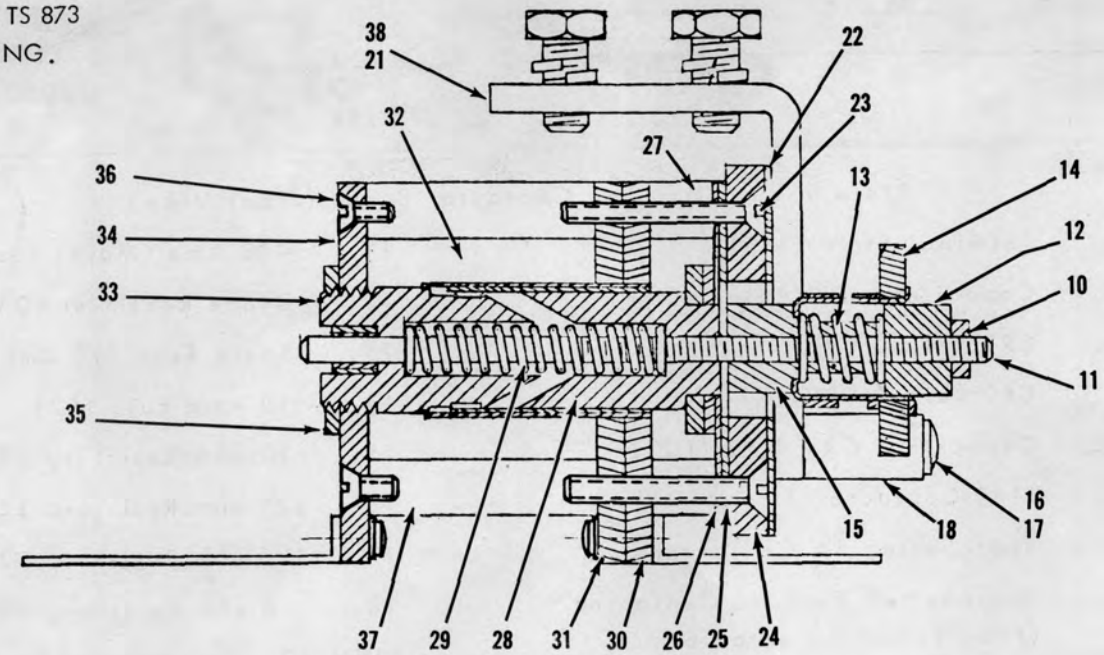


Plate 9224. Hartman Panel (1A and Pump Contactors)

see Plate 9223, tight against the non-threaded portion of the rod (11). Insert bushings (30 & 33), spring (31) and bridge assembly (32) and tighten together with 10-32 lock nut (28).

4. 1A and PUMP CONTACTORS ONLY: insert core rod (11) through the stationary core (33) and thread it into the movable core (28), see Plate 9224, until it barely protrudes past the end of the stationary core (33). Apply Locktite to the core rod (11) at the movable core (28).

5. FORWARD and REVERSE CONTACTORS ONLY: screw this assembly through the movable core (46) with an .080 inch shim placed between the movable core and the detent plate (26) until the N.C. main contacts just kiss. Apply Locktite to the core rod (11) at the movable core (46).

ALL CONTACTORS: the assembly of the N.O. contacts is preadjusted. Assemble bushings (12), springs (13) and bridge assembly (14) to the core rod and apply 10-32 lock nut (10).

Auxiliary Switch Contact Adjustment

Switch operating point should occur after main N.O. contacts touch but before the movable core closes with a .050 inch spacer between the head of movable core (46, Plate 9223 and 28, Plate 9224) and End Plate (49, see Plate 9223 and item 30, Plate 9224). If adjustment is required, follow procedure outlined above, loosen screws (1), see Plate 9223, and move switch (3) until correct adjustment is obtained. Tighten screws without moving switch out of adjustment. Repeat adjustment check as outlined above.

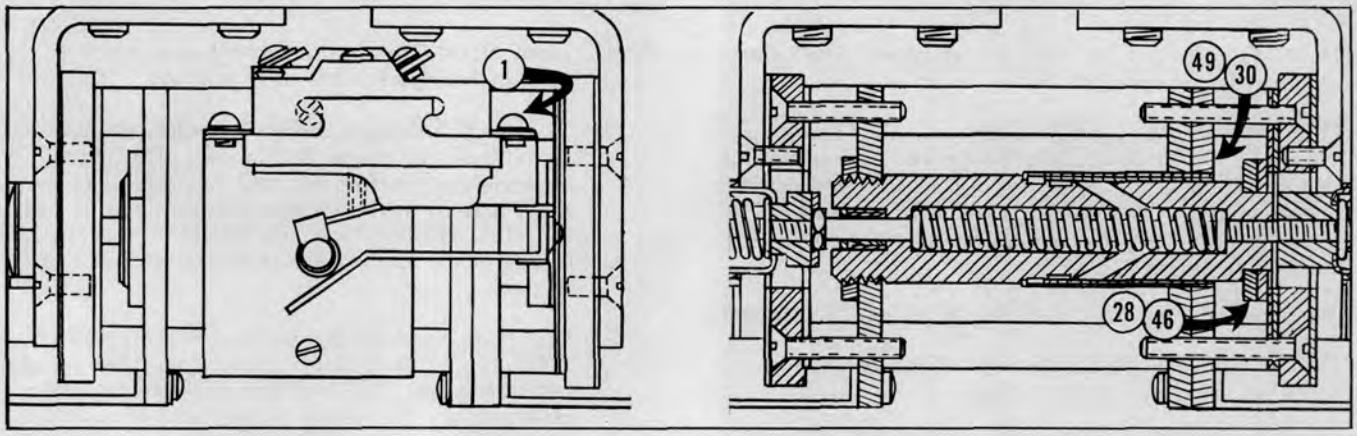


Plate 9225. Auxiliary Switch Adjustment

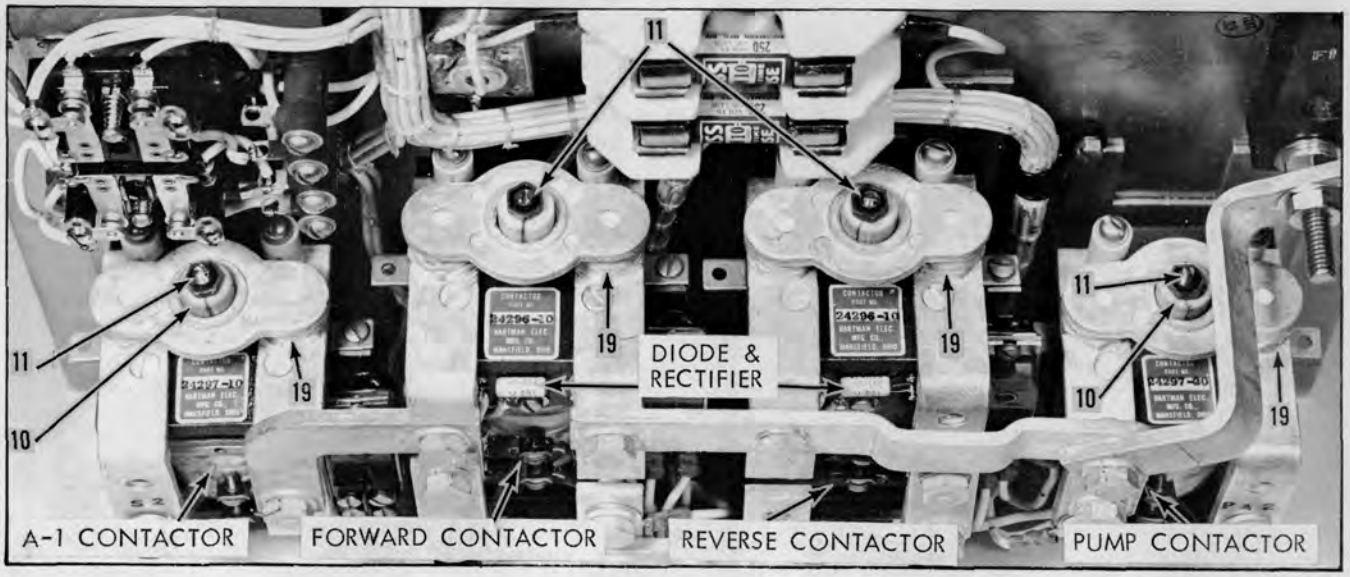


Plate 9221. Hartman Contactor (Control) Panel

Specifications, Hartman (Control) Contactor Panel, Clark Part Number 1680752

Forward and Reversing Contactors Coil Resistance	38 Ohms plus or minus 10% @ 25°C
Accelerator and Pump Contactors Coil Resistance	40 Ohms plus or minus 10% @ 25°C

Coil Data

Contact and Core - Gaps and Pressures 1A and Pump Contactors

(1) N.O. contacts are .080 plus or minus .010 inches apart in the open position.

(2) N.O. contacts closed - overtravel .080 plus or minus .010 inches. This is measured by inserting a .080 inch shim between movable core and detent plate (items 28 and 30, Plate 9224 on Page 17M001D). Bridge assembly should just kiss the stationary contacts at this gap.

(3) Test Point -1- Switch starting to close, 2 lbs. approx.

(4) Test Point -2- N.O. contacts at kiss position, 6 lbs. approx.

(5) Test Point -3- Switch fully closed 8.8 lbs. approx.

Contact and Core - Gaps and Pressures Forward and Reverse Contactors

(1) Front N.O. contacts are .160 plus or minus .010 inches apart in the open position.

(2) Front N.O. contacts closed - overtravel should be .080 plus or minus .010 inches. This is measured by inserting an .080 inch shim between the movable core and the end plate (items 46 and 49, Plate 9223 on Page 17M001C). The contact bridge should just kiss the stationary contacts at this gap.

(3) Rear N.C. contacts closed - overtravel should be .080 plus or minus .010 inches. This is measured by inserting an .080 inch shim between the movable core and the detent plate (items 46 and 26, Plate 9223 on Page 17M001C). The contact bridge should just kiss the stationary contacts at this gap.

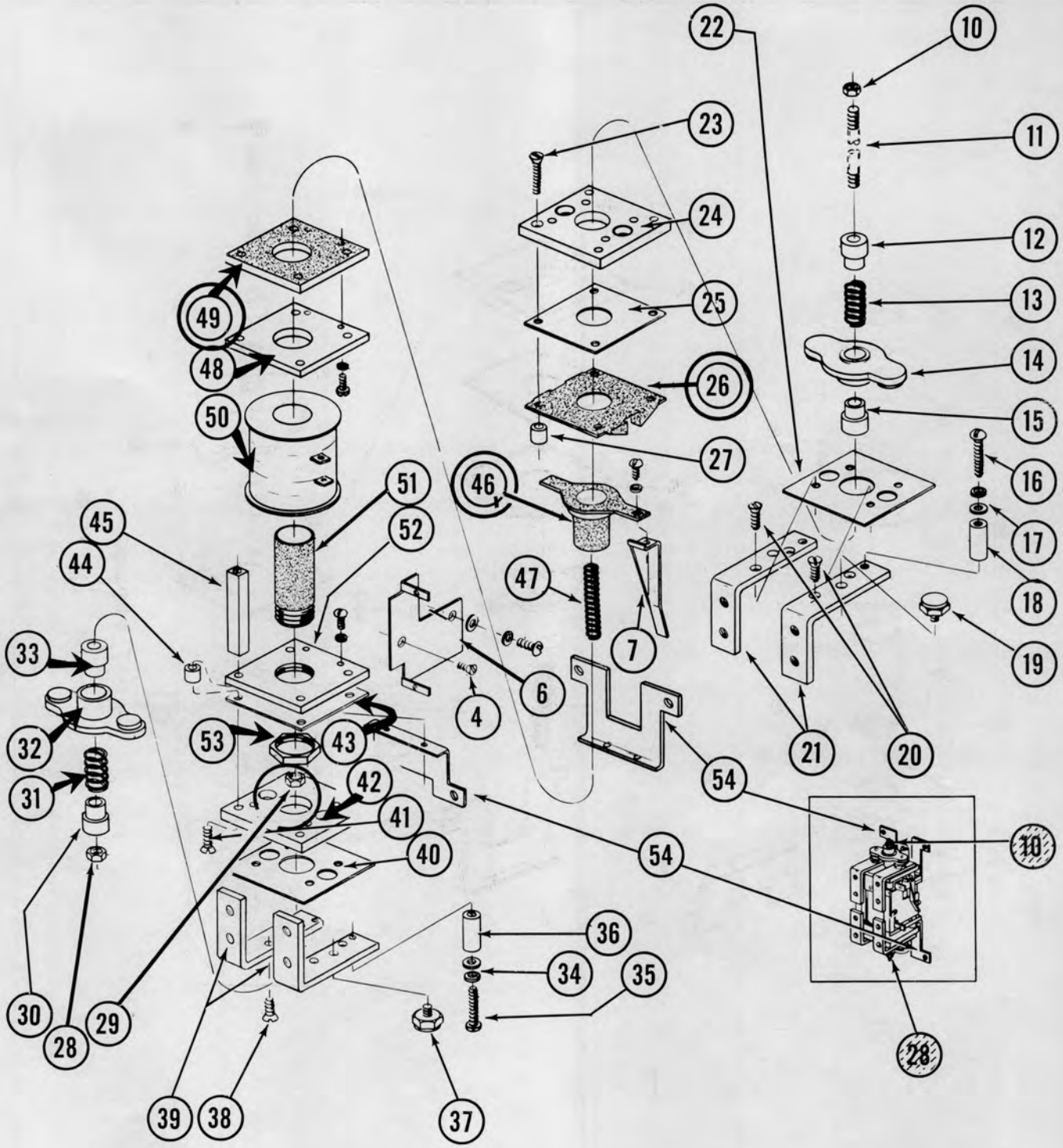
(4) Rear contacts N.C. are .160 plus or minus .010 inches apart in the energized position.

(5) Test Point -1- Switch starting to close 2.1 lbs. approximately.

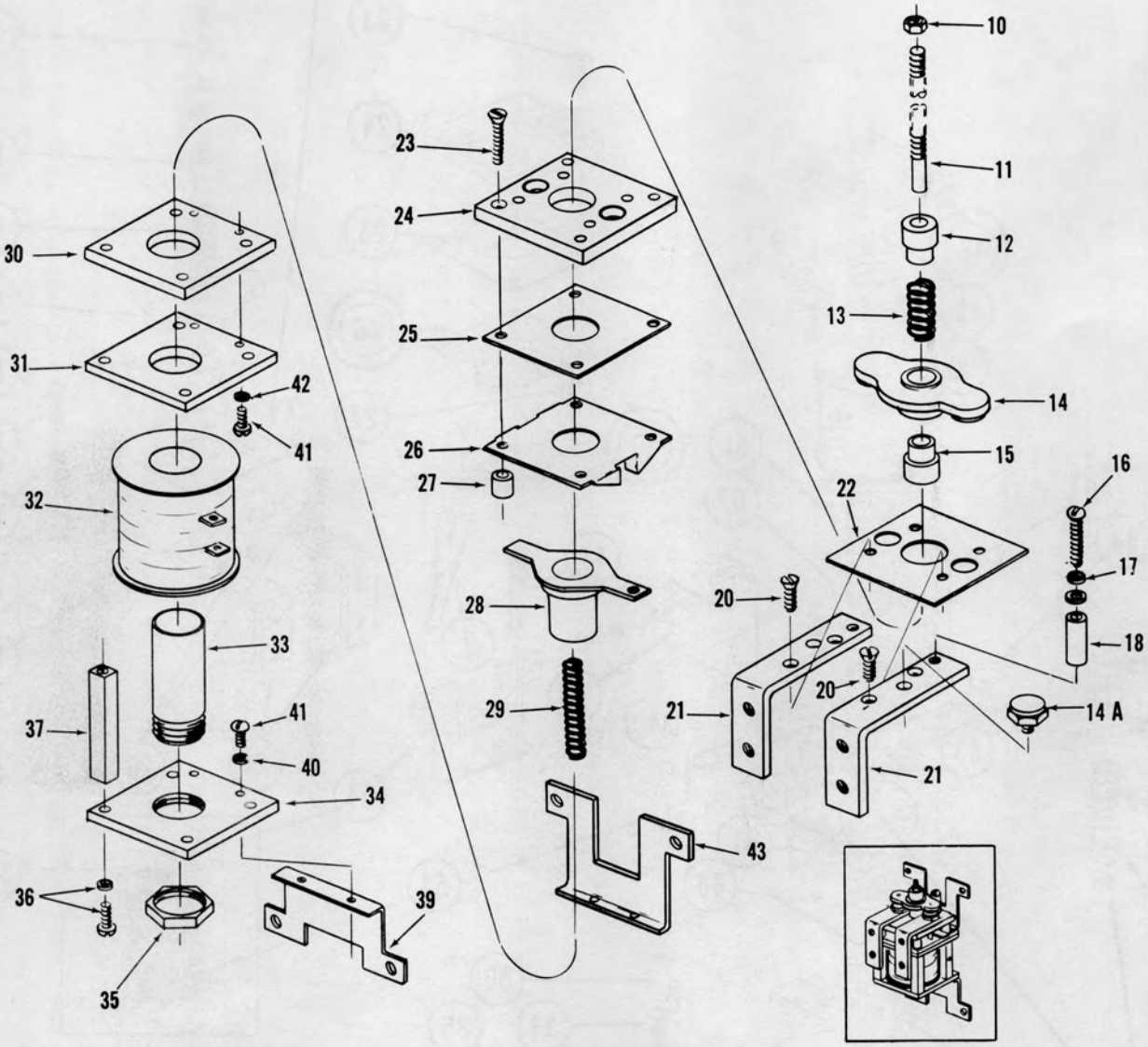
(6) Test Point -2- Switch 1/3 closed, rear N.C. contacts starting to open 8.5 lbs. approximately.

(7) Test Point -3- Switch 2/3 closed, rear N.C. contacts meeting 13 lbs. approximately.

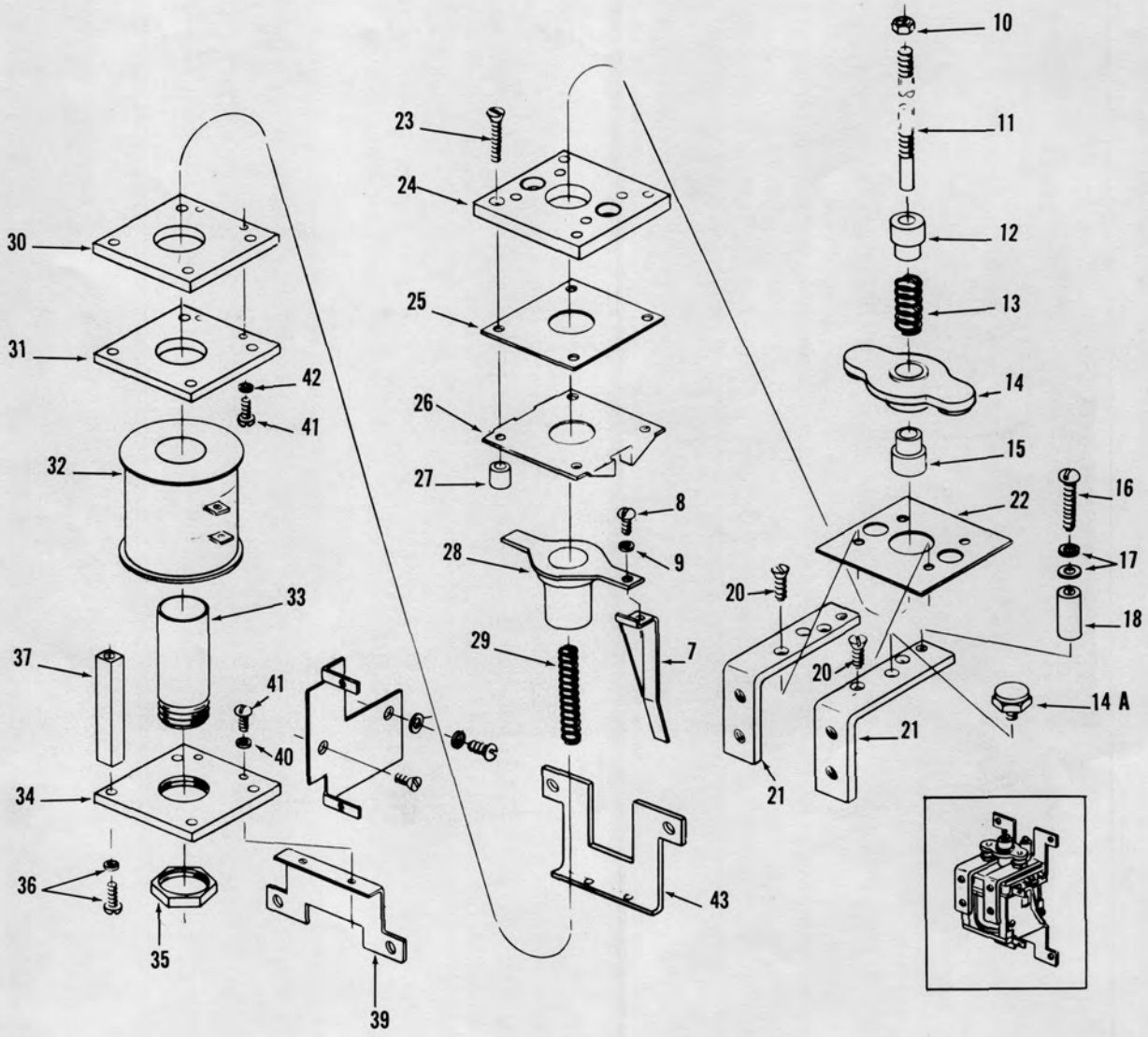
(8) Test Point -4- Switch all the way closed 16.3 lbs. approximately.



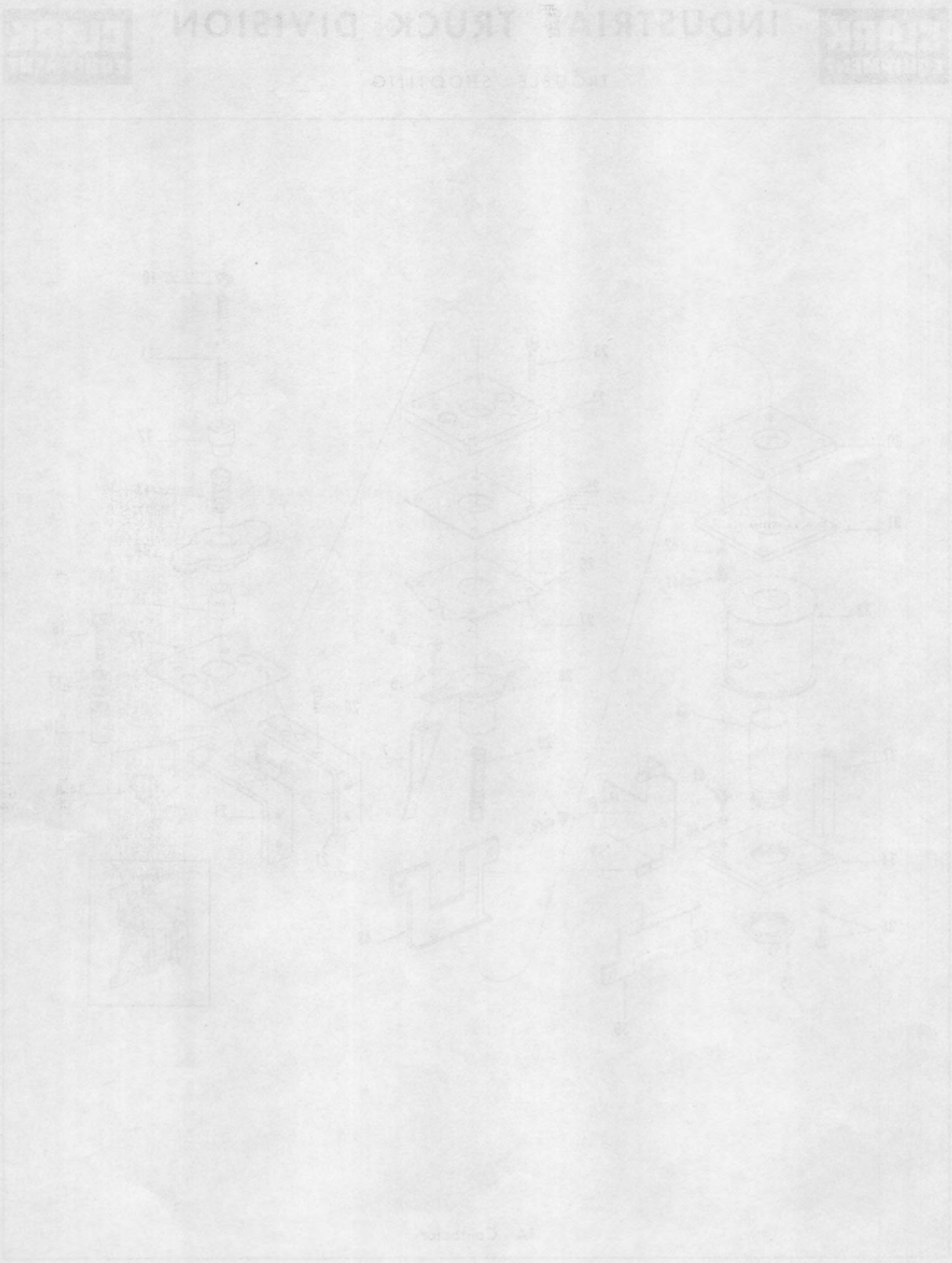
Forward and Reverse Contactors



Pump Contactor



1A Contactor



EC20/25-30-40 AND ECS50SG

GE C-80

SUBJECT: PROPER SCR CHECK OUT PROCEDURE FOR GE C 80 SYSTEM; EC 20/25-30-40 and ECS 50 SG. IMPORTANT: Machines must be thoroughly checked before being put into service.

The attached CHECK OUT SHEET must be filled out and has to accompany the installation report before we will accept any warranty claims.

DO NOT use a motor generator unit such as Ready Power to move and/or check machines as serious damage may occur.

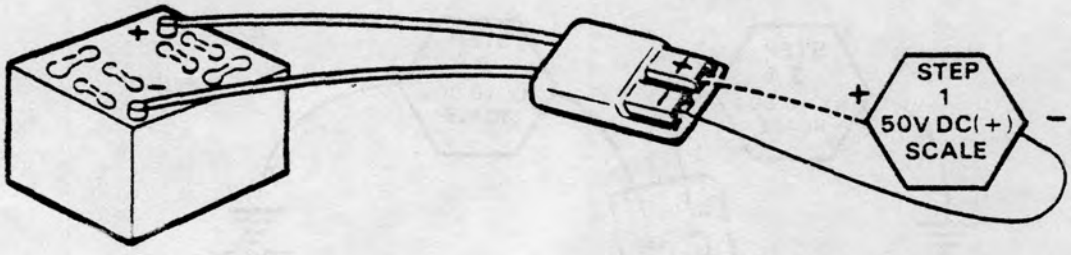
If, for any reason, a machine does not comply with the adjustment, inspection and test procedures, the figures you enter on the check out sheet will have to be known prior to contacting the factory.

The following checks MUST be made with a Simpson V-O-M 260 Meter or equivalent.

NOTE: IF METER READINGS ARE NOT WITHIN SPECIFICATIONS OF EACH STEP, REFER TO ADDITIONAL TROUBLESHOOTING INSTRUCTIONS FOLLOWING THE CHECK OUT PROCEDURE. DO NOT CONNECT BATTERY UNTIL STEP 7.

1. CHECKING BATTERY POLARITY & BATTERY VOLTAGE.

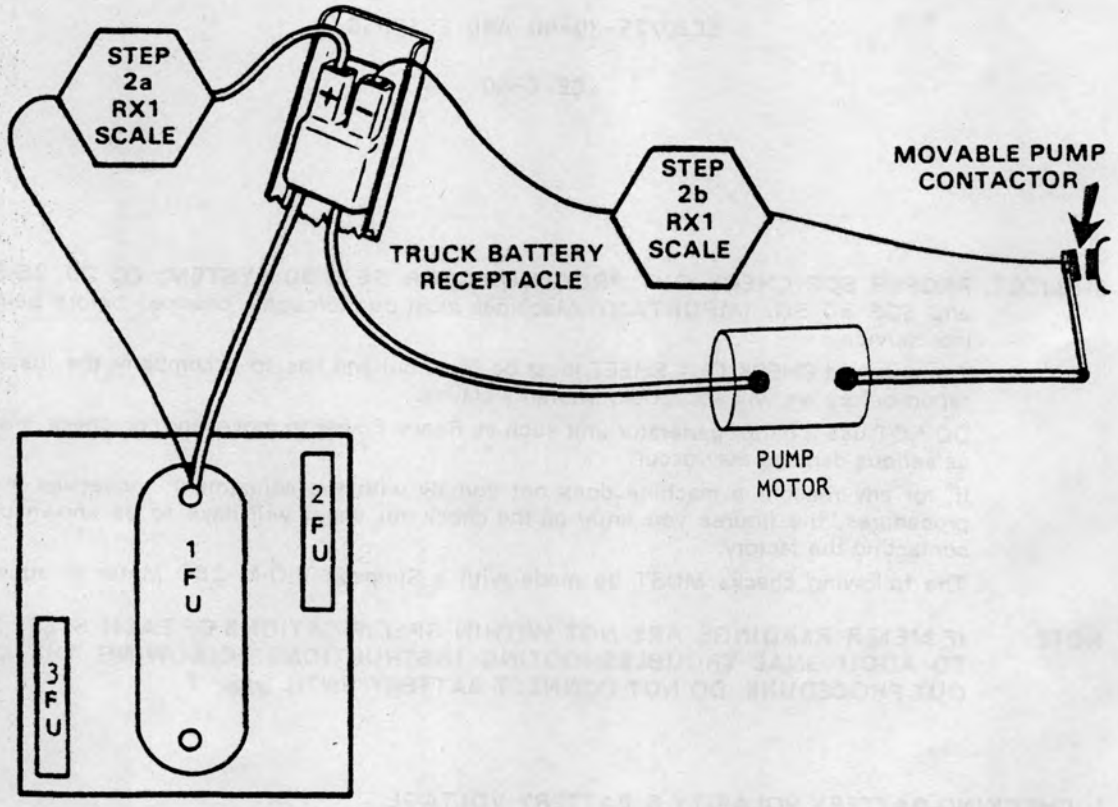
With voltmeter set on the 50 V DC (+) scale, place the red lead on positive (+) and the black lead on negative (—) battery connector. You should read battery volts. If meter needle moves backwards, the power cables are connected wrong in the battery and should be reversed before connecting battery to machine.



2. CHECKING TRUCK POLARITY. Checking continuity of power cables for proper polarity.

a. With ohmeter on RX1 scale, either lead red or black on the positive side of truck battery receptacle, the other lead on the 1FU fuse. Should have no resistance. Ohms.

b. Still on the RX1 scale, either lead red or black on the negative side of truck battery receptacle, the other lead on the movable pump contactor power tip, should have no resistance. Ohms.



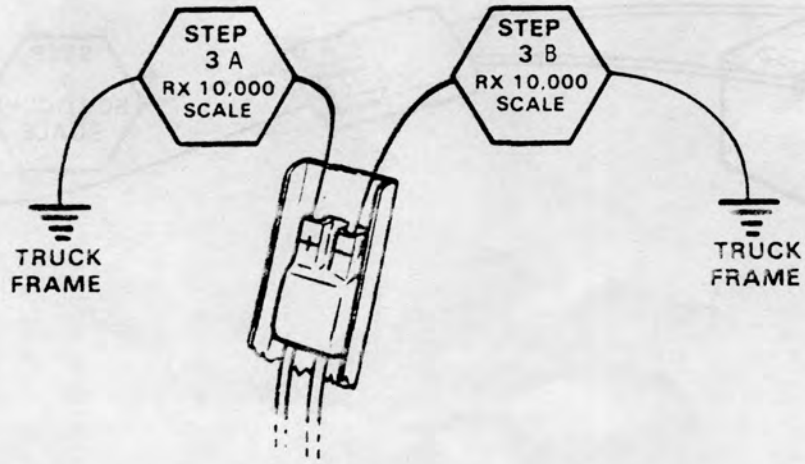
3. GROUND TEST.

With ohmmeter set on RX 10,000 ohm scale, check for grounds.

a. Positive (+) of truck receptacle to truck frame.

b. Negative of truck receptacle to truck frame, with 1A contactor held closed.

Resistance for 3a and 3b should be 50,000 ohms or higher on new trucks, 30,000 ohms is acceptable on used trucks.



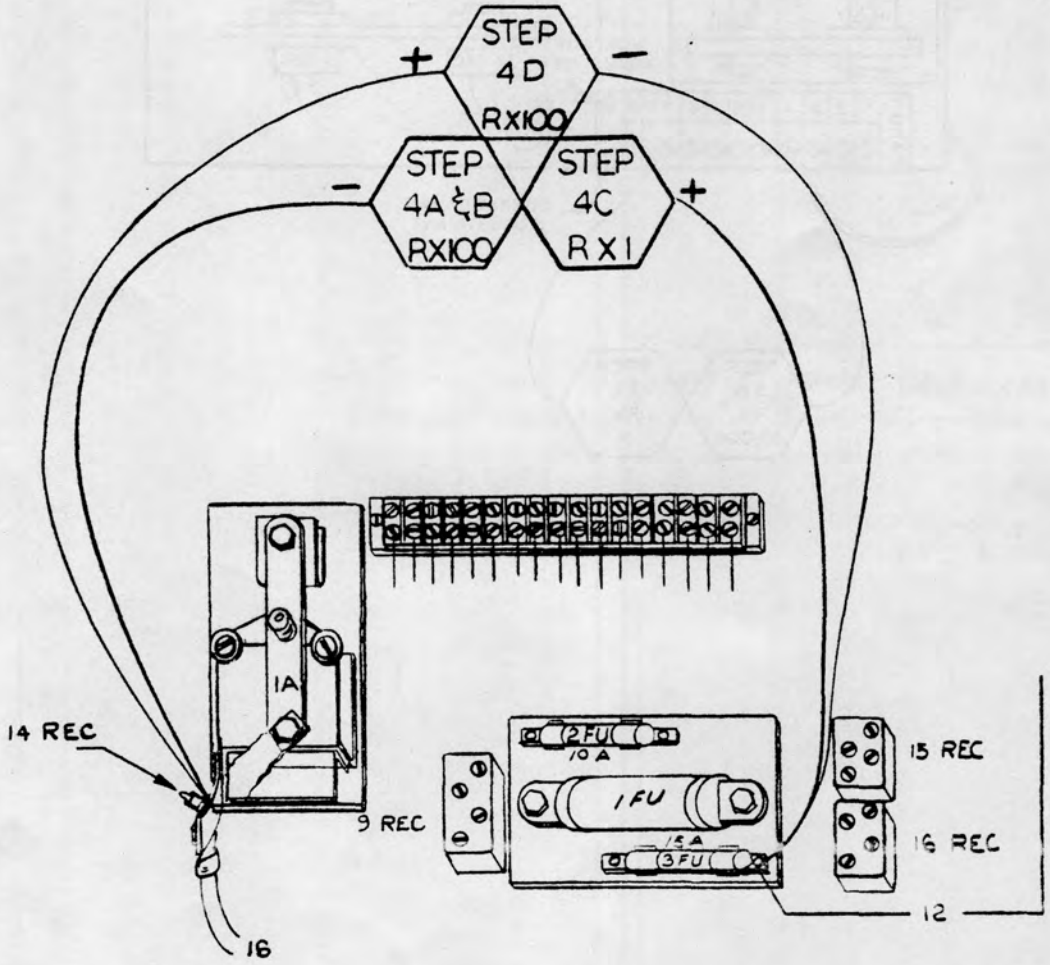
4. CHECKING CONTROL WIRING USING OHMMETER.

   a. With all switches open, measure open circuit between wire 12 (+) on 3FU and wire #16 (-) on (lower) cable connection of 1A contactor. RX 100 scale.

   b. Close key and seat switches and measure approximately 300 to 750 ohms between wires 12 (+) and 16 (-). RX 100 scale.

   c. Close key seat, accelerator 1MS and directional switches and measure 30 or more ohms between wires 12 (+) and 16 (-). RX 1 scale.

   d. Remove 15 amp fuse, reverse polarity. Should measure minimum of 700 ohms resistance on RX 100 scale.
   NOTE: Remove back up light (if used) at reverse contactor.



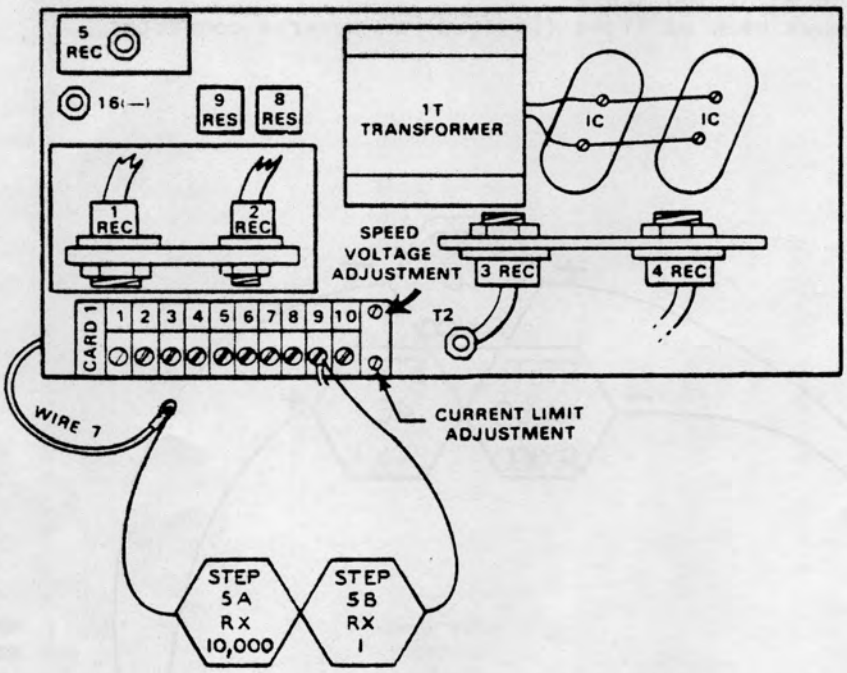
5. CHECKING SPEED POT, 1MS & 2 MS SWITCHETTE OPERATION

a. Disconnect wire 7, from terminal 3 card 1, connect ohmmeter (RX 10,000) on wire #7 and wire #8 (terminal 9). Depress accelerator pedal until 1MS clicks, meter at the click should read between 180,000 and 250,000 ohms.

NOTE: Higher resistance allows slower creep speed, set 1MS to highest resistance possible.

b. With ohmmeter still connected on wire 7 & 8, switch ohmmeter to RX 100 scale, depress accelerator completely, 2MS switch should click, at this point meter should read 300 ohms or less when the 2 MS switch clicks.

c. Remove meter and reconnect wire 7 to terminal 3 on card 1.



6. CHECKING CONTACTORS MANUALLY.

Before connecting battery, manually push the armature plate in until power tips contact and wipe. NOTE: Interlocking switchette should not actuate until after power tips make contact. This check is performed to detect contactor binding, switchette operation and wire interference with contactor tips.

THE BATTERY SHOULD BE FULLY CHARGED AND SPECIFIC GRAVITY 1.250 OR HIGHER.

CAUTION: DO NOT USE ANY OTHER POWER SOURCE — BATTERY ONLY AND WITH NO POWER CABLE EXTENSIONS. NOTE: If fault detector is used, jump 2T & 2V wires.

CONNECT BATTERY

7. CHECKING CONTACTORS ELECTRICALLY.

a. Insert insulated material (cardboard, etc.) between the normally open power tips of contactors to prevent current flow. Move the F & R directional lever in forward, depress the accelerator until the forward contactor energizes, depress the accelerator completely until the 1A contactor coil energizes. The same applies for reverse. With F contactor energized, depress R contactor armature plate and F coil should drop out and vice versa. This is an interlocking switchette check.

NOTE: FW (Field Weakening) contactor (if used), should not engage. This will be covered on a separate sheet.

b. With insulator between pump contactor power tips to prevent current flow, operate the lift and tilt lever to see if pump contactor coil operates properly.

8. CHECKING PLUGGING OF TRUCK. Remove insulators from power tips.

The PR and APR (Plugging Relay and Auxiliary Plugging Relay) are in the circuit for controlled plugging or to prevent sudden reversal of machine when changing directions. Proper operation of PR and APR relays can be checked by running truck at low speed and reversing directions. If truck slows down gradually before reversing, the relays are working properly. If reversal is severe, adjust 7RES clockwise (located in the upper left corner of the contactor panel, underneath the PR and APR relays). If this does not help, then check the PR & APR as follows.

CHECK OPERATION OF PR & APR CIRCUIT WITH DRIVE WHEELS RAISED OFF GROUND.

TRUCK SHOULD NOT BE PLUGGED WITH DRIVE WHEELS OFF GROUND.

9. CHECK OPERATION OF APR RELAY.

a. Relay should pick up when direction switch is in neutral and remain picked up when direction switch is moved to forward or reverse position.

b. Depress accelerator. Relay should drop out after 3/4 second time delay when direction switch is moved to forward or reverse position. (Make sure relay picks up with rapid reversal of directional switch.)

10. CHECK OPERATION OF PR RELAY.

a. Hold PR relay closed manually. With accelerator depressed, operate directional switch and note that APR picks up and stays in until PR is released.

b. Remove insulator from F & R contactor tips. Holding PR closed, depress accelerator and note "ticking" in control at frequency of about 3-5 "ticks" per second. If frequency is out of this range, adjust 7RS, being sure that frequency is not set so low that "ticking" stops at low speed position of accelerator. (Adjust 7RS counterclockwise to increase frequency.)

WITH DRIVE WHEELS JACKED UP AND INSULATOR IN POWER TIP GAPS OF 1A AND FW CONTACTORS, CHECK MAXIMUM SPEED VOLTAGE AND CURRENT LIMIT. THESE ADJUSTMENTS HAVE BEEN PRESET AT THE FACTORY AND SHOULD NOT REQUIRE ADJUSTMENT.

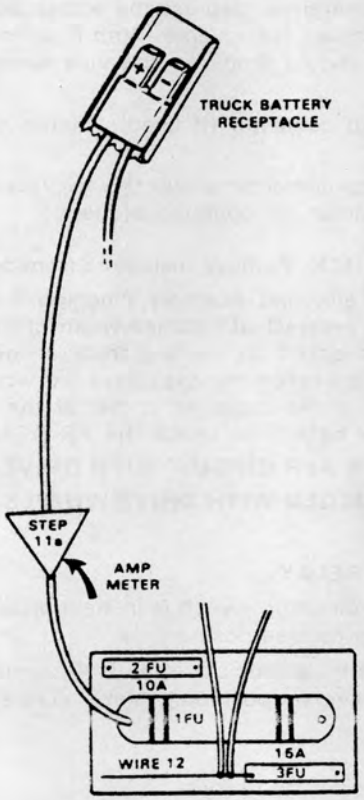
11. CHECKING SPEED VOLTAGE AND CURRENT LIMIT.

NOTE: DO NOT STALL MOTOR FOR MORE THAN 30 SECONDS AT A TIME. ALLOW TIME FOR MOTOR COOLING BETWEEN STALLS. DO NOT OPERATE MOTOR AT HIGH SPEEDS OR REVERSE DRIVE MOTOR WITH DRIVE WHEELS JACKED UP.

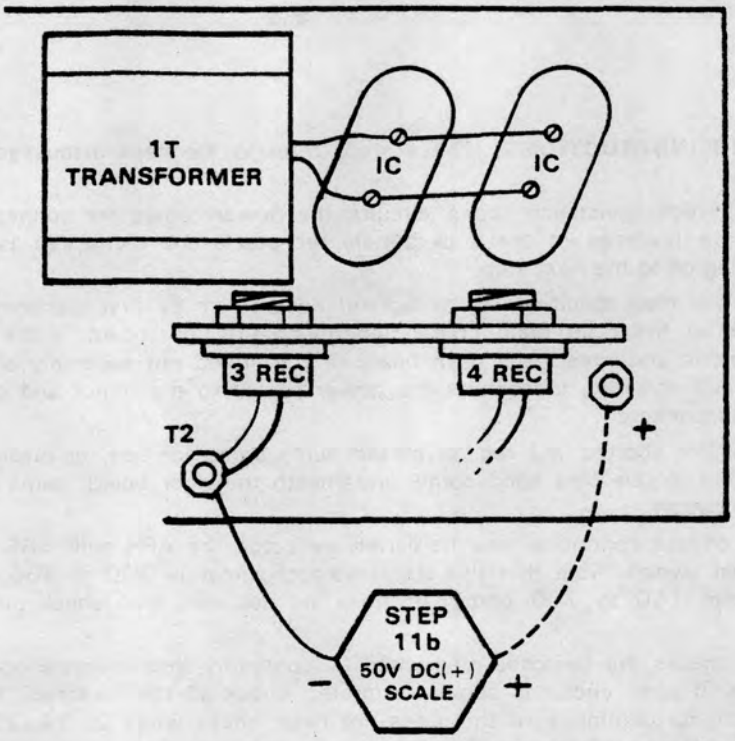
Equipment required:

1. Volt Ohmmeter, Simpson 260-5P or equivalent.
2. Ammeter, Clark Part # 1800979 or
   50 MV 600 amp shunt and 50 MV 600 ammeter

a. Disconnect the positive power cable from 1FU and connect the ammeter (or shunt) between the power cable and the 1FU.



b. Connect the voltmeter positive (red) lead to positive terminal next to 4 rec. and negative (black) lead to T2 on the SCR panel.



NOTE: If truck is equipped with brake switch, place jumper between wire #2 and wires 24 & 25 on brake switch.

c. Check maximum speed voltage first by depressing the accelerator completely and applying the brakes until battery current is 60 amperes. Voltmeter at this point should read between 22-26 volts. If not, adjust maximum speed voltage on card 1, trim pot located on the upper right hand corner, clockwise to increase.

d. Now check current limit by locking drive wheels with brakes, depress accelerator completely, current should read as follows:

EC20/25	180 amps min - 210 amps max
EC30/40	165 amps min - 180 amps max
ECS50	165 amps min - 175 amps max

If current limit does not meet specifications, adjust current limit on card 1. Turn pot adj. screw located on the lower right hand corner clockwise to increase current limit.

If equipped with field weakening, remove brake switch jumper after field weakening adjustment.

12. FIELD WEAKENING ADJUSTMENTS.

a. On trucks equipped with field weakening kit, remove insulators from all contactors. With wheels jacked up, check that FW contactor picks up and drops out at correct values of current.

EC20	pick up	125-150	amps	-	drop out	250-300 amps.
EC40	pick up	150-175	amps	-	drop out	300-350 amps.
ECS50	pick up	150-175	amps	-	drop out	300-350 amps.

Lower drive wheels to the ground and give truck a general operational check out, including plugging from various speeds.

TROUBLE SHOOTING INSTRUCTIONS: (These steps refer to the steps discussed in the foregoing check out procedure.)

1. If the meter reads high resistance (open circuit), the power cables are connected wrong in the truck and should be reversed in the truck battery receptacle and rechecked as per step 2a and 2b before proceeding on to the next step.
2. If resistance is lower than specified, try to isolate the problem by first disconnecting the control wire plugs located in the right hand corner underneath the floor board, if the ground is lost at this point, the short is underneath the dash board or the speed pot assembly or the seat switch. If the ground is still showing, disconnect the power cables to the motor and observe the meter each time one is disconnected.
3. a. If shorted, check for shorted #3 rec. or closed pump contactor tips, or disconnect the control wire plugs located in the right hand corner underneath the floor board, same as step 3, check for shorted horn button.
   b. This procedure checks continuity thru the battery indicator, the APR coil, 5RS and the normally closed directional switch. Note that this step says approximately 300 to 500 ohms, acceptable readings are from 150 to 700 ohms. If these are not met, than check the above items for continuity.
   c. This procedure checks the switches mentioned — continuity thru the interlock switchettes and the F or R coils. If open circuit is shown on meter, check all the switches, the interlocks and the F and R coil for continuity, if this does not help, check wires 2, 24, 25, 15, 5, 3, 21, 23, 50, 14 rec. and wire 16 for continuity.
   d. If resistance is less than indicated, check 14 rec. for high and low resistance in opposite directions.
4. a. If the 1MS switch clicks at more or less resistance than specified, the 1MS switch (closest to the speed pot) is adjusted by loosening the lock nut underneath the retaining bar and turning the screw clockwise to raise the switch and counterclockwise to lower it.
   b. The 2MS is adjusted in the same manner as the 1MS switch.
5. a. If F or R don't energize, check step 4b again.

INDUSTRIAL TRUCK DIVISION

DEALER CHECK-OUT SHEET FOR GE C80 SYSTEM
EC20/25-35-40 & ECS 50 SG

Truck Serial No._____ Date _____

1. Battery Polarity Checked? _____ Battery Voltage _____ Volts

2. Truck Polarity

   a. Positive Lead to 1FU Checked? _____

   b. Negative Lead to Pump Contactors Checked? _____

3. GROUND TEST (+) to Frame _____ ohms, (—) to Frame _____ ohms.

4. CHECKING CONTROL WIRING.

   a. Term's 12 (+) to 16 (all switches open) _____ ohms

   b. Term's 12 (+) to 16 (key and seat switches closed) _____ ohms

   c. Term's 12 (+) to 16 (key, seat, 1MS & directional switches closed) _____ ohms

   d. Term's 12 (+) to 16 (all switches closed) _____ ohms

5. SPEED POT, 1MS & 2MS SWITCHETTE OPERATION

   a. Wires 7 and 8 — 1MS actuates _____ ohms.

   b. Wires 7 and 8 — 2MS actuates _____ ohms.

6. Checked contactors manually? _____

7. Checked contactors electrically? _____

8. Checked plugging of truck? _____ If no controlled plugging,

9 & 10. APR & PR relays checked? _____

11. CHECKING SPEED VOLTAGE AND CURRENT LIMIT

   c. Maximum speed voltage _____ volts.

   d. Current limit _____ amps.

12. FIELD WEAKENING ADJUSTMENTS.

   FW pickup (FW equipped machines only) _____ amps.

   FW drop out (FW equipped machines only) _____ amps.

Maximum speed sealed? _____ Current limit sealed? _____

Mechanic _____ Hour Meter Reading _____