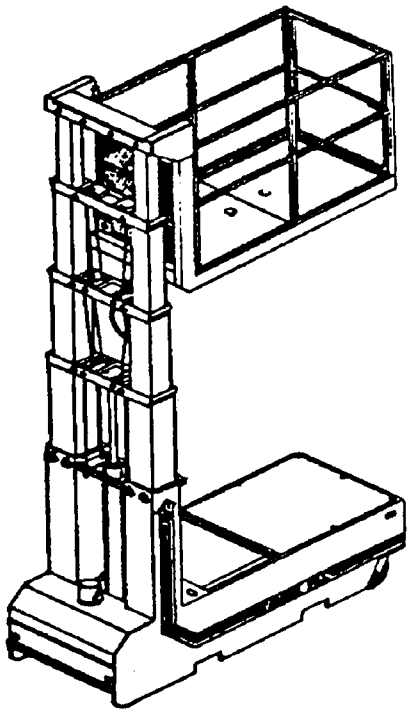
The Marklifts.®

A Product of Mark Industries

SELF-PROPELLED PAL OPERATION MAINTENANCE AND PARTS MANUAL



Model: SP 19

FIRST EDITION: May 1981

Mark Industries

P.O. Box 2255
Brea, California 92622
205 South Puente Street, Brea, California 92621
(714) 879-MARK, FAX (714) 879-8884

Rev. 1: April 1982

17211

REV.1
4-82

TABLE OF CONTENTS

MARKPAL SELF-PROPELLED PAL

(SP 19)

OPERATION MAINTENANCE AND PARTS MANUAL

TABLE OF CONTENTS

MARKPAL SELF-PROPELLED PAL

(SP 19)

OPERATION MAINTENANCE AND PARTS MANUAL

MARKPAL SELF-PROPELLED PAL
(SP 19)
OPERATION MAINTENANCE AND PARTS MANUAL

The purpose of this Manual is to provide the customer with operation maintenance and parts information that will enhance the reliable performance of the MarkPal. Schematic and vendor information is also furnished.

WARNING: IMPROPER USAGE OF THIS MACHINE MAY RESULT IN SERIOUS PERSONNEL INJURY. TO PROTECT YOURSELF AND THE EQUIPMENT, STUDY THIS MANUAL BEFORE STARTING OPERATIONS.

The model capacity, pressure setting and serial number can be found on the ID Plate mounted on the front driven column cross-arm.

The serial number must be used when ordering parts. This will help our Parts Department in giving prompt and accurate service.

If additional information or service is needed, we urge the customer to contact his local dealer. If this is not possible, please get in touch with the Mark Industries Service Department.

All Markpals are tested and operated to assure their proper operating condition before shipment. At this time all necessary adjustments are made and an overall physical inspection is conducted. After the unit is delivered, some final minor adjustments and inspections may be required prior to putting the unit in service. These functions are outlined in the inspection and checkout instructions in the operation section of this Manual.

MARKPAL SELF-PROPELLED PAL

(SP 19)

DESCRIPTION	ENGLISH	METRIC
HEIGHT-WORKING (EXTENDED)	25'-0"	7.62 m.
HEIGHT-PLATFORM (EXTENDED)	19'-0"	5.8 m.
(LOWERED)	2'-6"	.76 m.
HEIGHT-STOWED	6'-7"	2.0 m.
BASE WIDTH	2'-6"	.76 m.
OUTRIGGERS	NOT REQ'D	NOT REQ'D
BASE LENGTH	7'-4"	2.23 m.
WEIGHT	3,210 LBS.	1315.4 kg.
PLATFORM-INSIDE SIZE	2'-2"x4'-7"	.65mx1.39 m.
PLATFORM-GUARD RAILS (WITH MIDRAIL)	3'-6"	1.06 m.
PLATFORM-TOE PLATE	4"	.10 m.
PLATFORM FEATURES SPRING LOADED SELF LOCKING GATE.		
LOAD CAPACITY	500 LBS.	226.8 kg.
POWER SOURCE	4 SIX VOLT 250 AMP HOUR BATTERIES	
POWER SYSTEM	24 VDC	24 VDC
CASTERS: 2 SWIVEL, 2 FIXED 8 INCH URETHANE NON-MARKING.		
DRIVE WHEEL	4.80x8 PNEUMATIC	
OUTSIDE TURNING RADIUS	9'-2"	2.79 m.
VARIABLE DRIVE SPEED	0-2 MPH	0-3.2 KMS/HR

ELECTRIC DRIVE WITH INFINITLY VARIABLE SPEED CONTROL. DRIVE WHEEL CAN EASILY BE DISENGAGED FOR FREE WHEELING CAPABILITY.

MARKPAL SELF-PROPELLED PAL

(SP 19)

OPTION	TITLE
93043	GRADE ASSIST CONTROL
93044	ROTATING AMBER BEACON
93045	TRAVEL WARNING HORN
93046	HOUR METER
93047	STEERING INDICATOR
93048	115V AC WIRING TO PLATFORM
93049	375 AMP/HR. BATTERIES IN LIEU OF STANDARD

MARKLIFT SELF-PROPELLED PAL

(SP19)

OPERATION MAINTENANCE AND PARTS MANUAL

When a revision is added to this manual, enter date inserted and initial.

REV. DATE	PAGE NUMBERS	DATE INSERTED	BY	REV. DATE	PAGE NUMBERS	DATE INSERTED	BY
REV.1 4-82	FRONT TITLE PAGE						
	CONTENTS iii,iv,vi						
	OPERATION 9,10,11,14,						
	15,21,22.1 MAINT						
	23,26,28, 29,30,31,						
	32,32.1, 32.2,32.3,						
	32.4,32.5, 33,37.1						
	SCHEM. 40,41,42,						
	43,44 PARTS INDEX						
	1,2,3,4,13 THRU 38						
	VENDOR CC-1,DGB-1						
	DGB-2, LBC-1,						
	PQC-2						

MANUFACTURERS' LIMITED WARRANTY

Mark Industries makes no warranty, express or implied, on any product manufactured or sold by Mark Industries except for the following limited warranty against defects in materials and workmanship on products manufactured by Mark Industries.

> Mark Industries warrants the products manufactured by Mark Industries to be free from defects in material and workmanship under normal use and service for a period of six (6) months from the date of shipment. This limited warranty does not extend to any product of another manufacturer or to any part, component, accessory or attachment not manufactured by Mark Industries. The warranty, if any, with respect to any product of another manufacturer or to any part, component, accessory or attachment not manufactured by Mark Industries is limited to the warranty, if any, extended to Mark Industries by the manufacturer of the other product, part, component, accessory or attachment.

This limited warranty does not extend to any product (or any part or parts of any product) which has been subject to improper use or application, misuse, abuse, operation beyond its rated capacity, repair or maintenance except in accordance with the sales and service manuals and special instructions of Mark Industries, or modification without the prior written authorization of Mark Industries (whether by the substitution of nonapproved parts or otherwise).

The sole obligation and liability of Mark Industries under this limited warranty (and the exclusive remedy for any purchaser, owner or user of Mark Industries products) is limited to the repair or replacement, at the option of Mark Industries, of any product (or any part or parts of any product) manufactured by Mark Industries which, within six (6) months from the date of shipment, shall have been returned to the Mark Industries facility in Carson, California (or any other location within the United States as shall be designated by Mark Industries), at no expense to Mark Industries, and demonstrated to the satisfaction of Mark Industries as being defective in material or workmanship.

To make a claim under this limited warranty, contact Mark Industries or the Mark Industries distributor from whom the product was originally purchased. A statement giving the model and serial number of the allegedly defective product, the date and a description of the alleged defect, the date of the purchase and proof of the purchase and purchase date must accompany the returned product (or any part or parts of any product). Any product (or any part or parts of any product) determined by Mark Industries to be defective will be repaired or replaced, at the option of Mark Industries, free of charge, f.o.b. Carson, California. No credit will be given for any allegedly defective product (or any part or parts of any product) not returned to Mark Industries.

There are no other warranties, express or implied, in addition to this limited warranty. **This limited warranty is exclusive and in lieu of all other warranties, express or implied (in fact or by operation of law or otherwise), including the implied warranties of merchantability and fitness for a particular purpose.**

Mark Industries shall not be liable for any special, indirect or consequential damages. Further, no representation or warranty made by any person, including any representative of Mark Industries, which is inconsistent or in conflict with, or in addition to the terms of the foregoing limited warranty (or the limitations of the liability of Mark Industries as set forth above) shall be binding upon Mark Industries unless reduced to writing and approved by an officer of Mark Industries.

Tires, batteries, filter elements and electrical components are specifically excluded from this limited warranty.

Mark Industries

P.O. Box 2255 • Brea, California 92622
(714) 879-MARK • FAX (714) 879-8884

NEW EQUIPMENT CONDITION REPORT

(WARRANTY REGISTRATION)

REV.1
4-82

PAL	YES	NO
1. CAPACITY DECAL IS _____		
2. ALL APPLICABLE WARNING DECALS ARE INSTALLED		
3. EMERGENCY DESCENT VALVE FUNCTIONS PROPERLY		
4. OPERATORS INSTRUCTIONS ARE PROPERLY INSTALLED		
5. OPERATION MAINTENANCE AND PARTS MANUAL RECEIVED		
6. ALL CONTROLS (UPPER & LOWER) ARE IDENTIFIED & OPERATE PROPERLY		
7. STOP SWITCHES OPERATE PROPERLY		
8. CONDITION OF PLATFORM GUARD RAILS		
9. BASKET ACCESS GATE WORKS PROPERLY		
10. HORN OPERATES PROPERLY		
11. CIRCUIT BREAKERS OPERATE PROPERLY		
12. HYDRAULIC CYLINDER IS FREE OF LEAKS		
13. HYDRAULIC CYLINDER ROD IS FREE OF PAINT/SCRATCHES		
14. HYDRAULIC PUMP IS FREE OF LEAKS		
15. DRIVE GEAR BOX OIL LEVEL IS _____		
16. LUG NUTS ON WHEEL ARE TORQUED AT ____FT. LBS.		
17. BATTERY FLUID LEVEL IS FULL		
18. HYDRAULIC HOSES & FITTINGS ARE TIGHT & FREE OF LEAKS		
19. AIR PRESSURE IN TIRE IS ____PSI		
20. HYDRAULIC OIL LEVEL IS _____		
21. LIFTING ARM CABLE TENSION CHECKED		
22. HYDRAULIC TANK AND FITTINGS FREE OF LEAKS		
23. ALL ELECTRICAL CONNECTIONS ARE TIGHT		
24. ROTATING BEACON OPERATES PROPERLY (OPTION)		
*25. CONTROL CABLE STRAIN RELIEF		
*26. WEAR PAD ADJUSTMENTS		

MODEL NUMBER _____ SERIAL NUMBER _____

OPTIONS _____

INSPECTOR # _____

*IT IS ESSENTIAL THAT THESE ITEMS ARE CAREFULLY CHECKED ON YOUR NEW (SP19).

PURCHASER

COMPANY NAME

ADDRESS

CITY STATE ZIP CODE

( ) AREA CODE TELEHONE NUMBER

DATE OF INVOICE _____ DATE SHIPMENT RECEIVED _____

DATE UNIT PUT INTO SERVICE _____

☐ UNIT WILL BE USED IN RENTAL FLEET

☐ UNIT WILL BE SOLD; THE INITIAL WORK APPLICATION WILL BE:

INSPECTION	_____	GEN'L MAINTENANCE	_____	PAINTING/SANDBLASTING	_____
MINING	_____	HEATING/AIR COND.	_____	STEEL FABRICATION	_____
WELDING	_____	CARPENTRY	_____	RIGGING	_____
CONSTRUCTION	_____	PLUMBING	_____	ROOFING	_____
SCAFFOLDING	_____	ELECTRICAL	_____	GLAZING	_____
MECHANICAL	_____	SPRINKLER	_____	OTHER	_____

COMMENTS:

INSPECTION COMPLETED BY: _____

(Please print legibly)

WARRANTY WILL BE VOID UNLESS THIS INSPECTION REPORT IS POSTMARKED TO MARK INDUSTRIES NOT MORE THAN 14 DAYS FROM DATE SHIPMENT RECEIVED

MARKPAL SELF-PROPELLED PAL
(SP 19)

UNLOADING

Before unloading the MARKPAL, inspect for any physical damage. Note any such damage on the freight bill before signing, and report same to carrier.

When a loading dock is unavailable and a fork lift must be used, make sure that the fork lift has forks as long as the MARKPAL is wide. Do Not attempt to lift the machine from either the front or rear. ALWAYS LIFT THE MACHINE FROM THE SIDE.

If a rollback truck with a winch is used, attach the winch cable to the tie down brackets and pull the unit onto the truck. For unloading, reverse procedure.

TRANSPORTING

The MARKPAL may be free wheeled for very short distances at a speed no greater than 5 mph. (see page 3&4) To transport the MARKPAL over long distances a truck or trailer must be used.

When securing the MARKPAL to the truck, put the chains through the tie down brackets ONLY. DO NOT CHAIN OR STRAP OVER the platform or guard rails. Severe damage may result from excess pressure due to securing the machine over the top of the platform. (see page 5)

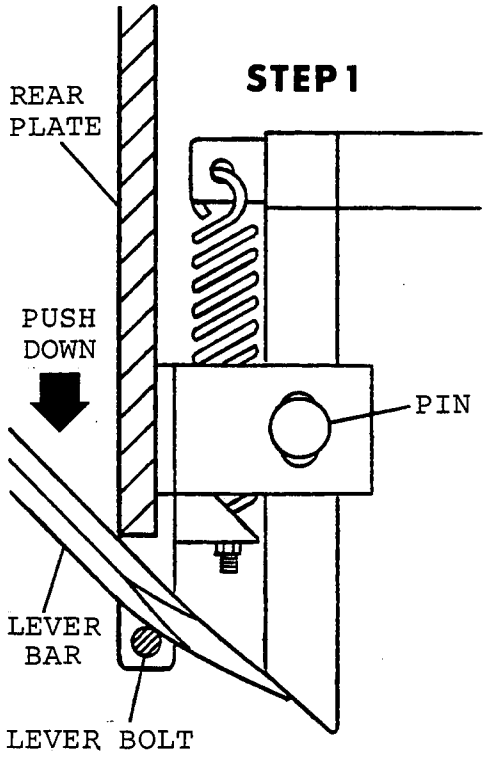
Before binding tie down chains, unit should be resting on 4x4 blocks in order to raise casters from bed of truck. Failure to follow blocking instructions could damage casters or possibly cause loss of unit from truck.

MARKPAL SELF-PROPELLED PAL
(SP 19)

NOTE: The emergency lowering valve must be OPEN whenever the MARKPAL is transported. This will prevent damage to the unit if a short occurs in the electrical system. This Manual valve is located at the front beside the lift cylinder between the base columns.

MARKPAL SELF-PROPELLED PAL

(SP 19)



Before starting adjustments, be sure machine is on a level surface.

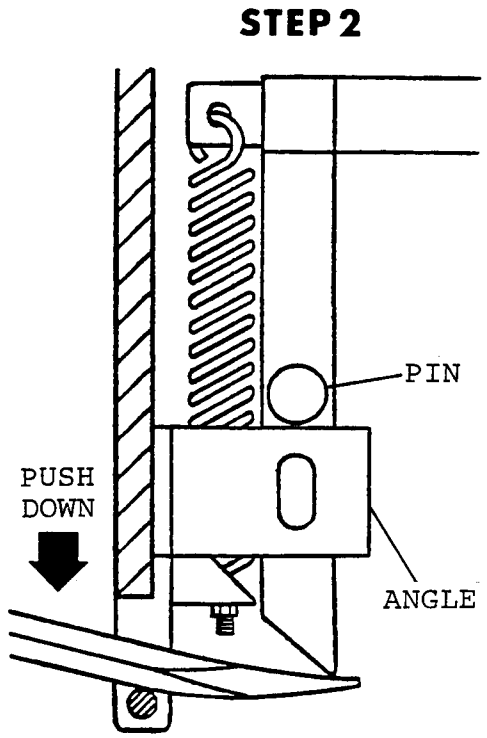
This procedure is done at the bottom rear end of the Chassis. Look for the lever bolt between two brackets that extends down below rear plate.

The lever bar is stowed inside the Chassis on a side plate near the rear.

STEP 1

A. With chisel end in, push down on lever bar until pin is free.

B. Pull pin out.



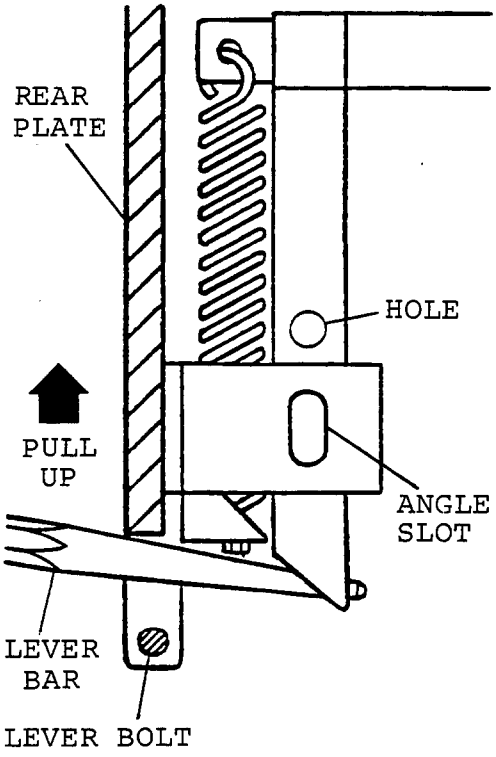
STEP 2

C. Continue pushing down until hole comes up above angle.

D. Put pin back in.

The Machine is now in the free wheeling position.

STEP 3



In order to take the machine out of the free wheeling position and back into the drive position, the following procedure is done:

STEP 3

A. With chisel end in, Push Down on Lever Bar until pin is free. (Same as Step 1)

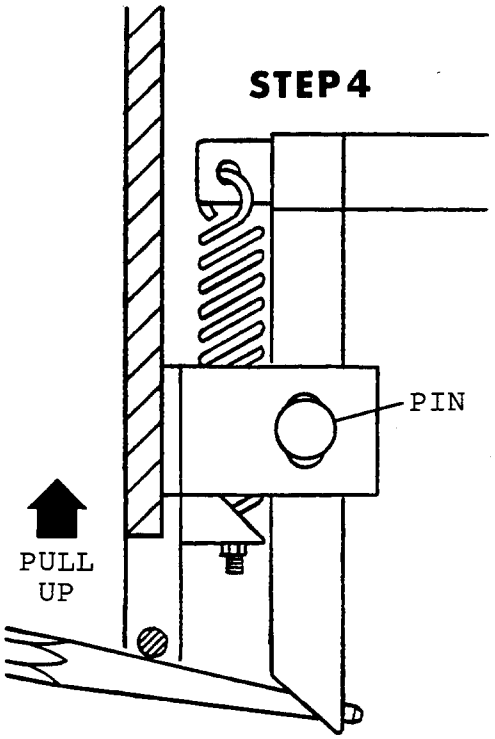
B. Pull pin out.

C. Remove bar and turn around to tapered end.

D. Put bar between lever bolt & frame plate and into back hole of vertical tube.

E. Pull up as far as possible.

STEP 4



STEP 4

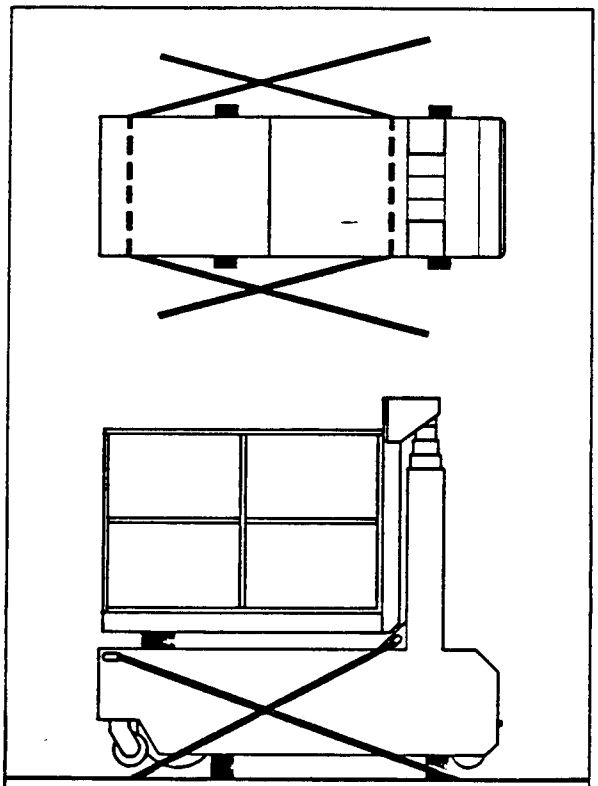
F. Take lever bar out & put underneath lever bolt.

G. Pull up until hole is in line with angle slot.

H. Put pin in.

MARKPAL SELF-PROPELLED PAL

(SP 19)



FACTORY RECOMMENDED TIE DOWN
TRANSPORTING DIAGRAM

92204

Each SP-19 MarkPal is shipped from the factory with support blocking between the frame and the truck bed of transporter. This is to assure damage to casters does not occur in transit.

It is suggested that the blocks be retained by the customer and used during future transit from jobsite to jobsite.

The tie down decal at the rear of the unit demonstrates the correct method of securing to transporter and we recommend this method be used at all times.

We further recommend, when using a winch line for loading, that a small tapered ramp be used so casters roll from ground level to tilt bed easily. Forcing the casters over edge of tilt bed may damage them, either by bending the axle pin or crushing the aluminum wheel.

MARKPAL SELF-PROPELLED PAL
(SP 19)

All MARKPAL units are tested and operated to assure their proper operating condition before shipment.

At this time, all necessary adjustments are made and an overall physical inspection is conducted. After the unit is delivered, some minor adjustments and inspections may be required before putting the unit into service.

The following items should be reviewed:

1. Perform complete charging of batteries. (See battery care page 35)
2. Check electrical system by actuating proper controls for following movements. (See aerial Operation Instructions decal)

   A. Forward C. Left E. Up
   B. Reverse D. Right F. Down

3. Inspect all electrical connections.

   A. See B. Feel C. Tighten

4. Check hydraulic system.

   A. Hydraulic fluid level-fill if required
   B. Hydraulic lines-tighten if loose
   C. Hydraulic pump
   D. Hydraulic cylinder
   E. Emergency lowering valve-for function

5. Check tire & wheel.

   A. For cuts
   B. Correct pressure - 32 PSI
   C. Tight lugs

6. Structural connections and fittings.

   A. Check all nuts and bolts for tightness.

   B. Check for cracked welds.

MARKPAL SELF-PROPELLED PAL
(SP 19)

Every operator of the MARKPAL must know, understand and follow the safety rules set forth herein.

1. The MARKPAL self propelled Powered Aerial Lift is a personnel lifting device, and it is essential that it be properly maintained and operated to perform all functions with maximum safety and efficiency.

2. The operation of any new and unfamiliar equipment can be hazardous in the hands of untrained operators. Only trained operators must be assigned to operate the MARKPAL.

3. It is the responsibility of the operator to be familiar with this manual and to follow all recommendations made. Never exceed manufacturer's recommended platform load capacity of 500 lbs.

4. Although the MARKPAL conforms to specified ANSI & OSHA requirements, it is the responsibility of the owner to instruct the operators with safety requirements made not only by Mark Industries, but by the various safety boards in your area, as well as additional requirements set forth by ANSI & OSHA.

5. The MARKPAL is a non-insulated personnel carrier and must not be operated with in 10 feet of a 50,000 volt line. (See page 12 & 13 articles)

6. Remember, the load capacity of the MARKPAL is total combined weight of personnel and tools, fixtures, accessories, etc.

7. Always distribute load evenly over platform floor area.

8. Make sure platform gate is closed and latched before operating unit.

9. It is recommended that head gear (Hard Hats) be worn by all personnel in the work platform.

10. Under no condition should horseplay be tolerated. Report any misuse of equipment to the proper personnel.

11. The MARKPAL structure must not be used as a welding ground. Disconnect both battery leads prior to performing any welding operations.

12. DO NOT lean over platform guard railings to perform work.

13. DO NOT use ladders or scaffolding on the platform to obtain greater height.

14. Battery sulphuric acid can cause a serious burn. Flush away acid with water.

15. Hydrogen and oxygen gases are produced during normal battery operation. This gas mixture can explode if flames or sparks are near battery vents.

16. DO NOT override any hydraulic, mechanical, or electrical safety devices.

17. DO NOT drive on uneven, sloping or soft terrain, as this is hazardous and must be avoided.

18. DO NOT work on platform if your physical condition is such that you feel dizzy or unsteady in any way.

19. DO NOT jump start other vehicles using MARKPAL battery.

20. Units shall be repaired immediately when damaged or weakened from any cause. They shall NOT be used until repairs are completed.

21. Employees shall NOT work on units when exposed to high winds, storms, or when they are covered with ice or snow (until all ice and snow has been removed).

22. Where moving vehicles are present, the work area shall be marked with warnings such as flags, roped off areas, or other effective means of traffic control shall be provided.

23. Unstable objects such as barrels, boxes, loose brick, tools, debris, shall not be allowed to accumulate on the work platform.

24. In operations involving production of small debris, chips, etc., and the use of small tools and materials, and where persons are required to work or pass under equipment, screens shall be required between toeboards and guardrails. The screen shall extend along the entire opening and shall consist of No. 18 gauge U.S. Standard Wire 1/2 inch mesh, or equivalent.

25. The MARKPAL platform is equipped with safety belt rings. A body belt for each person must be worn with the safety strap attached.

26. DO NOT affix any extensions or fabrications to the platform, handrails or gate.

Article 86. Provisions for Preventing Accidents Due to Proximity to Overhead Lines

2946. Provisions for Preventing Accidents Due to Proximity to Overhead Lines. (a) **General.** No person, firm, or corporation, or agent of same, shall require or permit any employee to perform any function in proximity to energized high-voltage lines; to enter upon any land, building, or other premises and thereto engage in any excavation, demolition, construction, repair, or other operation; or to erect, install, operate, or store in or upon such premises any tools, machinery, equipment, materials, or structures (including scaffolding, house moving, well drilling, pile driving, or hoisting equipment) unless and until danger from accidental contact with said high-voltage lines has been effectively guarded against.

(b) **Clearances or Safeguards Required.** Except where electrical distribution and transmission lines have been de-energized and visibly grounded or effective barriers have been erected to prevent physical and arcing contacts with the high-voltage lines, the following provisions shall be met:

(1) **Over Lines.** The operation, erection, or handling of tools, machinery, apparatus, supplies, or materials, or any part thereof, over energized high-voltage lines shall be prohibited.

(2) **Equipment and Materials in Use.** The operation, erection, or handling of tools, machinery, equipment, apparatus, materials, or supplies, or any part thereof within the minimum clearances from energized lines set forth in Table X shall be prohibited.

Table X
Required Clearances from Overhead High-Voltage Lines

Nominal voltage (Phase to Phase)	*Minimum Required Clearance (Feet)*
750 - 50,000	10
over 50,000 - 75,000	11
over 75,000 - 125,000	13
over 125,000 - 175,000	15
over 175,000 - 250,000	17
over 250,000 - 370,000	21
over 370,000 - 550,000	27
over 550,000 - 1,000,000	42

(3) **Transportation or Transit.** The transportation or transit of any tool, machinery, equipment, or apparatus, or the moving of any house or other building in proximity to overhead high-voltage lines shall be expressly prohibited if at any time during such transportation or transit such tool, machinery, equipment, apparatus, or building, or any part thereof, can come closer to high-voltage lines than the minimum clearances set forth in Table Y.

Article 86. Provisions for Preventing Accidents

Except where the boom of boom-type equipment is lowered and no load is imposed thereon, the equipment in transit shall conform to the minimum required clearances set forth in Table X.

Table Y
Required Clearances from Energized High-Voltage Conductors
(While in Transit)

Nominal Voltage (Phase to Phase)		*Minimum Required Clearance (Feet)*
750–	50,000	6
over 50,000–	345,000	10
over 345,000–	750,000	16
over 750,000–	1,000,000	20

(4) **Storage.** The storage of tools, machinery, equipment, supplies, materials, or apparatus under, by, or near energized high-voltage lines is hereby expressly prohibited if at any time during such handling or other manipulation it is possible to bring such tools, machinery, equipment, supplies, materials, or apparatus, or any part thereof, within the minimum required clearances from high-voltage lines as set forth in Table X.

(c) The specified clearance shall not be reduced by movement due to any strains impressed (by attachments or otherwise) upon the structures supporting the high-voltage line or upon any equipment, fixtures, or attachments thereon.

(d) Insulated cage-type boom guards, boom stops, insulating links, or proximity warning devices may be used on cranes, but the use of such devices shall not alter the required clearances set forth in Table X.

(e) Any overhead conductor shall be considered to be energized unless and until the person owning or operating such line verifies that the line is not energized, and the line is visibly grounded at the work site

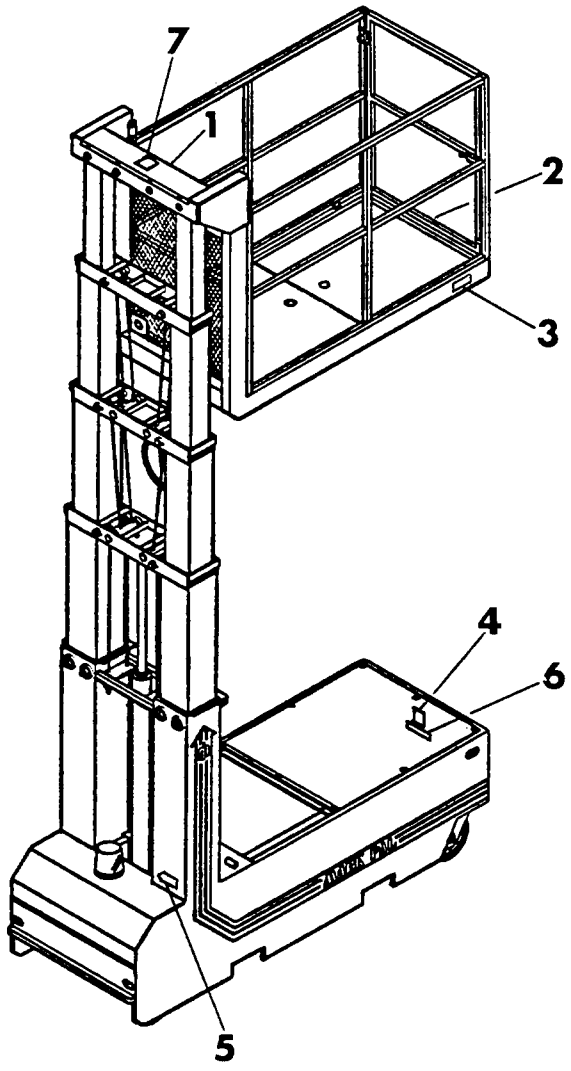
2947. **Warning Signs Required.** The owner, agent, or employer responsible for the operations of equipment shall post and maintain in plain view of the operator and driver on each crane, derrick, power shovel, drilling rig, hay loader, hay stacker, pile driver, or similar apparatus, a durable warning sign legible at 12 feet reading: **"Unlawful To Operate This Equipment Within 10 Feet Of High-Voltage Lines of 50,000 Volts Or Less."**

In addition to the above wording, the following statement in small lettering shall be provided on the warning sign: **"For Minimum Clearances of High-Voltage Lines In Excess of 50,000 Volts, See Article 86, Title 8, High-Voltage Electrical Safety Orders."**

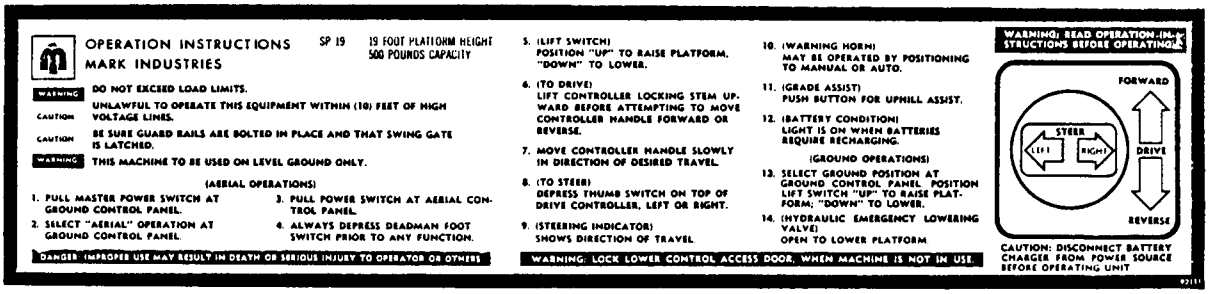
MARKPAL SELF-PROPELLED PAL
(SP 19)

Be completely familiar with all warning and caution decals that are posted on the unit.

Keep in mind to be alert and use common sense and judgement in responding to dangerous situations and conditions that might develop during unit operation.



1



92111

2

CAUTION

DO NOT USE AROUND ELECTRICAL EQUIPMENT

11053

AT REAR OF PLATFORM

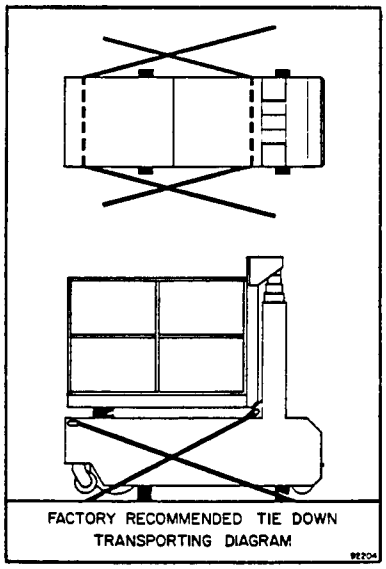
3

500 LBS. CAPACITY

BOTH SIDES OF PLATFORM 11056

AT REAR OF UNIT

4



92204

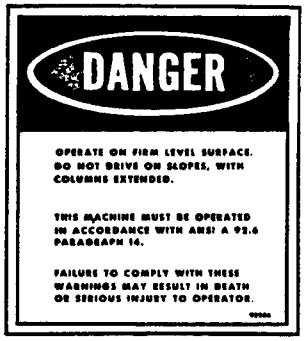
5

MANUAL DOWN VALVE

To Lower
Turn Counter Clockwise

11066

7



92236

6

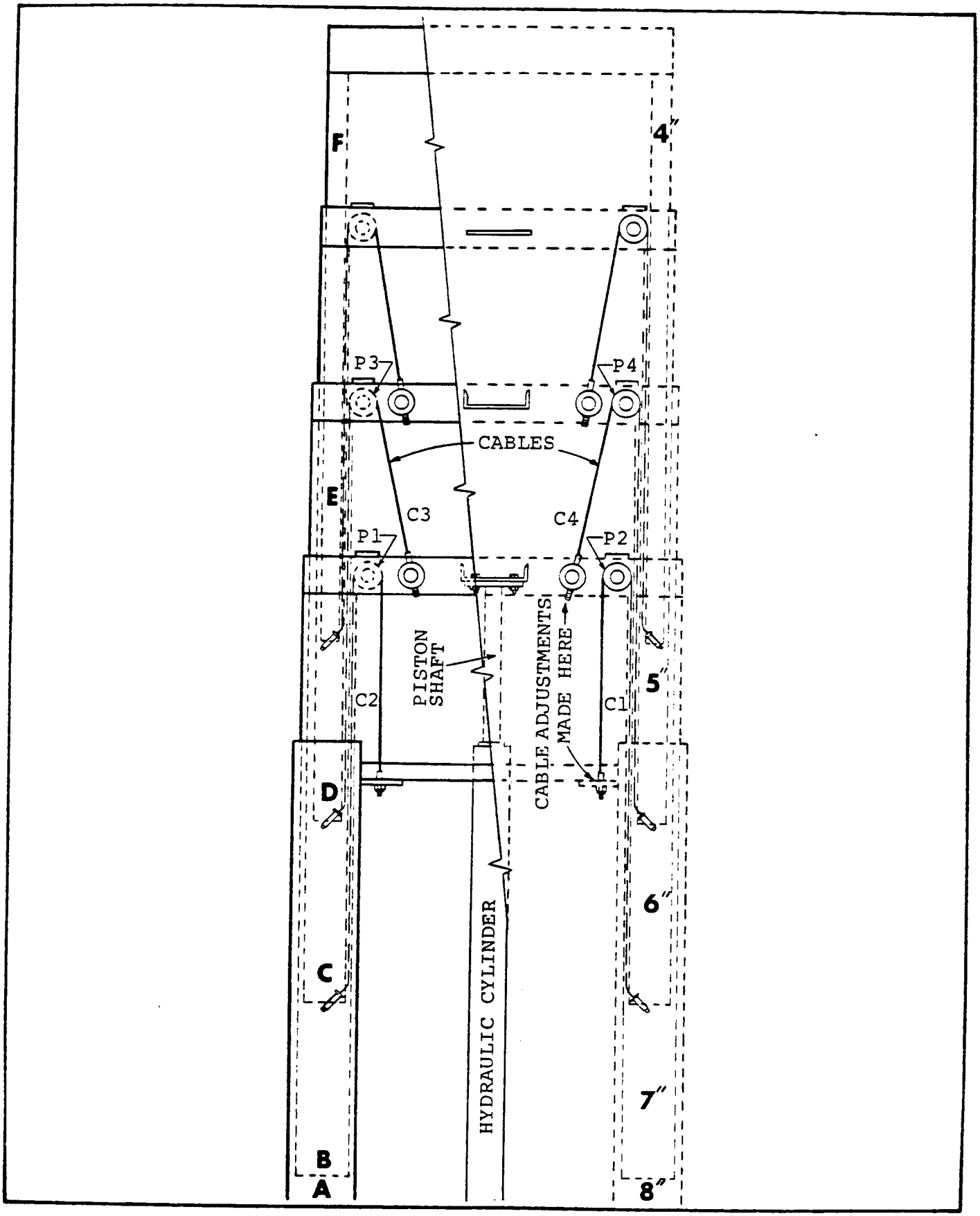
92242

MARKPAL SELF-PROPELLED PAL
(SP 19)

The operational diagram (page 17)is a drawing of a MARKPAL column assembly. In order to understand the working principle involved, assume the platform to be mounted on Section E.

In order for the platform to be raised from its nested height of 79" to its extended height of 228" the platform must move a total distance of 149". To accomplish this, the hydraulic rod must press Section B upwards a total of 53". In other words, the platform moves up or down four inches for every inch of hydraulic cylinder rod travel for the SP-19 units.

To understand how this is accomplished, consider a one inch upward movement of hydraulic cylinder rod and first moveable Section B. Note cables C-1 and C-2 are firmly anchored at one end to base section with adjusting nuts, and the opposite end is attached to lower part of section C. Thus, it can be seen that an upward movement of one inch of Section B and pulleys P-1 and P-2 would cause Section C to move upward two inches. Now, consider the same effect between Section C and D, with C-3 and C-4 anchored at one end to top part of Section B, and opposite ends anchored to bottom part of Section D to move up two inches. In other words, the one inch gained by Section E over D, D over Section C, and the one inch gained by Section C over Section B, plus the one inch movement of Section B would cause a total platform movement of four inches for each inch of hydraulic rod movement.


F
4"
P3
P4
CABLES
E
C3
C4
P1
P2
PISTON SHAFT
CABLE ADJUSTMENTS MADE HERE
C2
C1
5"
D
6"
C
HYDRAULIC CYLINDER
7"
B
A
8"

The ratio of platform movement related to hydraulic cylinder rod movement for the SP-19 IS 4 to 1. This height has been derated approximately 6% to provide greater intersection overlap, increasing safety margin.

MARKPAL SELF-PROPELLED PAL
(SP 19)

It shall be the responsibility of all users of the MARKPAL to read and comply with following operating instructions. They are designed to promote safety and a better understanding of the operation of the Self-Propelled Powered Aerial Lift.

GROUND CONTROL PANEL

The MARKPAL can be raised or lowered from either the platform control panel or the ground switch panel located at front of chassis. Before either position will function, the Master switch must be activated.

Pull the Master switch to "ON" position and move selector switch to "GROUND". The only function that can be operated from ground panel is the lift circuit. Move lift switch up to raise and down to lower.

UPPER CONTROL PANEL

1. Prior to entering the platform,pull master switch to "ON" position and set Ground/Aerial selector switch to "AERIAL" position. These switches are located on the ground control panel.
2. Enter platform and pull power switch to "ON" position. Always depress foot switch prior to any function.

LIFT

A momentary switch has been provided so that in order to raise platform, the operator must push the switch to the "UP" position, and to lower the platform,the operator must push the switch to the "DOWN" position.

LIFT

When the switch is released, it will automatically return to the off position and the platform will remain stationary.

There is a hydraulic manual emergency lowering valve which is located at the front beside the lift cylinder between the base columns.

This valve, as part of the hydraulic system, can be used to safely lower the platform if there is a loss of electrical power, or if the operator is injured while on the fully extended platform. Before the platform will lift again, the emergency lowering valve must be closed.

DRIVE

Lift controller locking stem upward before attempting to move controller handle forward or reverse. The machine is capable of variable speeds for both forward or reverse travel.

Variable drive speed is directly proportional to controller movement. Drive speed will automatically slow to approximately 50% when platform is elevated to 50% of its height.

CREEP SPEED

Creep speed will automatically cut-in when the platform is raised over one half of its rated height.

STEERING

The steering switch is located on top of the drive control handle and is actuated by the thumb. By pushing the thumb switch to the left, the steering will go left. By pushing the thumb switch to the right, the steering will go right.

STEERING

Because a momentary type switch is used, when the operator releases the switch, it will automatically return to off position. The wheels will remain at an angle until returned, by pushing the thumb switch in the opposite direction.

STEERING INDICATOR

The needle indicates direction of travel to assist the operator.

GRADE ASSIST

This momentary push button switch removes all proportional control from drive handle, by connecting drive motor directly to battery.

BATTERY INDICATOR

The light will come on when batteries require recharging.

WARNING HORN

May be operated by pushing switch to "MANUAL" or "AUTOMATIC". To stop horn, return switch to center position.

FREE WHEELING

In order to move machine in a free wheeling condition for loading, unloading and positioning, make sure that the ground panel selector switch is in the off position. The MARKPAL can be free wheeled at a low speed up to 5mph maximum without damage to any of the components or structure. (see page 3 & 4)

HYDRAULIC PRESSURE SYSTEM

Mark Industries has incorporated an itegrated hydraulic system.

HYDRAULIC PRESSURE SYSTEM

To prevent damage to either the pumps or any other part of the hydraulic system, the pump setting should be as follows:

Maximum Pressure 1,500 PSIG

MARKPAL SELF-PROPELLED PAL

(SP19)

The Lester battery charger is designed to either shut off when the batteries are fully charged or at 12 hours, whichever comes first.

There are two relays, one 24 V DC and one 110 V AC. The AC relay is mounted on the mounting plate. Its function is to turn the charger on when plugged in. The DC relay is mounted on the card. Its function is to work in conjunction with the card to turn the charger on when the batteries are at 26 volts or less and turn off at 30 volts.

If the fault reset light comes on when the unit is plugged in, that means the batteries are between 26 and 30 volts. When you push the fault reset button, you temporarily interrupt the charge sensing circuit to the card and the DC relay so that the relay sees 0 voltage (less than 26 volts). Now the unit will begin to charge. When the batteries are fully charged (30 volts) the DC relay will cut out the charging circuit. At this point, the charge light will go out (both lights will be out).

If the batteries are not fully charged after 12 hours, the charger will turn off and the fault light will come on. A fully discharged battery should fully charge after 12 hours. If the batteries are not fully charged after 12 hours, this is an indication that there is something wrong with the batteries.

MARKPAL SELF-PROPELLED PAL

(SP 19)

HYDRAULIC FLUID TABLE

OIL COMPANY	Chevron	Gulf	Shell	Union
BRAND NAME	ATF Dexron 11	ATF Dexron 11	Donax-T6	ATF Dexron
VISCOSITY -				
SUS @ 100°F	187.4	195	200	200
SUS @ 210°F	49.2	50.4	50	52.3
VISCOSITY -				
INDEX TYPICAL	153°	155°	160°	172°
FLASH POINT °F	400°	405°	390°	395°
POUR POINT °F	-40°	-50°	-50°	-45°

SERVICE TOOLS

To properly and efficiently service your MARKPAL, several basic tools are required. The following list of tools should be available.

1. Volt/ohm meter
2. Hydraulic pressure guage (0-3000 PSI)
3. Battery hydrometer
4. Battery load tester
5. Standard mechanics hand tools

WARNING

Do not use an electrical test light on the MARKPAL (SP19) as circuit damage may result.

MARKPAL SELF-PROPELLED PAL
(SP 19)

1. Check side column guides and lubricate with zinc base grease (or equivalent) if needed. Nylon guides do not require lubrication.

2. Check lifting arm cables for proper tension. If any damage or fraying is evident, replace affected cable immediately before use.
3. Charge battery after each period of usage. (see instructions on Battery Care page 35)

4. Check hydraulic lines for any signs of leakage.

5. If used for sandblasting or similar operation, steam clean moving surfaces and relubricate as in #1.

MARKPAL SELF-PROPELLED PAL
(SP 19)

1. Check cables for even tension, and make adjustments when necessary, replace cable if any broken strands or other damage is found.

2. Check battery for electrolyte level. If low, add water only.

3. Check hydraulic fluid level. Fill with ATF-Dexron 11 or equivalent, when necessary.

4. Clean corrosion from battery terminals. Remove cables from battery, clean battery posts and cable ends to shiny metal, then replace. Lube outside of connection with non-melting grease if desired.

Keep all moving parts free from sand and other abrasives. If used for sandblasting or similar operations, steam clean and relubricate immediately before re-use.

MARKPAL SELF-PROPELLED PAL
(SP19)

INTRODUCTION

Whenever trouble shooting any problem the initial consideration MUST be "Check The Basics".

Check the basics, means to insure that the batteries are in good shape, and have at least a three quarter charge, determined by use of a hydrometer, and Battery Care instructions (page 35).

A large percentage of electrical problems can be attributed to insufficiently charged or defective batteries.

(Some Helpful Hints)

ELECTRICAL

1. If problem seems to be electrical, utilize your applicable schematic, and volt OHM meter to trace power flow (electrical current) starting at battery and continuing through system until the problem is located. The entire Chassis is grounded to negative side of battery making the use of a volt OHM meter extremely easy.

2. Keep in mind, if you DO NOT have a good ground to a valve coil, relay etc., then even if you have proper electrical current to the coil or relay, the item will not function properly.

3. Diodes can be thought of as "One way electrical check valves" they permit current flow in one direction and stop it in the opposite direction.

Current Flow. ➡

ACTUAL

SCHEMATIC

4. The basic purpose of a relay is to maintain full electrical current. When sending an electrical signal to the relay coil, the electrical current flows through relay contracts and to the desired valve coil.

MARKPAL SELF-PROPELLED PAL

(SP19)

ALL FUNCTIONS

PROBLEM	PROBABLE CAUSE	REMEDY
No functions.	1) Battery connector disconnected.	1) Reconnect.
	2) 250 amp fuse burned.	2) Check and replace if necessary.
	3) 20 amp circuit breaker tripped.	3) Reset or replace.
	4) Low state of charge in batteries	4) Check and charge if necessary.
	LIFT	
Platform creeps down.	1) External hydraulic hose or fitting leakage.	1) Tighten or replace fittings on hose.
	2) Manual lowering valve. a. Manual lowering valve out of adjustment.	2) Manual lowering valve. a. Loosen jam nut on needle valve by turning counter clockwise and retighten jam nut.
	b. Needle not seating due to contamination or damage.	b. Remove needle, clean and check for damage. If damage to needle is evident, replace valve.
	3) Defective solenoid lowering valve.	3) To check valve, install a manually operated needle valve between the pressure port of the pump and the hose. Open valve raise the hydraulic cylinder by operating the pump. After extending the cylinder, close valve. If columns do not creep down, solenoid lowering valve is defective; replace. A

PROBLEM	PROBABLE CAUSE	REMEDY
		solenoid lowering valve may be repaired most of the time by checking for damaged 'o' ring or seals. Replace as needed.
	4) Hydraulic cylinder seal leakage.	4) Follow procedures in Remedy #3, page 28. If colums continue to creep down with needle valve closed, then cylinder seals are defective. Repack cylinder.
Pump motor runs, column assembly will not lift rated load to full height.	1) Emergency lowering valve open.	1) Turn needle valve clockwise until firmly seated.
	2) Insufficient hydraulic fluid in reservoir.	2) Check level and fill if necessary.
	3) Pump pressure by-pass out of adjustment.	3) Adjust pressure by pass with rated load (500 lbs) on platform. Adjust pressure by-pass so that pump will just lift load to full heighth. Important note!!! Excessive pressure adjustment will permit pump to lift in excess of rated load capacity, and exceed machine safety standards. Adjustment screw located on side of pump body. Remove cover cap, turn clock-wise for more pressure.

PROBLEM	PROBABLE CAUSE	REMEDY
	4) Broken or loose wires from dump valve. (Located inside of hydraulic reservoir).	4) Check and repair if necessary.
	5) Defective piston seals in hydraulic cylinder.	5) See section 3, page 28 and 1st section 4, page 29.
	6) Defective dump valve (Located inside of hydraulic reservoir).	6) Check by installing a manually operated flow control valve and a pressure gauge between the pressure port of the pump and the hose. The pressure gauge should be between the pump and the manually operated flow control. Then while operating the lift function from the lower control, begin gradually closing flow control while watching pressure gauge. If no pressure develops, then either the pump or the dump valve is defective. If after disassembly and inspection, the dump valve is found to be operating correctly, the pump is bad.
	7) Defective pump.	7) Follow procedures in Remedy #6

PROBLEM	PROBABLE CAUSE	REMEDY
Pump motor will not run when "up" switch is depressed.	1) Broken wire or loose connections.	1) Check.
	2) Master switch not "on".	2) Check.
	3) Circuit breaker tripped.	3) Reset or replace.
	4) Battery output "low".	4) Check and recharge.
	5) Defective toggle switch.	5) Switches are of normally open configurations. Check for continuity with switch activated. (Replace if defective).
	6) Defective motor start solenoid.	6) Check voltage across the motor side of the solenoid and ground with a volt meter, while the lift switch is activated, if items 1 through 5 check out and there is no voltage to the motor side of the solenoid, replace.
	7) Defective pump motor.	7) Inspect motor for worn or broken brushes, defective armature and field windings. (Replace as needed).
	Lowering	
Column assembly will not lower when down switch is depressed.	1) Tripped circuit breaker.	1) Reset or replace
	2) Broken or loose wires in control circuit.	2) Inspect and repair as necessary.
	3) Defective "down" control switch.	3) Switches are of normally open con-

PROBLEM	PROBABLE CAUSE	REMEDY
		figuration. Check for continuity when switch is actuated. (Replace if necessary).
	4) Defective solenoid lowering valve.	4) If items 1 through 3 check OK, check for voltage to solenoid lowering valve. If column assembly does not come down when voltage is applied to solenoid lowering valve, the valve is defective. (Replace).
Column assembly shifting from side to side or sticking on the way down.	1) Wear pads out of adjustment.	1) See page 37.1 on wear pad adjustment.
	Steering	
No steering.	1) Loose plug on actuator.	1) Check and reconnect.
	2) Loose or broken wire to steering relays.	2) Check wire #5 or #1 . (Tighten).
	3) Defective steering actuator.	3) Check voltage across the spade connectors that connect to the plug on the steering actuator. If the actuator does not function when voltage is applied, it is defective. Replace.
	4) Loose wire #18 or #19.	4) Tighten.
Steers in one direction only.	1) Loose wire #34 or #35.	1) Tighten.

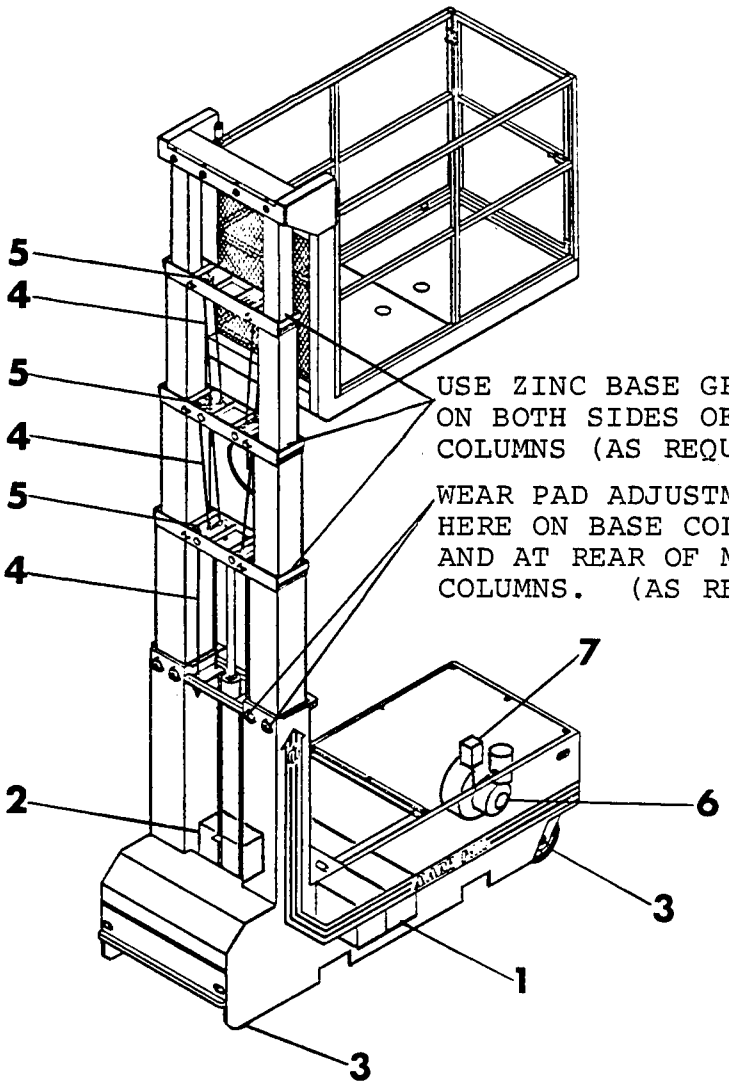
PROBLEM	PROBABLE CAUSE	REMEDY
	2) Faulty micro switch in control handle.	2) Check for continuity from wire #26 to wire #34 and wire #26 to wire #35. Be sure foot switch is not not depressed during this test. Activate steering button from left to right while checking continuity. If no continuity is attained between wire #26 and wire #34, the micro switch that wire #34 is connected to is defective, replace.
	3) Defective steering relay.	3) Observe steering relays while activating the steering button from right to left. If either relay is not functioning, check voltage across coil on that relay while activating the steering button to the direction that does not function. If there is a voltage to the coil of the relay, and it does not function, it is defective, replace. Also, check for contamination between actuator arm and electromagnet of relay.

PROBLEM	PROBABLE CAUSE	REMEDY
	Drive	
No drive.	1) Low battery output.	1) Check and recharge.
	2) Blown fuse in circuit #24 or circuit #9.	2) Check and replace if necessary.
	3) Loose wire #24 or #9.	3) Tighten.
	4) Defective main disconnect solenoid.	4) Check by first disconnecting all leads from large right hand post of main disconnect solenoid, then check voltage with volt-meter from large left hand post of main disconnect solenoid to ground if there is a voltage activate solenoid by putting a jumper from the control post not connected to wire #26 to ground and depressing foot switch. Then check for voltage with meter across large right hand post to ground.
	5) Loose power cable to drive motor.	5) Tighten.
	6) Defective speed control.	6) Call your local Mark Dealer.
	7) Flat tire.	7) Replace.
Drives in one direction only.	1) Loose wire #81 or #82.	1) Tighten.
CAUTION! Do not actuate grade assist in this condition.	2) Defective diode.	2) There are two diodes (IN5401) in the control circuit between the directional contactors and the main disconnect contactor.

PROBLEM	PROBABLE CAUSE	REMEDY
		Check and replace if necessary.
	3) Defective directional contactor.	3) There are four directional contactors (K2,K3,K5,K6). To check these contactors it is necessary to isolate them completely be removing all secondary wiring (large posts). After isolating contactors, check for continuity across large posts while activated and no continuity when not activated.
	4) Defective micro switch in control handle.	4) Remove control handle from upper control panel. With emergency stop button pushed in, use ohmeter to check for continuity from wire #9 to wire #81 only with control handle forward and wire #82 only with control handle pulled back. Make these checks at the terminal in the bottom of the control handle.
	5) Defective transistor speed control.	5) Call your local Mark Dealer.
Drive not proportional, fast only.	1) Defective by-pass contactor (K-4).	1) Remove all leads from contactor and check for continuity across large posts.If there is continuity contactor is defective, replace

PROBLEM	PROBABLE CAUSE	REMEDY
	2) Grade assist switch defective.	2) The grade assist switch is a momentary contact switch. Check for continuity across switch when depressed and no continuity. When switch is not depressed, make these checks with switch removed from the circuit. Variance from either of the above checks indicate the switch is defective, replace.
	3) Defective transistor speed control.	3) Call your local Mark Dealer.
No grade assist.	1) Improper understanding of the operation of grade assist.	1) There may be up to a 10 second delay in the grade assist circuit. There is very little difference in speed between grade assist and full speed without grade assist. Drive the machine at a slow speed while depressing the grade assist button, wait at least 10 seconds. If grade assist is working, the machine will suddenly go to full speed. It is not necessary to be at a slow speed to operate grade assist in normal operation, this is just a check.

PROBLEM	PROBABLE CAUSE	REMEDY
	2) Defective grade assist switch.	2) See page 32.4 section #3.
	3) Defective by-pass contactor (K-4).	3) Remove leads from large posts of contactor. There should be no continuity across posts, check with ohmeter. Now activate contactor by putting selector in aerial and grounding wire #21 There should be continuity across the large posts of the contactor at this point, check with ohmeter. Any variance from the above checks indicates that the contactor is defective, replace.
	4) Defective transistor speed control.	4) Call your local Mark Dealer.
	5) Defective limit switch.	5) Disconnect wires from micro switch and check operation of switches with ohmeter.
		6) Check Plunger/ Roller location in relation to actuator strip on 7" column tube, to assure sufficient travel for engagement of switch.



ITEM	DESCRIPTION	LUBRICANT	INSPECTION	FREQUENCY
1	BATTERIES		WATER LEVEL	WEEKLY
2	HYDRAULIC OIL RESERVOIR	ATF DEXRON	HYDRAULIC OIL LEVEL	MONTHLY
3	CASTER ZERKS	MULTI-PURPOSE		MONTHLY
4	CABLES		IF FRAYED, REPLACE	2 MONTHS
5	CABLE ROLLERS		IF WORN, REPLACE	2 MONTHS
6	GEAR BOX	90 WT. GEAR OIL		6 MONTHS
7	SPINDLE BEARINGS (INSIDE BOX)	BEARING GREASE		6 MONTHS

MARKPAL SELF-PROPELLED PAL

(SP 19)

QTY.	PART NO.	DESCRIPTION
1	92012	BATTERY CHARGER
1	92203	CABLE REEL ASSEMBLY
1	92172	HAND CONTROL
1	4018	POWER SWITCH
1	5300	PALM KNOB
1	70057	HORN SWITCH
1	92178	WHEEL POSITION INDICATOR
1	4031	BATTERY CHARGE LIGHT
1	92168	BATTERY CHARGE INDICATOR
1	20481	LIFT SWITCH
1	4020	GRADE ASSIST SWITCH
1	70049	STEERING RELAY
1	20571	HOUR METER
1	20562	CIRCUIT BREAKER
1	4019	SELECTOR SWITCH
1	92212	EMERGENCY LOWERING FLOW CONTROL VALVE
1	92206	PRESSURE HOSE ASSEMBLY
1	92209	RETURN HOSE ASSEMBLY
2	92020	CABLE ASSEMBLY
1	66166	LIFT CYLINDER SEAL KIT

MARKPAL SELF-PROPELLED PAL
(SP 19)

IMPORTANT FACTS ON BATTERIES AND CHARGERS

Do not discard a good battery as being defective because its specific gravity does not show an increase immediately upon applying a charge. Many good batteries require a charging period as long as three hours before they show any increase in the specific gravity.

Do not charge a battery if the electrolyte temperature could rise above 120° F. This could damage both battery and charger. As a rule of thumb, the electrolyte temperature, during normal charging, is about 20° F. above the local air temperature.

There are only two test methods to determine if a discharged battery is defective without applying charge. These tests are given in steps 5 and 6 of the INSPECTION OF BATTERIES AND ASSOCIATED CIRCUITS. Voltage testing methods without fully charging or made while charging have no relationship to the battery defectiveness.

Failure to keep the battery electrolyte to the proper level will result in a crumbling (abnormal sulfation) of the plates and cause failure of the battery. Distilled water must be added to the battery regularly to make up for the loss due to evaporation, especially during periods of high charging rates. Add water only to fully charged batteries.

Both overcharging and undercharging can cause a premature failure of a battery. Overcharging destroys the positive plates. Consistent undercharging causes a buckling of the plates.

MARKPAL SELF-PROPELLED PAL
(SP 19)

INSPECTION OF BATTERIES AND ASSOCIATED CIRCUITS

An inspection of batteries and associated circuits is required often to assure that the batteries are capable of being fully charged. This inspection requires the use of a hydrometer.

1. Verify that all connections within the unit to be charged are clean and tight.

2. Check each battery for loose terminal posts.

3. Test for continuity between all battery terminals and the charging receptacle.

4. Verify that the top of each battery is free of moisture, grease, and acid films which may cause a current leakage.

5. Test each individual cell in each battery with the hydrometer to verify that all specific gravity readings are within 10 points of one another.

6. Using the hydrometer, pull out acid from a cell and then vigorously expel the acid back into the cell to cause a violent stirring action. Immediately draw out another sample of acid and visually inspect it to see if it contains a brownish sediment (indicates positive plates are deteriorated).

MARKPAL SELF-PROPELLED PAL

(SP 19)

CHARGING TIME CHART

The following chart provides useful information for determining the minimum charging time needed to restore a battery to a full charge condition. In addition to normal charging, the cells of the batteries should be equalized twice each month. This is done by charging the batteries an additional seven hours after a normal charge cycle. The current indications of the ammeter will be low during cell equalization.

SPECIFIC GRAVITY READING	CONDITION OF BATTERY	HOURS NEEDED TO CHARGE
1100	Fully discharged	12
1125	10% charged	10
1150	20% charged	8
1175	30% charged	7
1200	60% charged	4
1225	75% charged	2
1250	95% charged	½
1260	Fully charged	0

MARKPAL SELF-PROPELLED PAL

(SP19)

To check for proper wear pad adjustment, raise the platform to maximum height (do this from the upper control) and then lower the platform. While lowering, the platform may sway a little to the right or left. If you do detect any sway, the wear pads should be adjusted. While the sway may seem insignificant, it is important because it may cause one of the column assemblies to bind. If one of the column assemblies binds while the rest are lowering then slack will occur in the lifting cables for that column. This will either cause the platform to suddenly drop or the platform will not fully descend.

Before adjusting the wear pads, check for proper cable tension. Raise the platform approximately 4 ft. then grip a pair of cables in each hand and squeeze. You will be able to feel any difference in tension between the four cables in this manner. To loosen or tighten a cable, hold the cable with vise grips then turn the nut with a wrench. There are three sets of four cables. Each set lifts all of the column assemblies above it. Do not attempt to compare the tension between sets.

Once the cables are properly adjusted, you may move on to wear pad adjustments.

The platform will sway away from the tight side. Once you have determined which side is too tight, it is difficult to determine which wear pad on that side is the cause of the sway. It is usually the bottom wear pads, so start at the bottom and work your way up. The wear pads should be adjusted so that they contact the columns. Loosen the jam nut, loosen adjusting bolt until it turns freely, then turn the adjusting bolt in until you feel the wear pad contacting the column, then tighten the jam nut.

MARKPAL

MARK INDUSTRIES

MAINTENANCE CHECK LIST

Model: _____ Serial No. _____

Date: _____ Equip. No. _____

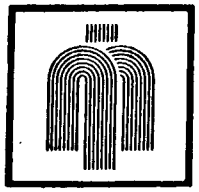
Location: _____ Mechanic: _____

ITEM	CODE	COMMENTS	ITEM	CODE	COMMENTS
1. Batteries			20. Lug Nuts		
2. Battery Terminals			21. Nuts & Bolts		
3. Motor Brushes			22. Guard Rails		
4. Hydraulic Fluid			23. Lubrication		
5. Hydraulic Oil			24. Warning Decals		
Filter			25. Operation		
6. Hydraulic System			Instructions		
7. Hydraulic Pressure			26. General Decals		
8. Hydraulic Hoses			27. Paint		
9. Cylinder			28. All Operations		
10. Emergency Lowering			29. Lift		
Valve			30. Steering		
11. Basket Controls			31. Variable Speed		
12. Lower Controls			Drive		
13. Relays			32. Literature		
14. Wire connections			33. Options		
15. Safety Cut-outs			34. Lifting Arm		
16. Bushings			Cables		
17. Rollers					
18. Tire Pressure					
19. Tire Condition					

CODE

F - Filled
R - Repaired
C - Checked
A - Adjusted
X - Needs Repair

Other Comments:



MARK INDUSTRIES

MARKPAL SERVICE MAINTENANCE RECORD

MODEL: _____

SER. NO.: _____

DATE SOLD _____

DATE IN SERVICE _____

OPTIONS _____

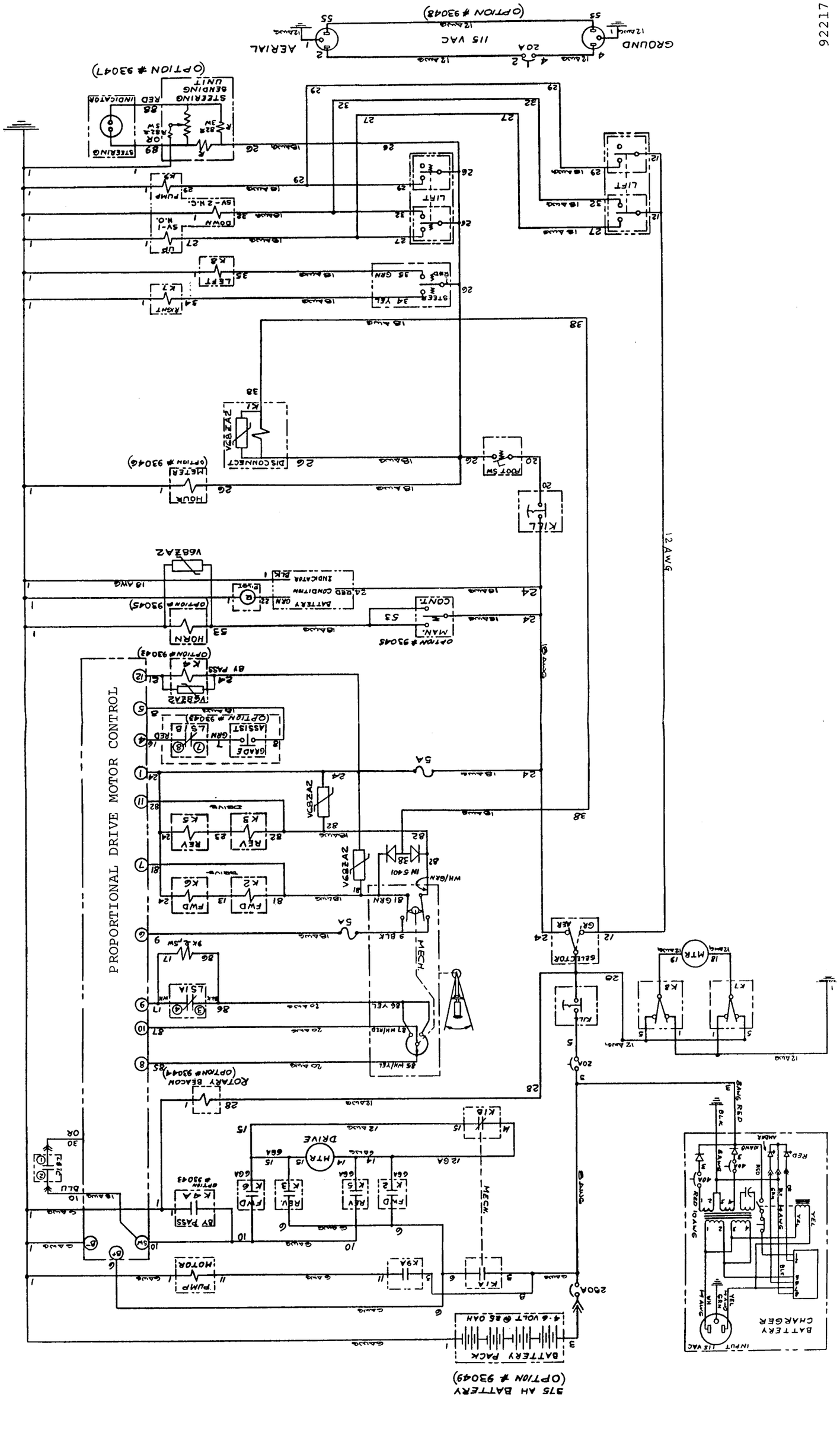
WARRANTY PERIOD _____

CODE:

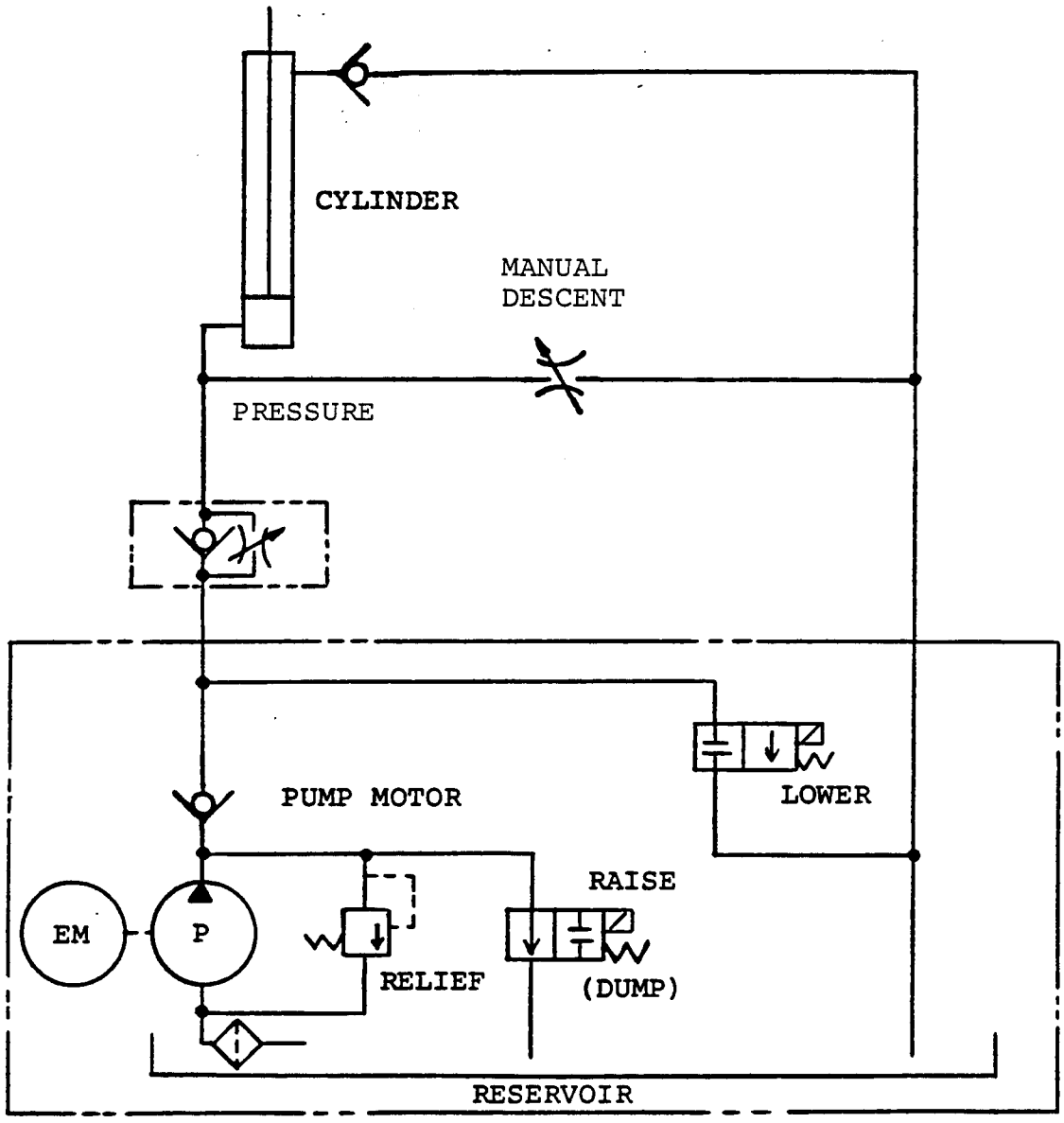
C—CHECKED
A—ADJUSTED
R—REPAIRED
N—NEW PART
X—NEEDS REPAIR

DATE	W.O.	MECH.	HR METER	PREVENTATIVE MAINT.										ELECTRICAL						HYDRAULIC												STEER			TIRE		MAJ.		MISC.				
				HYDRAULIC OIL CHANGE		DRIVE MOTOR		PUMP MOTOR BRUSHES		ELECTRICAL CONTROLS				BATTERY						HYDRAULIC SYSTEM			LIFT CYL SEALS			HYDRAULIC CONTROL VALVE			HYD PUMP			LIFT ROLLERS			HYD HOSES			STEERING			STEER CYL			DRIVE TIRE								

DATE	REMARKS	DATE	REMARKS	AGENCY

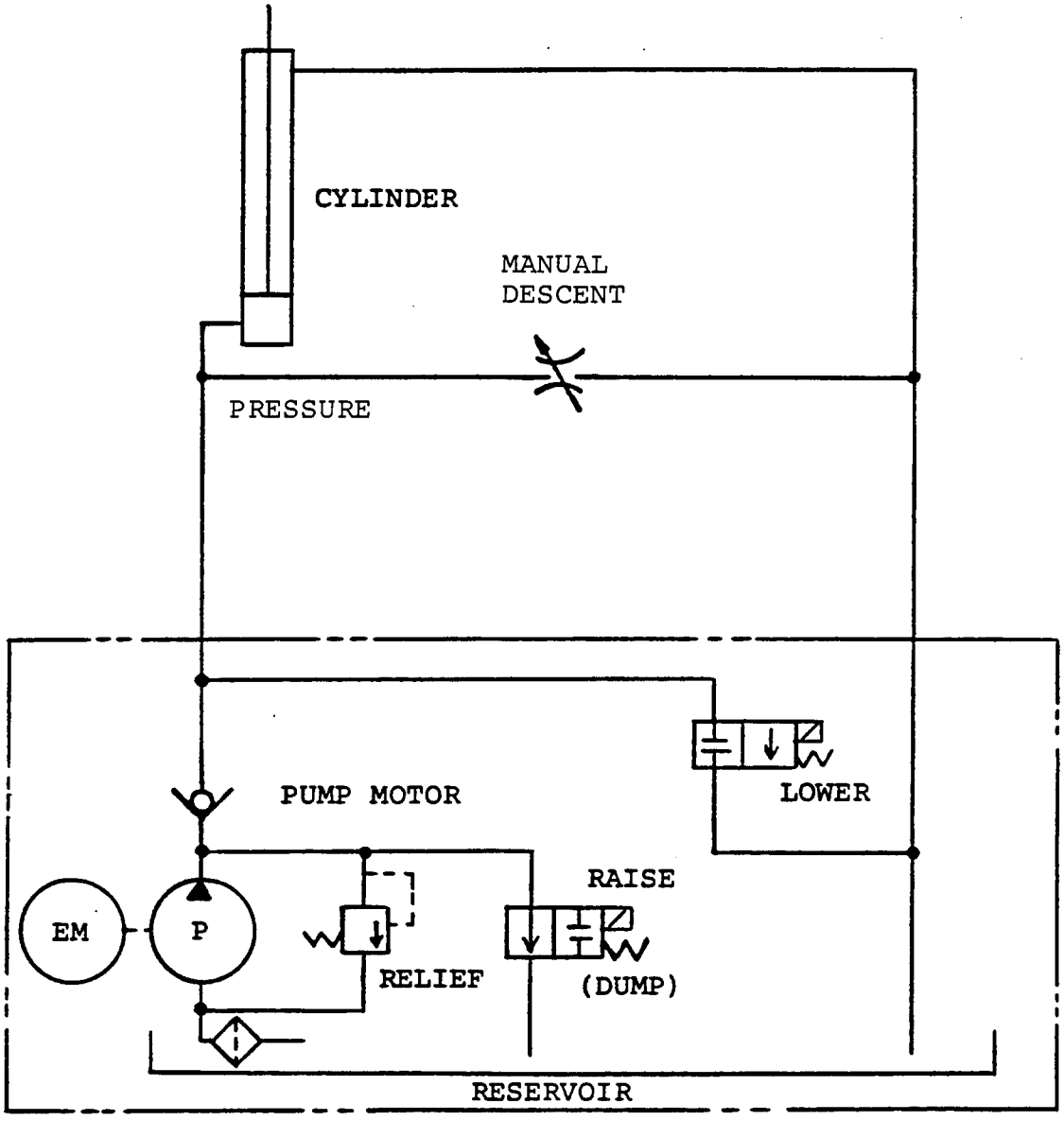

PROPORTIONAL DRIVE MOTOR CONTROL
375 AH BATTERY
(OPTION # 93049)
BATTERY PACK
36 VOLT @ 85 OAH
BATTERY CHARGER
INPUT 115 VAC
GROUND
AERIAL
115 VAC
20A
(OPTION # 93048)
STEERING SENSING UNIT
(OPTION # 93047)
LIFT
DOWN
PUMP
STEER
LEFT
RIGHT
DISCONNECT
(OPTION # 93046)
METER
HOUR
KILL
FOOT SW
HORN
(OPTION # 93045)
MAN. CONT.
BATTERY GRN
INDICATOR RED
24 RED CONDITION
(OPTION # 93043)
BY PASS
GRADE
ASSIST
FWD
REV
SEQUENCE
ROTARY BEACON
(OPTION # 93044)
PUMP
MOTOR
DRIVE
MTR
MECH
SELECTOR
GR
AER
12 AWG
18 AWG

HYDRAULIC SYSTEM SCHEMATIC (SP 19)
(FIRST 50 MACHINES)



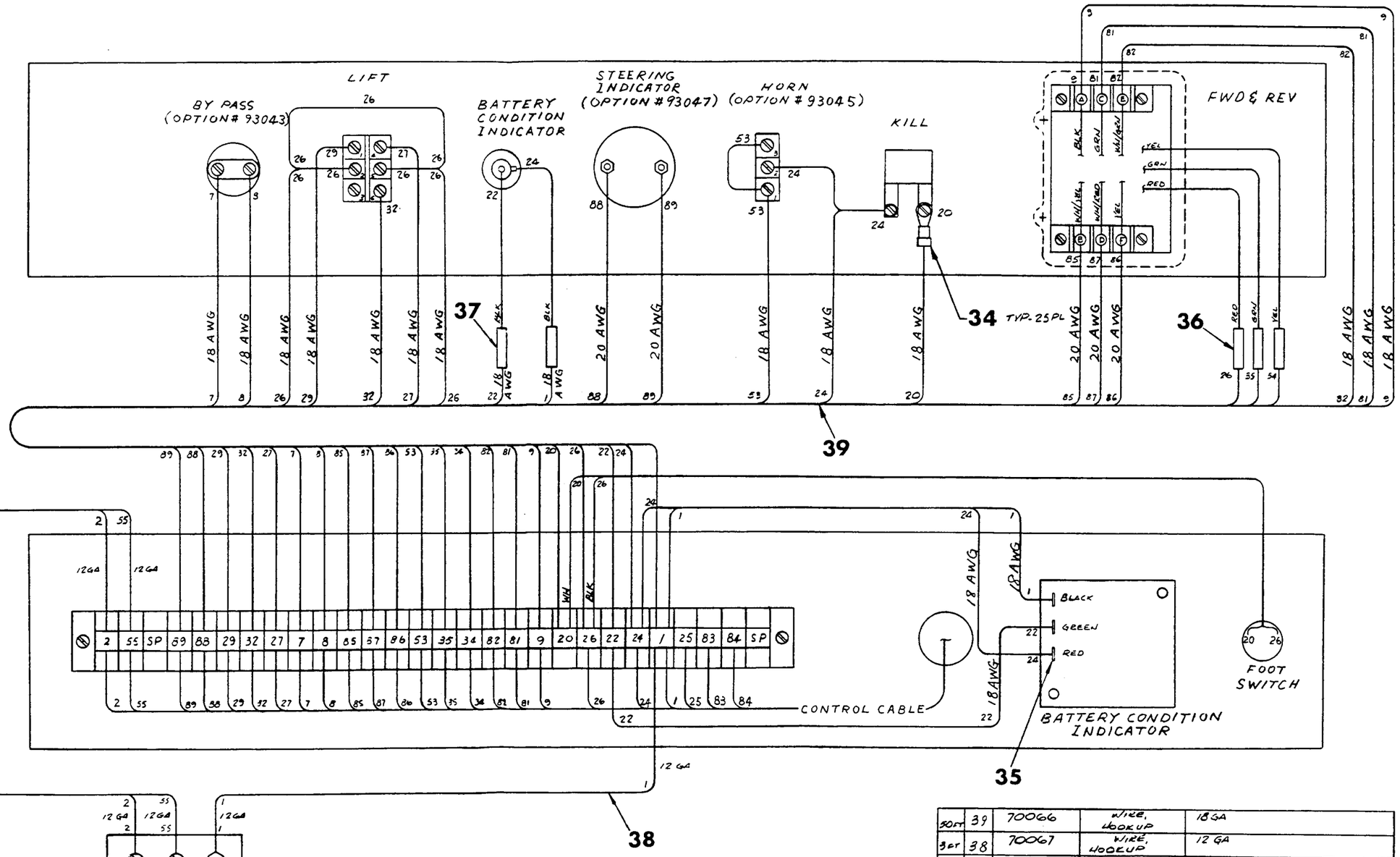
PART OF 92195

HYDRAULIC SYSTEM SCHEMATIC (SP 19)
(AFTER FIRST 50 MACHINES)



PART OF 92195

CONTROL CONSOLE ELECTRICAL WIRING DIAGRAM (SP19)



*SEE FIG. 9, IN PARTS SECTION, FOR BALANCE OF ITEMS.

WIRE NO	FUNCTION	WIRE NO	FUNCTION	WIRE NO	FUNCTION	WIRE NO	FUNCTION
22	INDICATOR LIGHT CONTROL	35	STEER LEFT CONTROL	87	SPEED CONTROL		
20	UPPER PANEL POWER	34	STEER RIGHT CONTROL	86	SPEED CONTROL		
9	FWD/REV. SW. POWER	32	"LOWER" SOLENOID CONTROL	85	SPEED CONTROL		
8	GRADE ASSIST SW. POWER	29	PUMP MOTOR SOL. CONTROL	82	REVERSE CONTROL		
7	GRADE ASSIST CONTROL	27	"LIFT" SOLENOID CONTROL	81	FORWARD CONTROL		
4	115 VAC POWER	26	CONDITIONED 24V + (AFTER KEY SW.)	55	115 VAC POWER	89	W/HEEL POS. INDICATOR
1	SYSTEM GROUND	24	SYSTEM 24 V +	53	HORN CONTROL	88	W/HEEL POS. INDICATOR

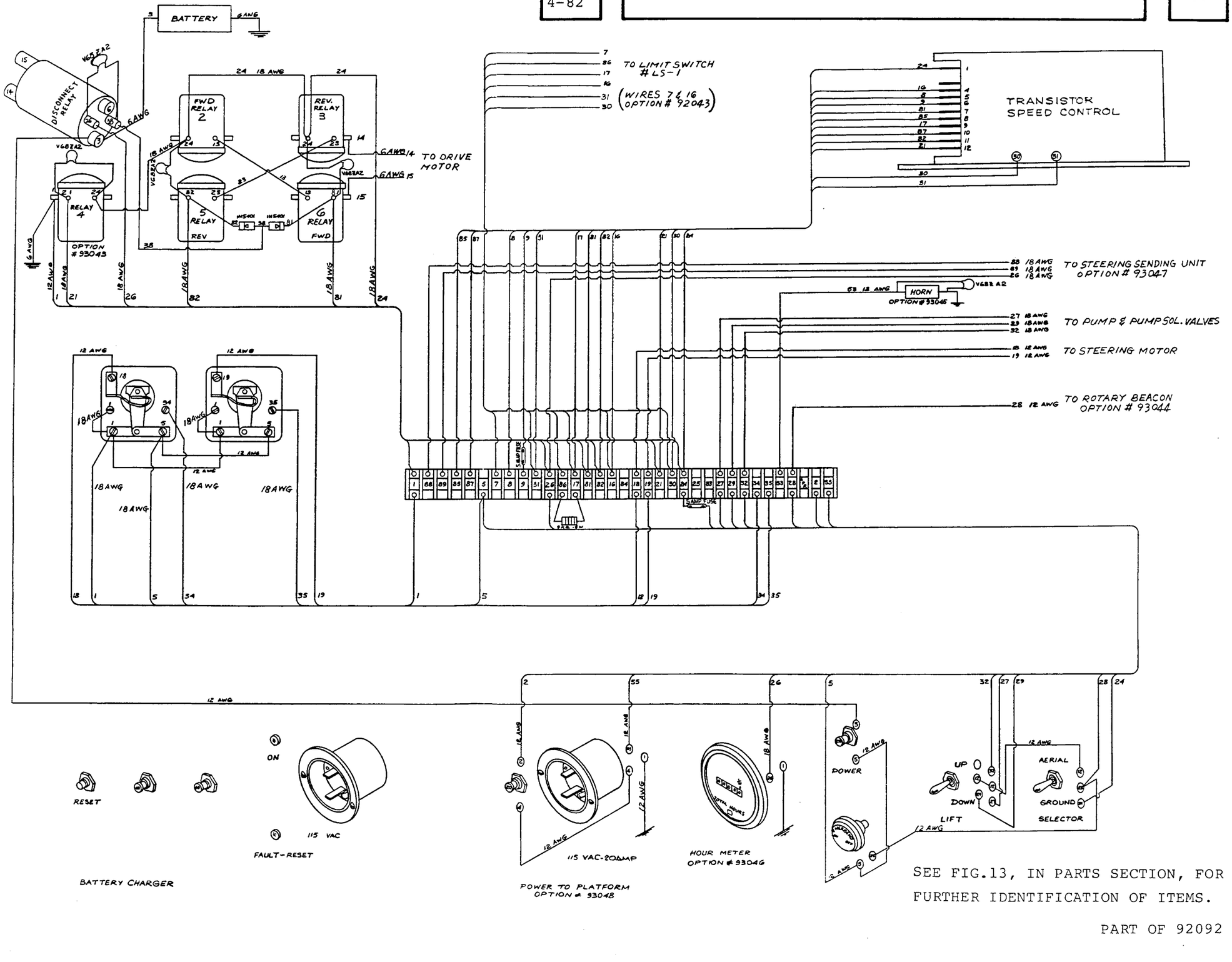
QTY REQ'D	ITEM NO	PART OR IDENTIFYING NO	DESCRIPTION	DATA: SPECIFICATIONS SIZES, NOTES, SUPPLIERS
50FT	39	70066	WIRE, HOOKUP	18 GA
3 FT	38	70067	WIRE, HOOKUP	12 GA
2	37	70068	CONNECTOR, BUTT	16-14 GA 3M NO. C-42-501 OR EQUAL
3	36	70069	CONNECTOR, BUTT	18-22 GA 3M NO B-42-501 OR EQUAL
3	35	70070	TERMINAL, FEM. QUICK-DISCON.	18-22 GA x ¼" BLADE 3M NO B-29-1101 OR EQUAL
25	34	70071	TERMINAL, RING TONGUE	18-22 GA x #10 STUD 3M NO B-01-412 OR EQUAL

* BILL OF MATERIAL

PART OF 92170

REV.1
4-82

COMPONENT PANEL ELECTRICAL WIRING DIAGRAM (SP19)



SEE FIG.13, IN PARTS SECTION, FOR FURTHER IDENTIFICATION OF ITEMS.

PART OF 92092

MARKPAL SELF-PROPELLED PAL

(SP 19)

INDEX

FIGURE 1-FINAL ASSEMBLY

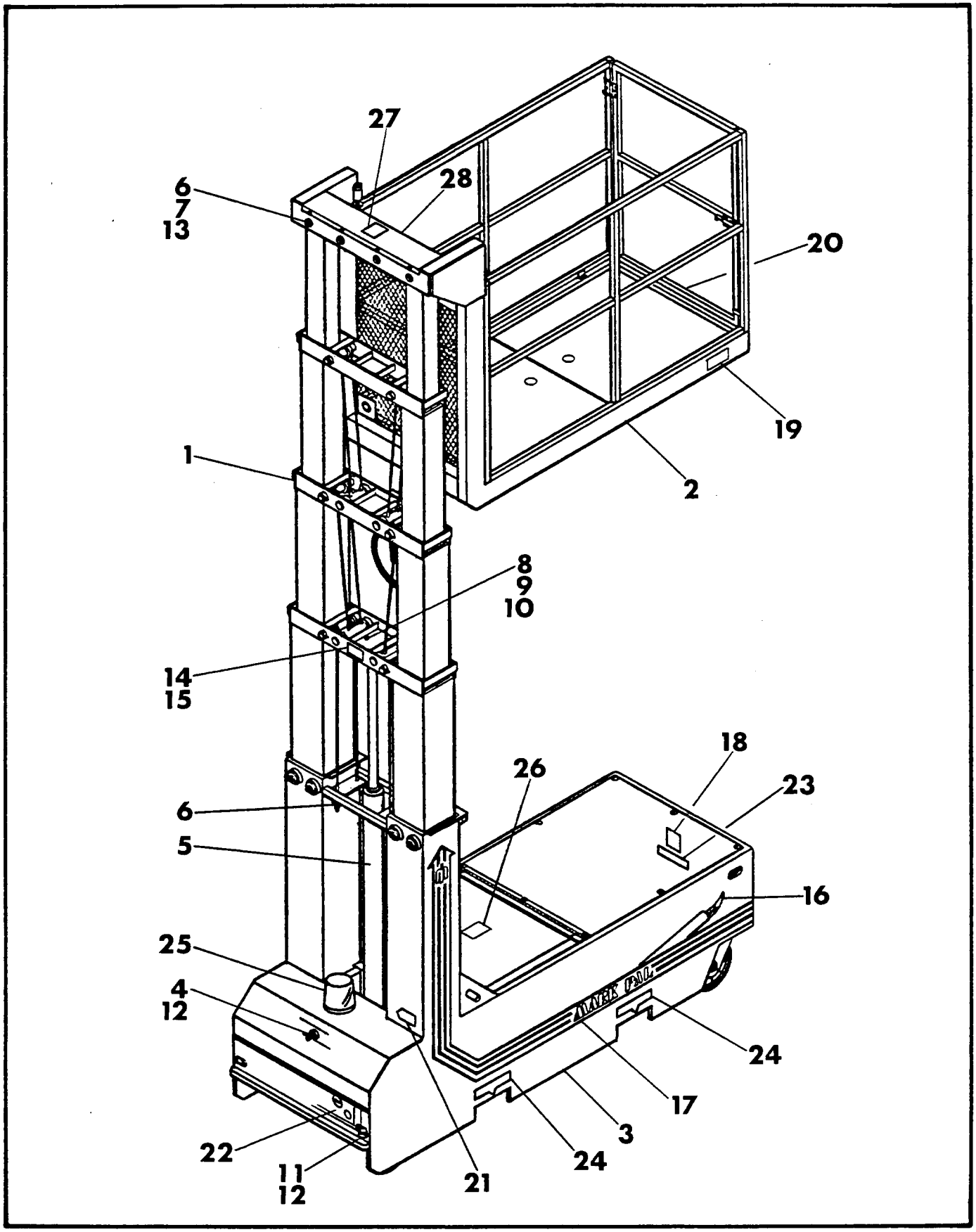
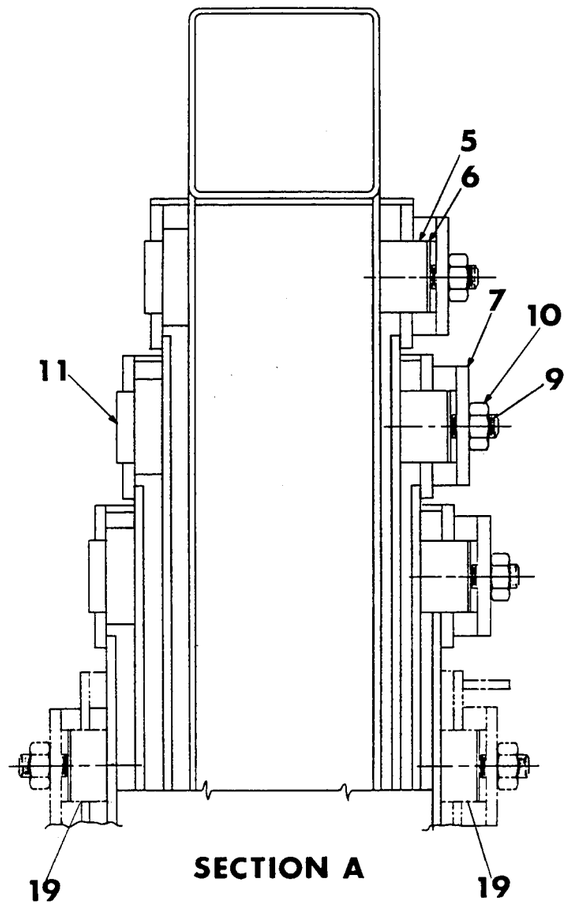
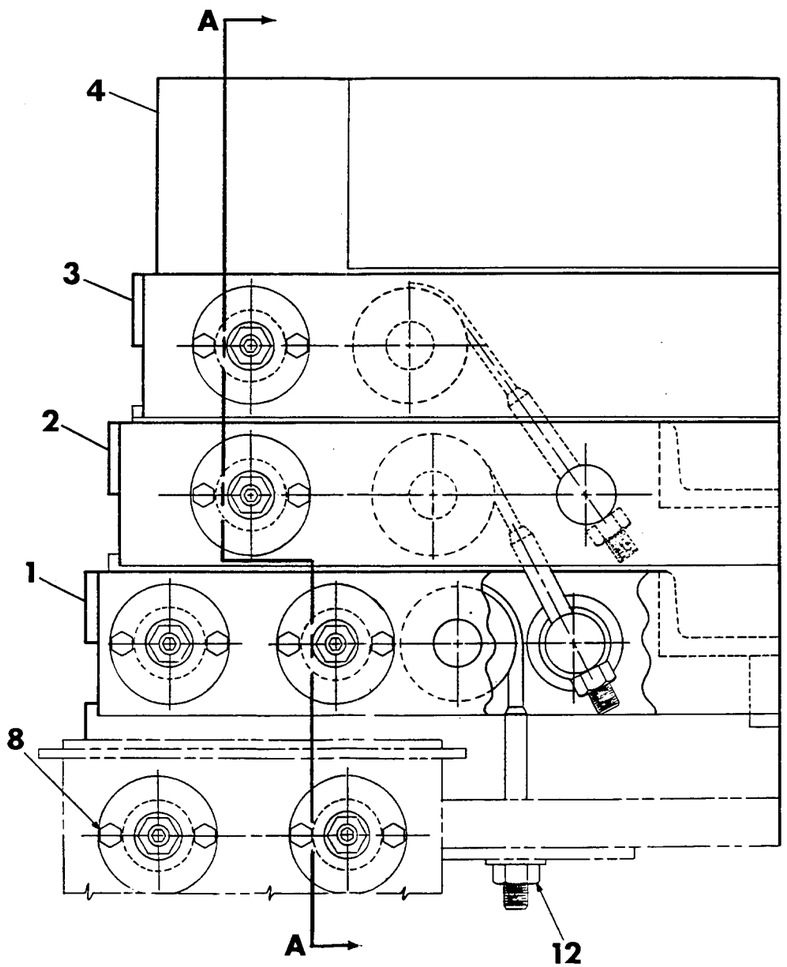


FIGURE 1-FINAL ASSEMBLY

ITEM	PART NUMBER	DESCRIPTION	QTY
1-	92100	FINAL ASSEMBLY	1
-1	92001	COLUMN ASSEMBLY (SEE FIG. 2)	1
-2	92047	BASKET ASSEMBLY (SEE FIG. 7)	1
-3	92066	CHASSIS ASSEMBLY (SEE FIG. 10)	1
-4	60309	HEX HEAD CAPSCREW-1/4-20UNC X 3/4	1
-5	92195	HYDRAULIC SYSTEM INSTALLATION (SEE FIG. 19)	1
-6	61305	SELF LOCKING HEX NUT-1/2-13UNC	16
-7	60348	HEX HEAD CAPSCREW-1/2-13UNC X 6	4
-8	60307	HEX HEAD CAPSCREW-3/8-16UNC X 1 1/2	2
-9	63403	FLAT WASHER-3/8	2
-10	61318	SELF LOCKING HEX NUT-3/8-16UNC	2
-11	60312	HEX HEAD CAPSCREW-1/4-20UNC X 1	2
-12	61313	SELF LOCKING HEX NUT-1/4-20UNC	3
-13	63405	FLAT WASHER-1/2	4
-14	63652	POP RIVET-1/8 X 3/8	4
-15	20415	I.D. PLATE-MODEL/SERIAL NUMBER	1
-16	92197	PRY BAR	1
-17	92050	DECAL-SP19 ARROW STRIPE	2
-18	92204	DECAL-TRANSPORTATION TIE DOWN	1
-19	11056	DECAL-"500 LBS. LOAD CAPACITY"	2
-20	11053	DECAL-"CAUTION-DO NOT USE AROUND ELECTRICAL EQUIPMENT" (AT REAR OF PLATFORM)	1
-21	11066	DECAL-MANUAL DOWN VALVE	1
-22	92092	ELECTRICAL COMPONENT PANEL ASSEMBLY (SEE FIG. 13)	1
-23	92242	DECAL-"CAUTION-FOOT STEP ONLY (LIFT FROM SIDE)"	1
-24	92244	DECAL-"FORK LIFT"	4
-25	92237	ROTATING BEACON (OPTION 93044)	1
-26	2003	DECAL-BATTERY WATER LEVEL	1
-27	92236	DECAL-DANGER	1
-28	92170	CONTROL CONSOLE ASSEMBLY (SEE FIG.9)	1



SECTION A



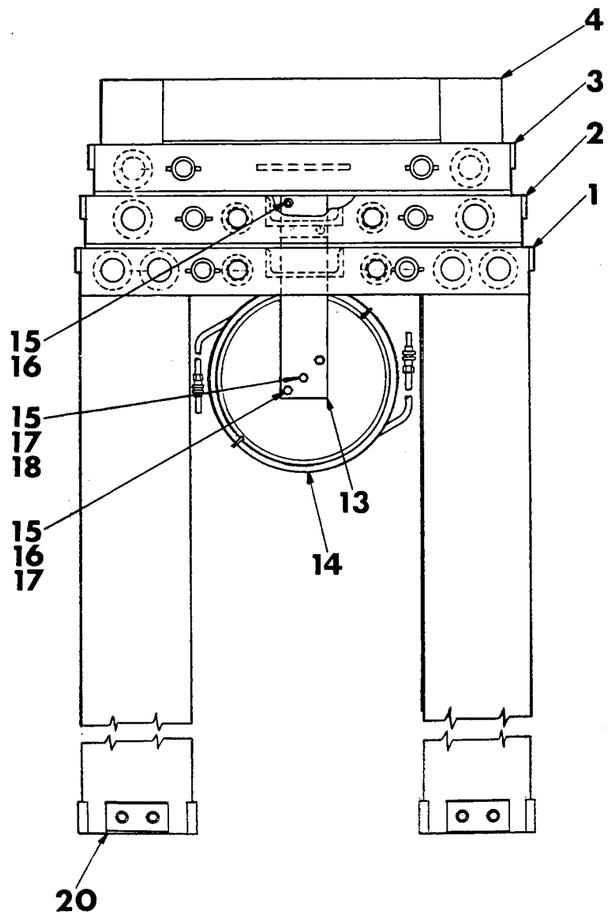


FIGURE 2 - COLUMN ASSEMBLY

ITEM	PART NUMBER	DESCRIPTION	QTY
2-	92001	COLUMN ASSEMBLY	1
-1	92002	1st STAGE ASSEMBLY (SEE FIG. 3)	1
-2	92003	2nd STAGE ASSEMBLY (SEE FIG. 4)	1
-3	92004	3rd STAGE ASSEMBLY (SEE FIG. 5)	1
-4	92005	4th STAGE ASSEMBLY (SEE FIG. 6)	1
-5	92121	UPPER WEAR PAD	8
-6	92122	BEARING PLATE	8
-7	92109	ADJUSTING PLATE	8
-8	60501	HEX HEAD CAPSCREW-1/4-20UNC X 3/4 (GR8)	16
-9	62210	HEX SOCKET SETSCREW-1/2-20UNF X 1	8
-10	60801	HEX NUT-1/2-20UNF	8
-11	92124	BACKUP PAD	8
-12	61305	SELF LOCKING HEX NUT-1/2-13UNC	12
-13	92192	CABLE REEL BRACKET	1
-14	92203	CABLE REEL ASSEMBLY (SEE FIG. 18)	1
-15	60338	HEX HEAD CAPSCREW-5/16-18UNC X 1	5
-16	61322	SELF LOCKING HEX NUT-5/16-18UNC	4
-17	63302	LOCKWASHER-5/16	3
-18	63429	FLAT WASHER-5/16	1
-19	92164	WEAR PAD (REFERENCE)	8
-20	20280	WEAR PAD (REFERENCE)	2

FIGURE 3 - 1st STAGE ASSEMBLY

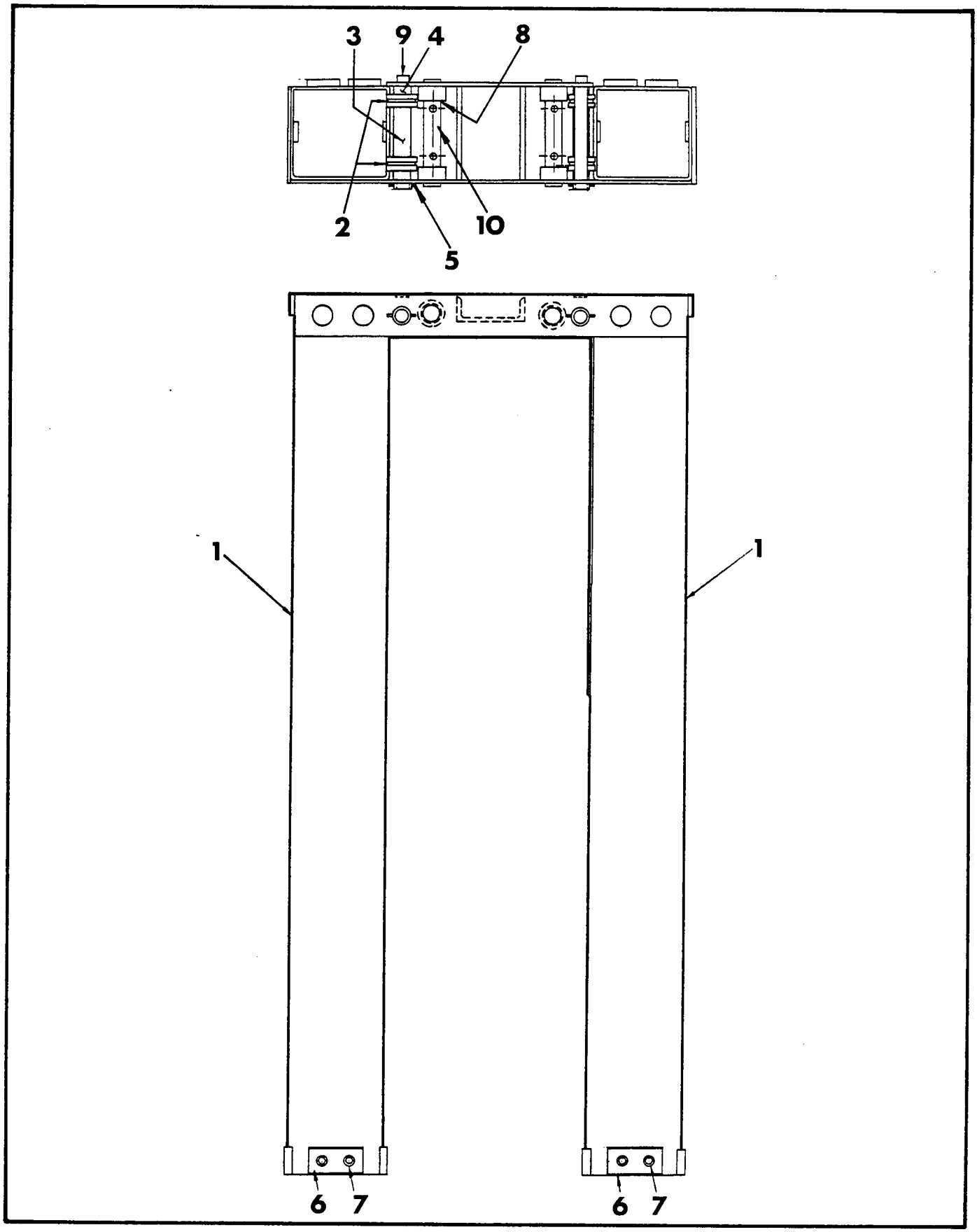


FIGURE 3 - 1st STAGE ASSEMBLY

ITEM	PART NUMBER	DESCRIPTION	QTY
3-	92002	1st STAGE ASSEMBLY	1
-1	92006	COLUMN WELDMENT	1
-2	92138	PULLEY	4
-3	95062	PULLEY SPACER (CENTER)	2
-4	95060	PULLEY SPACER (FRONT & REAR)	4
-5	64209	ROLL PIN - ¼ DIA. X 1 3/4	2
-6	20280	WEAR PAD	2
-7	61811	FLATHEAD HEX SOCKET CAPSCREW - 3/8-24 UNF X 5/8	4
-8	64906	BUSHING	4
-9	92024	PULLEY SHAFT	2
-10	92069	CABLE SHAFT	2

FIGURE 4 - 2nd STAGE ASSEMBLY

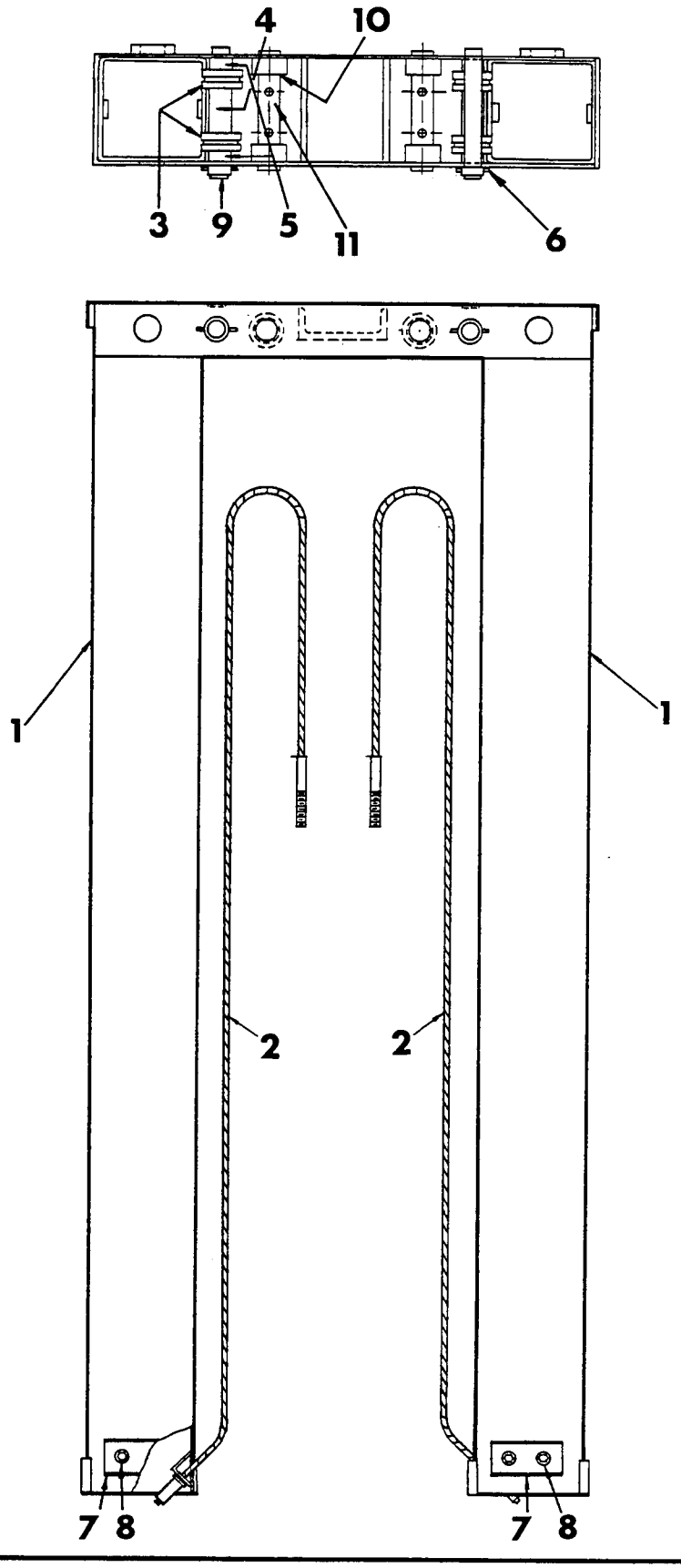


FIGURE 4 - 2nd STAGE ASSEMBLY

ITEM	PART NUMBER	DESCRIPTION	QTY
4-	92003	2nd STAGE ASSEMBLY	1
-1	92007	COLUMN WELDMENT	1
-2	92020	CABLE ASSEMBLY	4
-3	92116	PULLEY	4
-4	95062	PULLEY SPACER (CENTER)	2
-5	95064	PULLEY SPACER (FRONT & REAR)	4
-6	64209	ROLL PIN - ¼ DIA. X 1 3/4	2
-7	20280	WEAR PAD	2
-8	61811	FLATHEAD HEX SOCKET CAPSCREW - 3/8-24 UNF X 5/8	4
-9	92033	PULLEY SHAFT	2
-10	64906	BUSHING	4
-11	92070	CABLE SHAFT	2

FIGURE 5 - 3rd STAGE ASSEMBLY

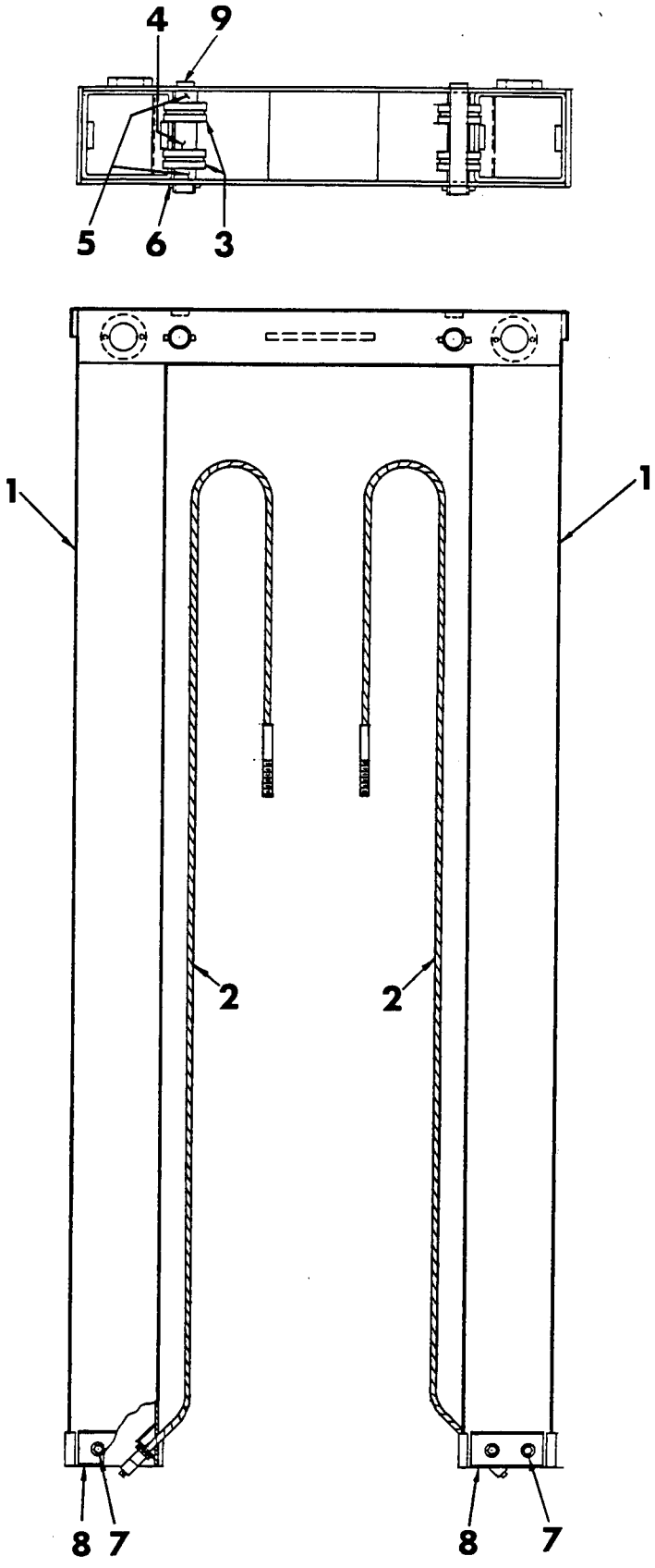


FIGURE 5 - 3rd STAGE ASSEMBLY

ITEM	PART NUMBER	DESCRIPTION	QTY
5-	92004	3rd STAGE ASSEMBLY	1
-1	92008	COLUMN WELDMENT	1
-2	92020	CABLE ASSEMBLY	4
-3	92116	PULLEY	4
-4	95068	PULLEY SPACER (CENTER)	2
-5	95064	PULLEY SPACER (FRONT & REAR)	4
-6	64209	ROLL PIN - ¼ DIA. X 1 3/4	2
-7	61811	FLATHEAD HEX SOCKET CAPSCREW - 3/8-24 UNF X 5/8	4
-8	20280	WEAR PAD	2
-9	92042	PULLEY SHAFT	2

FIGURE 6 - 4th STAGE ASSEMBLY

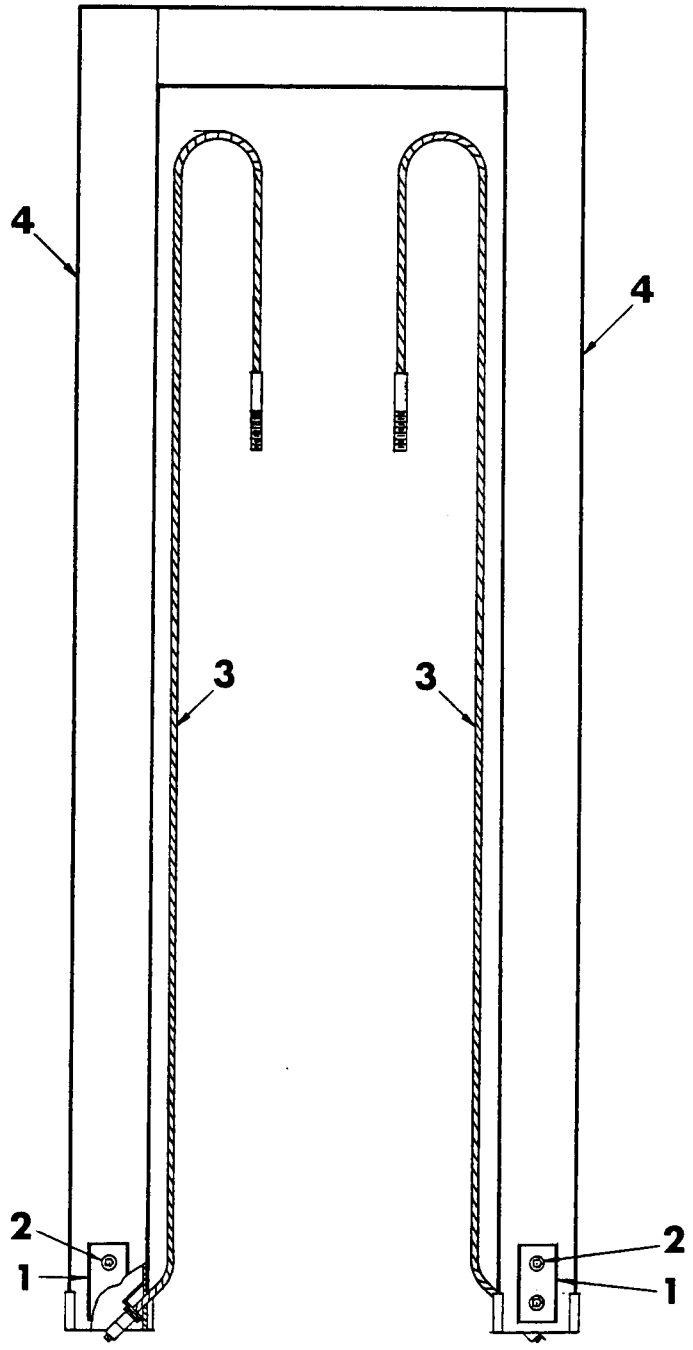


FIGURE 6 - 4th STAGE ASSEMBLY

ITEM	PART NUMBER	DESCRIPTION	QTY
6-	92005	4th STAGE ASSEMBLY	1
-1	20280	WEAR PAD	2
-2	61811	FLATHEAD HEX SOCKET CAPSCREW - 3/8-24 UNF X 5/8	4
-3	92020	CABLE ASSEMBLY	4
-4	92009	COLUMN WELDMENT	1

FIGURE 7-BASKET ASSEMBLY

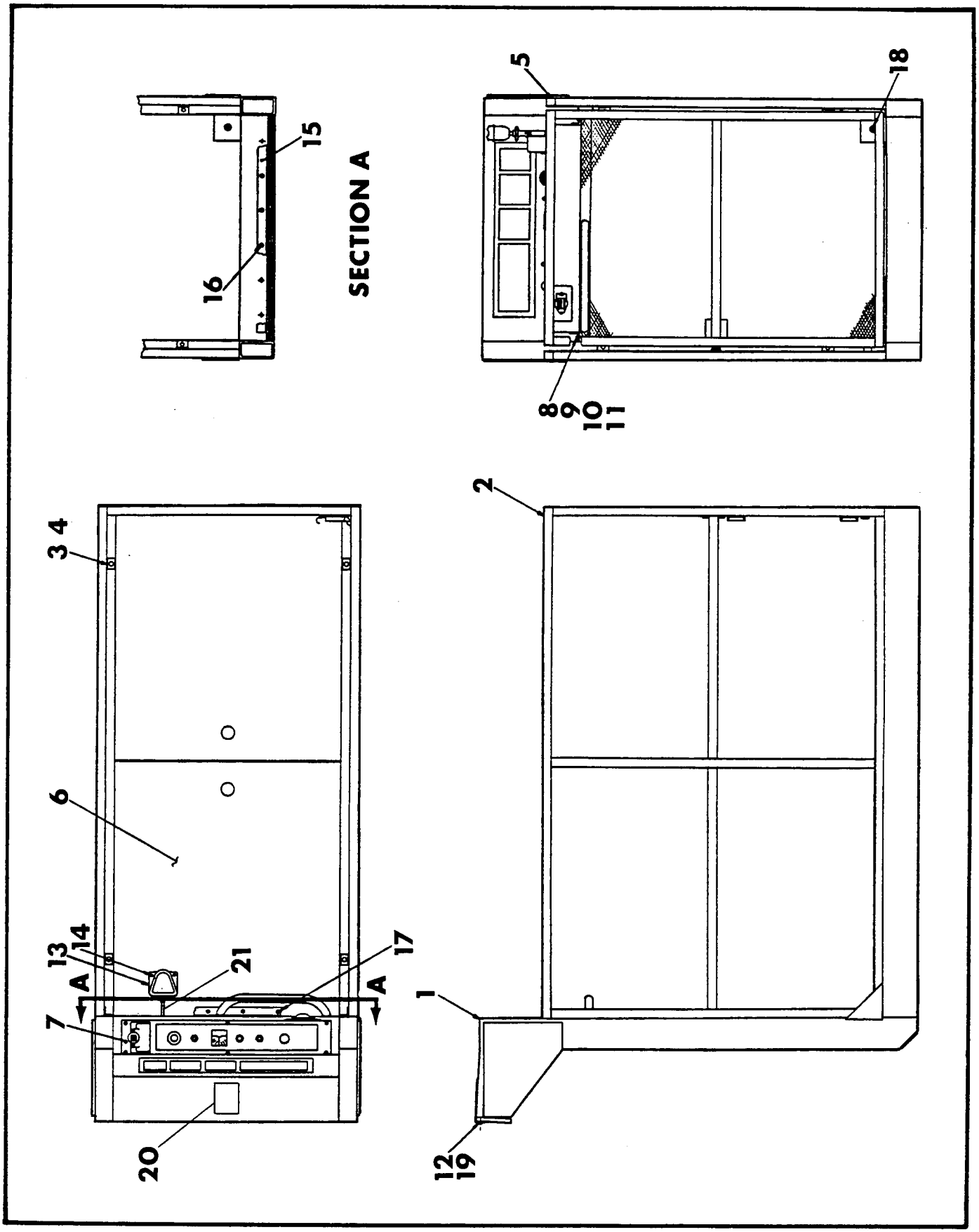
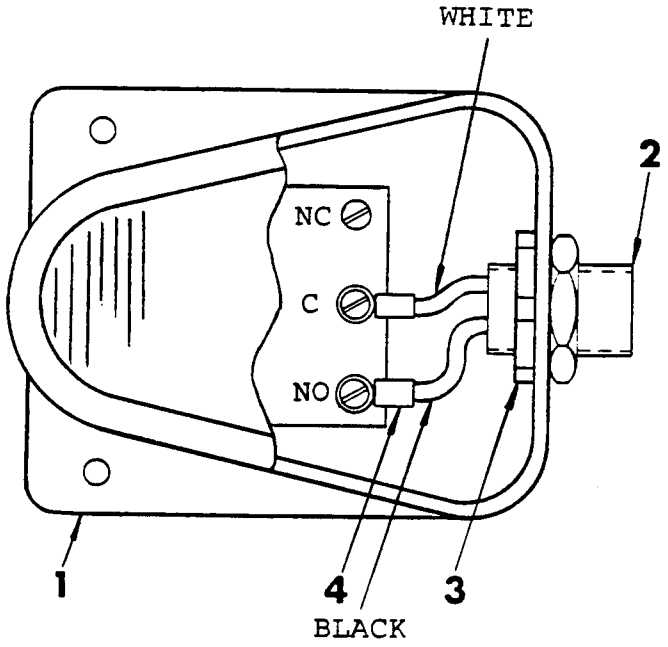


FIGURE 7-BASKET ASSEMBLY

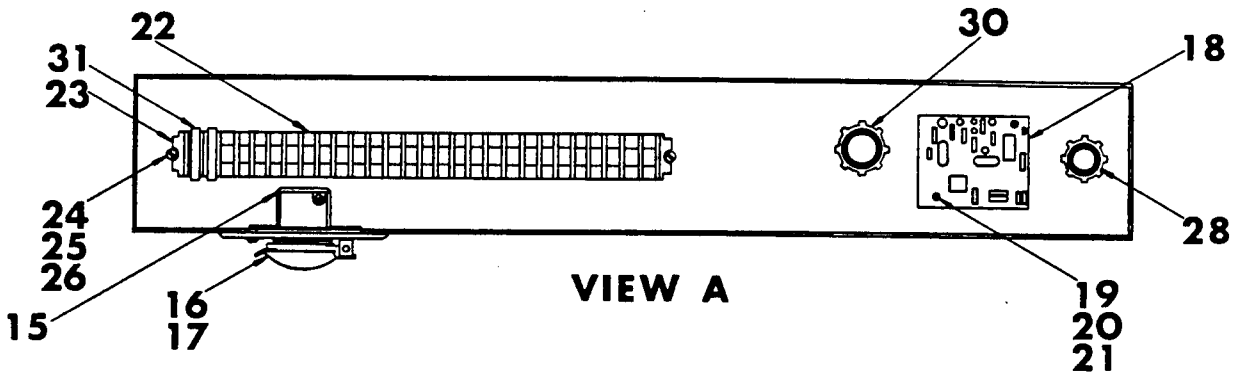
ITEM	PART NUMBER	DESCRIPTION	QTY
7-	92047	BASKET ASSEMBLY	1
-1	92048	PLATFORM WELDMENT	1
-2	92061	GUARDRAIL WELDMENT	1
-3	60102	HEX HEAD CAPSCREW-3/8-16UNC X 1	6
-4	63303	LOCK WASHER-3/8	6
-5	91541	PLUG	6
-6	92081	DECK FLOOR	2
-7	92170	CONTROL CONSOLE ASSEMBLY (SEE FIG.9)	1
-8	62620	ROUND HEAD MACHINE SCREW NO. 10-32 X 3/4	4
-9	63413	FLAT WASHER-NO. 10	4
-10	63313	LOCKWASHER-NO. 10	4
-11	61601	HEX NUT-NO. 10-32	4
-12	60353	HEX HEAD CAPSCREW-1/4-20UNC X 1/2	4
-13	92215	FOOT SWITCH ASSEMBLY (SEE FIG. 8)	1
-14	64503	ROUND HEAD WOOD SCREW-NO. 10 X 3/4	2
-15	92229	HINGE	2
-16	62501	FLAT HEAD MACHINE SCREW-NO. 10-32 X 3/8	10
-17	64504	FLAT HEAD WOOD SCREW-NO. 10 X 3/4	12
-18	70062	STRAIN RELIEF	1
-19	63301	LOCKWASHER-1/4	4
-20	92236	DECAL-DANGER	1
-21	70065	CHANGE OUT CONNECTOR	1

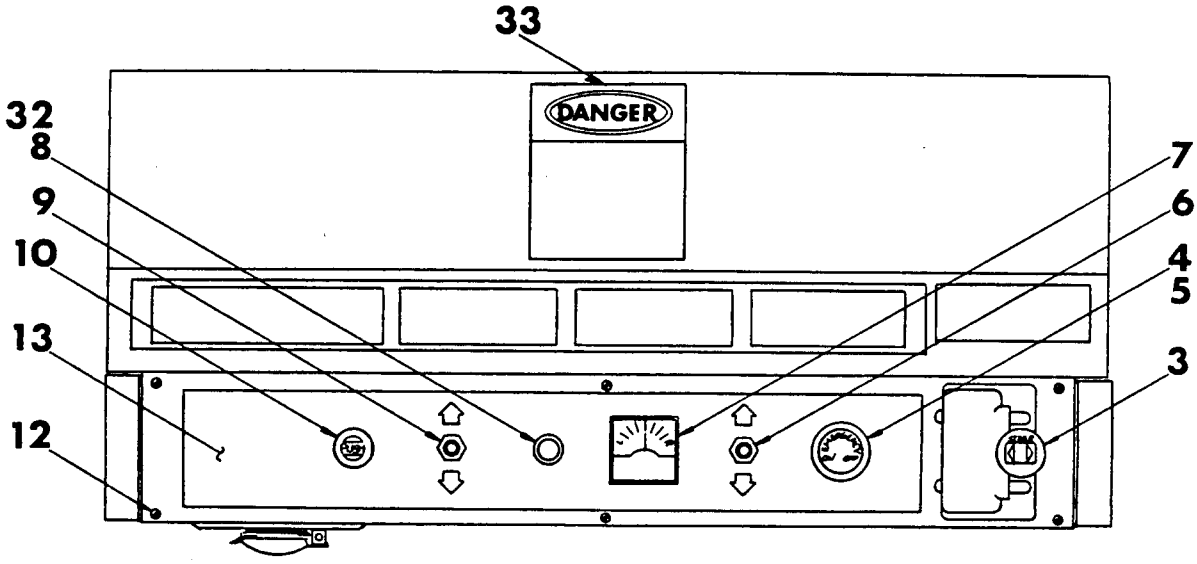
FIGURE 8 - FOOT SWITCH ASSEMBLY



ITEM	PART NUMBER	DESCRIPTION	QTY
8-	92215	FOOT SWITCH ASSEMBLY	1
-1	92202	FOOT SWITCH	1
-2	70064	RECEPTACLE - 2 POLE	1
-3	2808	CONDUIT LOCKNUT	1
-4	117C	TERMINAL RING TONGUE	2

FIGURE 9-CONTROL CONSOLE ASSEMBLY





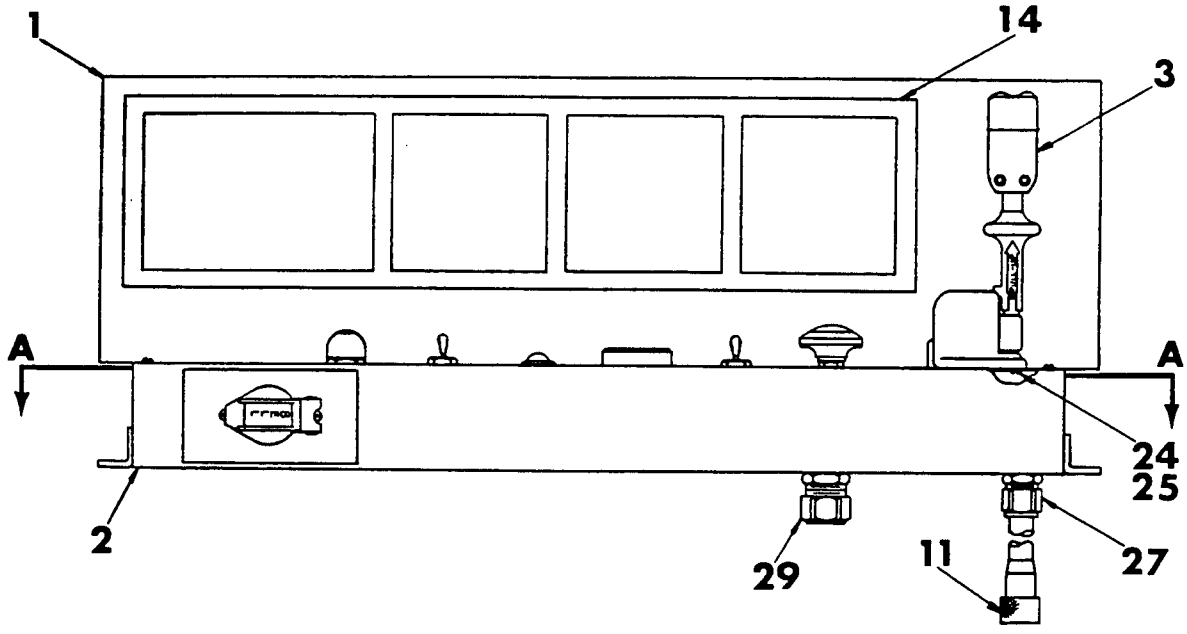
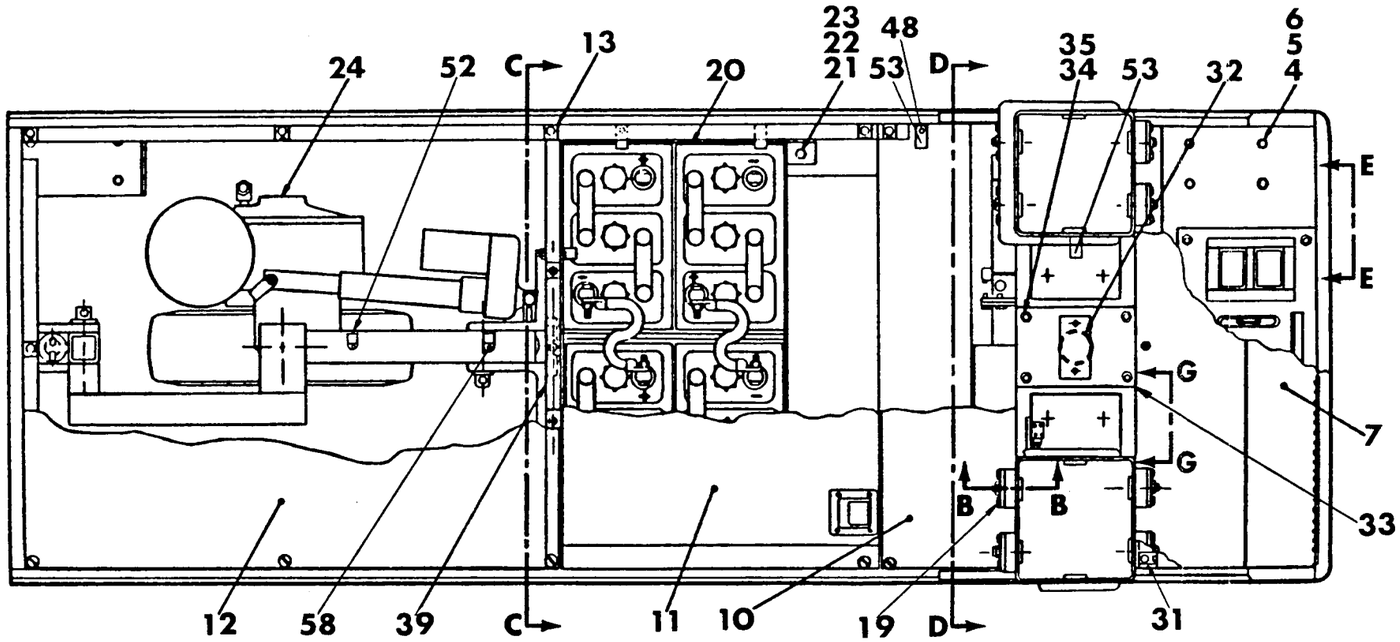


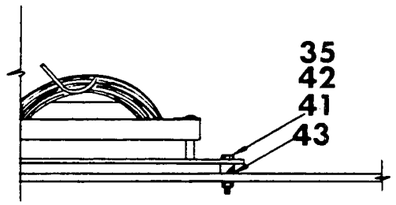
FIGURE 9- CONTROL CONSOLE ASSEMBLY

ITEM	PART NUMBER	DESCRIPTION	QTY
9-	92170	CONTROL CONSOLE ASSEMBLY	1
-1	92094	CONTROL CONSOLE PANEL	1
-2	92052	CONTROL CONSOLE BOX	1
-3	92172	HAND CONTROL	1
-4	4018	POWER SWITCH	1
-5	5300	PALM KNOB	1
-6	70057	HORN SWITCH	1
-7	92178	WHEEL POSITION INDICATOR	1
-8	4031	BATTERY CHARGE LIGHT	1
-9	20481	LIFT SWITCH	1
-10	4020	GRADE ASSIST SWITCH	1
-11	70065	PLUG- 2 CONDUCTOR	1
-12	61709	ROUND HEAD SELF-TAPPING SCREW-NO.6 X ½ (TYPE A)	6
-13	92112	DECAL- CONTROL PANEL	1
-14	92111	DECAL-OPERATION INSTRUCTIONS	1
-15	20515	RECEPTACLE- 125V	1
-16	356	RECEPTACLE COVER	1
-17	(REF)	FLAT HEAD MACHINE SCREW NO.6-32x½ (FURNISHED WITH ITEM16)	2
-18	92168	BATTERY DISCHARGE INDICATOR	1
-19	62606	ROUND HEAD MACHINE SCREW NO.6-32x3/4	2
-20	63311	LOCKWASHER-NO.6 MEDIUM	2
-21	61501	HEX NUT-NO.6-32	2
-22	4027	TERMINAL BLOCK	28
-23	117-A	TERMINAL BLOCK END	1
-24	62621	ROUND HEAD MACHINE SCREW NO.8-32x3/8	7
-25	63312	LOCKWASHER-NO.8 MEDIUM	7
-26	61502	HEX NUT- NO.8-32	3
-27	2806	STRAIN RELIEF	1
-28	2808	CONDUIT LOCKNUT	1
-29	66355	KELLUMS GRIP	1

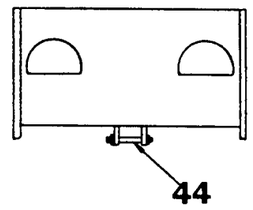
ITEM	PART NUMBER	DESCRIPTION	QTY
-30	2809	CONDUIT LOCKNUT	1
-31	70060	TERMINAL COVER	2
-32	70072	BULB-28V	1
-33	92236	DECAL-DANGER	1



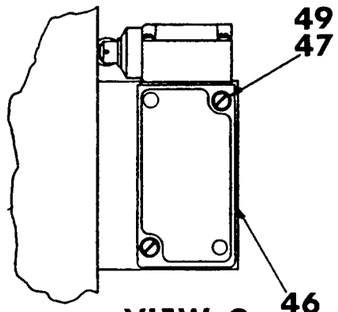
VIEW A



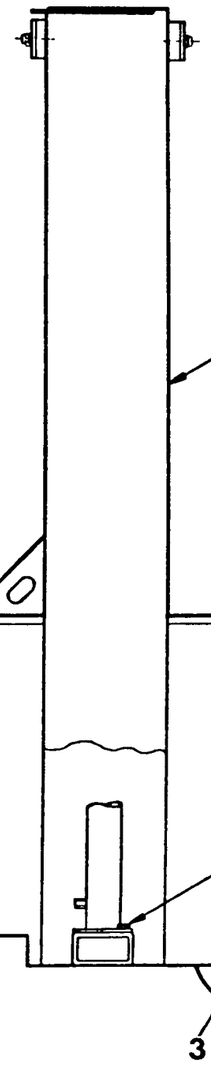
VIEW E

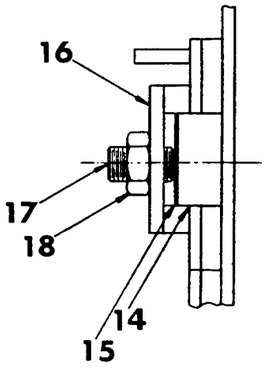


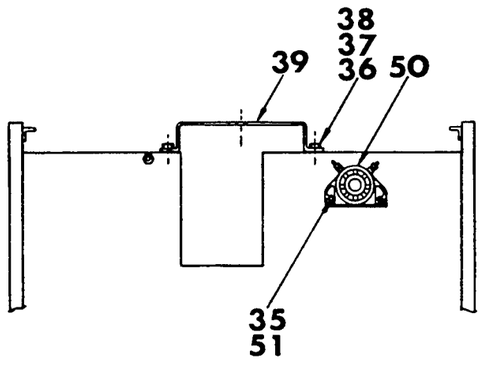
VIEW F



VIEW G

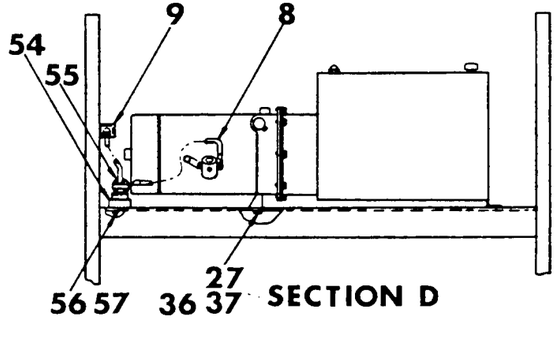






SECTION B

SECTION C



SECTION D

FIGURE 10 - CHASSIS ASSEMBLY

ITEM	PART NUMBER	DESCRIPTION	QTY
10-	92066	CHASSIS ASSEMBLY	1
-1	92067	CHASSIS WELDMENT	1
-2	92162	SWIVEL CASTER	2
-3	92163	RIGID CASTER	2
-4	60308	HEX HEAD CAPSCREW-1/2-13UNC X 1 1/2	16
-5	63405	FLAT WASHER-1/2 SAE	16
-6	61305	SELF LOCKING HEX NUT-1/2-13UNC	16
-7	92247	ELECTRICAL COMPARTMENT COVER	1
-8	92193	JUMPER CABLE	1
-9	92219	POSITIVE CABLE ASSEMBLY	1
-10	92184	FRONT BATTERY COMPARTMENT COVER ASSEMBLY (SEE FIG. 17)	1
-11	92183	REAR BATTERY COMPARTMENT COVER ASSEMBLY (SEE FIG. 16)	1
-12	92182	DRIVE GEAR COVER ASSEMBLY (SEE FIG. 15)	1
-13	65180	CLIP-ON RECEPTACLE	13
-14	92164	WEAR PAD	8
-15	92122	BEARING PLATE	8
-16	92109	ADJUSTER PLATE	8
-17	62210	HEX SOCKET SETSCREW-1/2-20UNF X 1	8
-18	60901	JAM NUT-1/2-20UNF	8
-19	60501	HEX HEAD CAPSCREW-1/4-20UNC X 3/4 (GRADE 8)	16
-20	92177	BATTERY PACK (SEE FIG. 11)	1
-21	60331	HEX HEAD CAPSCREW-3/8-16UNC X 1 1/4	2
-22	63303	LOCKWASHER-3/8 MED.	2
-23	60703	HEX NUT-3/8-16UNC	2
-24	92136	DRIVE GEAR ASSEMBLY (SEE FIG. 12)	1
-25	92196	TENSION SPRING	2
-26	65198	EYEBOLT-3/8 DIA. X 4	2
-27	60702	HEX NUT-5/16-18UNC	2
-28	92113	PIVOT PIN	2
-29	63427	FLAT WASHER-1 USS	4
-30	64209	ROLL PIN-1/4 DIA. X 1 3/4	6

ITEM	PART NUMBER	DESCRIPTION	QTY
-31	70120	CLIP-ON RECEPTACLE	5
-32	92194	LIFT CYLINDER (SEE FIG. 14)	1
-33	92185	CYLINDER MOUNTING PLATE	1
-34	60337	HEX HEAD CAPSCREW-1/4-20UNC-3	4
-35	61313	SELF LOCKING HEX NUT-1/4-20UNC	10
-36	60338	HEX HEAD CAPSCREW-5/16-18UNC X 1	6
-37	63302	LOCKWASHER-5/16 MED.	6
-38	63402	FLAT WASHER-5/16 SAE	2
-39	92155	COVER MOUNTING STAND OFF	1
-40	62721	ROUND HEAD MACHINE SCREW-NO. 14-20UNC X 1 1/4	1
-41	60358	HEX HEAD CAPSCREW-1/4-20UNC X 1 1/8	4
-42	63401	FLAT WASHER-1/4 SAE	4
-43	92225	MOUNTING SPACER	4
-44	92238	PIVOT PIN	1
-45	63426	FLAT WASHER-3/4 USS	2
-46	92222	LIMIT SWITCH	1
-47	62719	ROUND HEAD MACHINE SCREW-NO. 10-32 X 2 1/4	2
-48	63657	POP RIVET-3/16 DIA. X .575	4
-49	61324	SELF LOCKING HEX NUT-NO. 10-32	2
-50	70053	WARNING HORN	1
-51	60309	HEX HEAD CAPSCREW-1/4-20UNC X 3/4	2
-52	70121	CABLE CLIP	5
-53	70122	CABLE CLIP	2

FIGURE 11 - BATTERY PACK

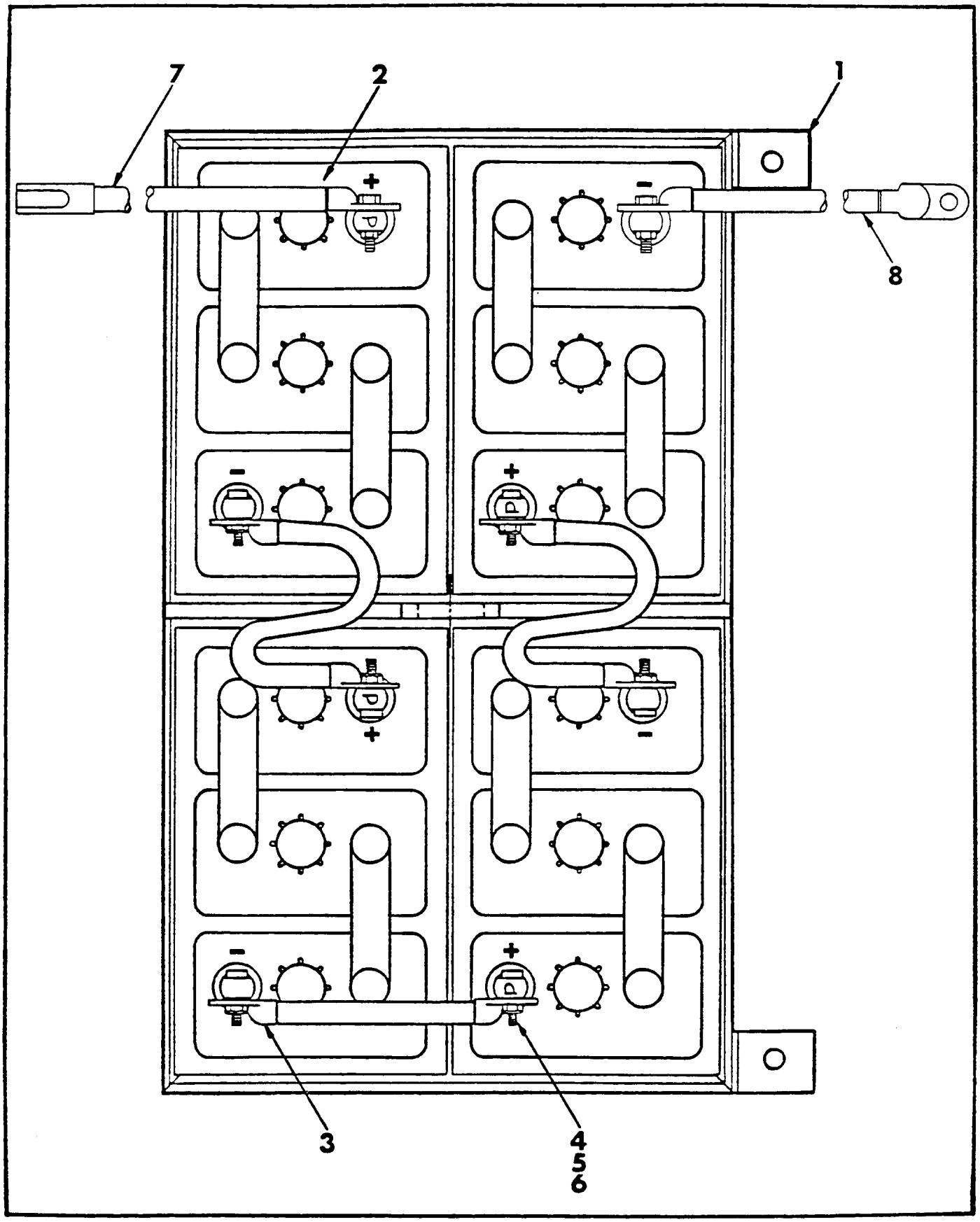
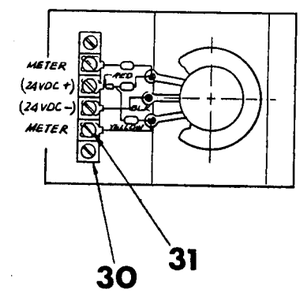
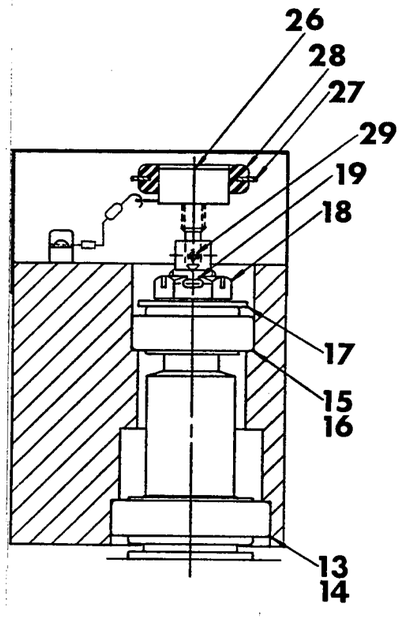


FIGURE 11 - BATTERY PACK

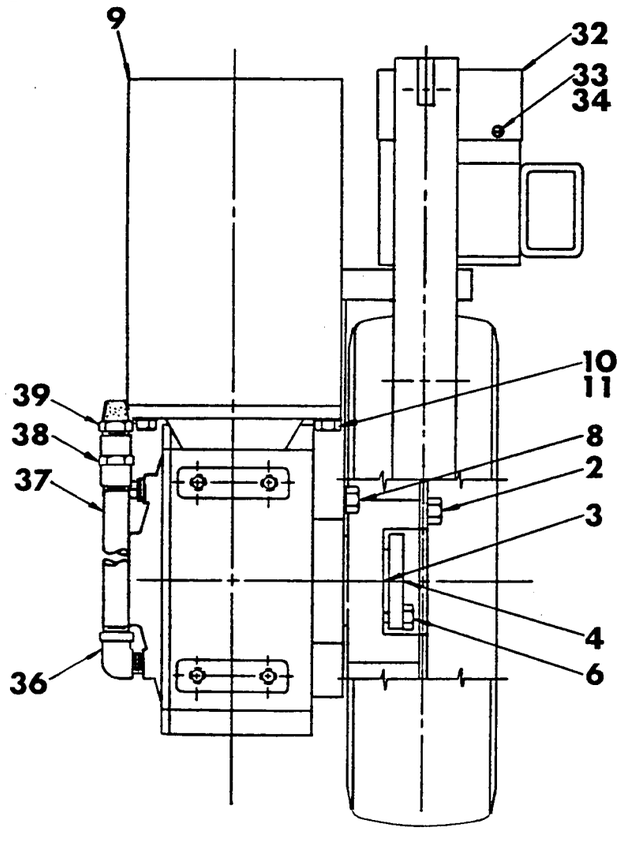
ITEM	PART NUMBER	DESCRIPTION	QTY
11-	92177	BATTERY PACK	1
-1	92108	BATTERY CARRIER	1
-2	4007	BATTERY - 6V - 250 AMP HOUR	4
	93049	BATTERY - 6V - 375 AMP HOUR (OPTION)	4
-3	92193	JUMPER CABLE	3
-4	60338	HEX HEAD CAPSCREW - 5/16-18 UNC X 1	8
-5	63302	LOCK WASHER 5/16	6
-6	60702	HEX NUT - 5/6-18 UNC	6
-7	92219	CABLE ASSEMBLY - POSITIVE	1
-8	92220	CABLE ASSEMBLY - NEGATIVE	1
	92249	BATTERY HOLD DOWN	

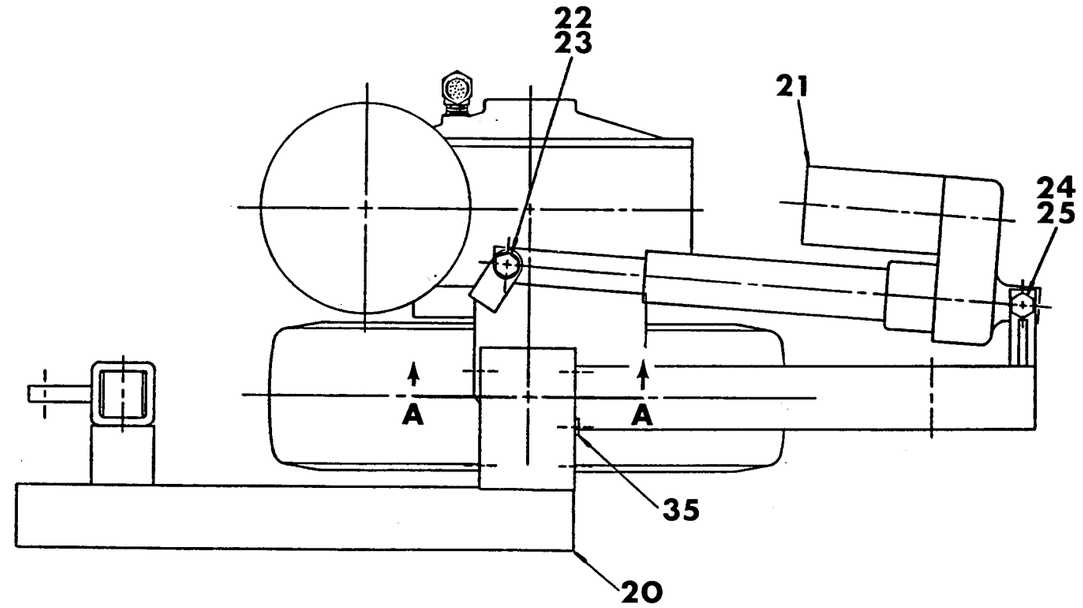
FIGURE 12 - DRIVE GEAR ASSEMBLY





SECTION A





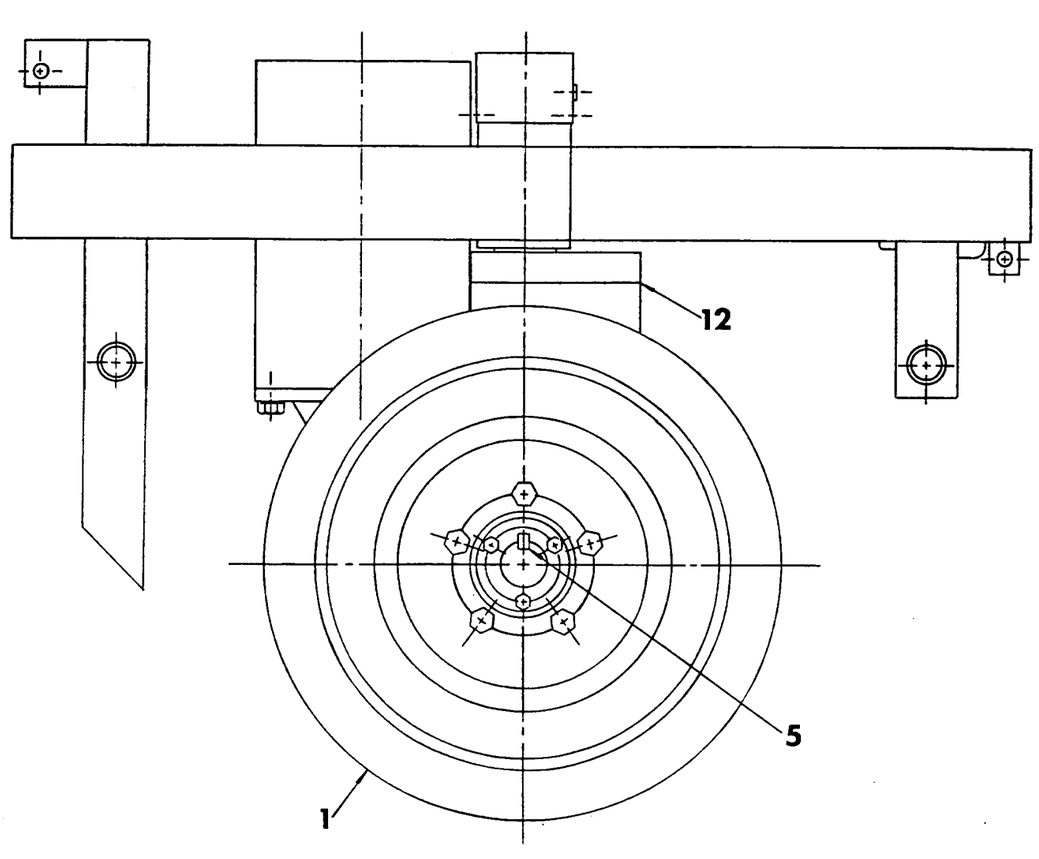


FIGURE 12 - DRIVE GEAR ASSEMBLY

ITEM	PART NUMBER	DESCRIPTION	QTY
12-	92136	DRIVE GEAR ASSEMBLY	1
-1	92165	TIRE & WHEEL ASSEMBLY	1
-2	2221	CONE BOLT	5
-3	92160	DRIVE HUB	1
-4	65007	SPLIT TAPER BUSHING	1
-5	(REF)	KEY - 3/8 X ½ X 3 (INCLUDED WITH ITEM 4)	1
-6	(REF)	HEX HEAD CAPSCREW 5/16-18 UNC X 1	3
-7	92161	WORM DRIVE GEARBOX	1
-8	60357	HEX HEAD CAPSCREW - ½-13 UNC X 1 3/4	4
-9	92000	DRIVE MOTOR	1
-10	60618	HEX HEAD CAPSCREW - 3/8-16 UNC X 1¼	4
-11	63303	LOCK WASHER	4
-12	92128	STEERING SPINDLE	1
-13	65058	LOWER CONE BEARING	1
-14	65057	LOWER BEARING CUP	1
-15	65056	UPPER CONE BEARING	1
-16	65055	UPPER BEARING CUP	1
-17	63426	SPINDLE WASHER - 3/4 USS	1
-18	66142	SPINDLE NUT - 3/4-16 UNF SLOTTED	1
-19	16244	COTTER PIN - 1/8 DIA. X 1½	1
-20	92126	DRIVE GEAR MOUNTING ARM	1
-21	92137	STEERING ACTUATOR	1
-22	60133	HEX HEAD CAPSCREW - ½-13 UNC X 2½	1
-23	63305	LOCK WASHER - ½ MED	1
-24	60167	HEX HEAD CAPSCREW ½-13 UNC X 2 3/4	1
-25	61305	SELF-LOCKING NUT - ½-13 UNC	1
-26	92166	WHEEL POSITION ELECTRICAL ASSEMBLY	1
-27	92158	POTENTIOMETER RETAINER	1
-28	70043	GROMMET	1
-29	62202	SOCKET HEAD SET SCREW NO.10-32 X ¼	1
-30	70044	TERMINAL STRIP	1
-31	62618	PAN HEAD MACHINE SCREW - NO.6-32 X ½	2
-32	92157	SPINDLE ENCLOSURE	1

FIGURE 12 - DRIVE GEAR ASSEMBLY

ITEM	PART NUMBER	DESCRIPTION	QTY
-33	62619	PAN HEAD MACHINE SCREW - NO.10-32 X 3/8	4
-34	63413	FLAT WASHER - NO.10	4
-35	0729	BUSHING	1
-36	2440	90° STREET ELBOW	1
-37	54707	PIPE NIPPLE	1
-38	54800	PIPE CONNECTOR	1
-39	92207	BREATHER	1

FIGURE 13 - ELECTRICAL COMPONENT PANEL ASSEMBLY

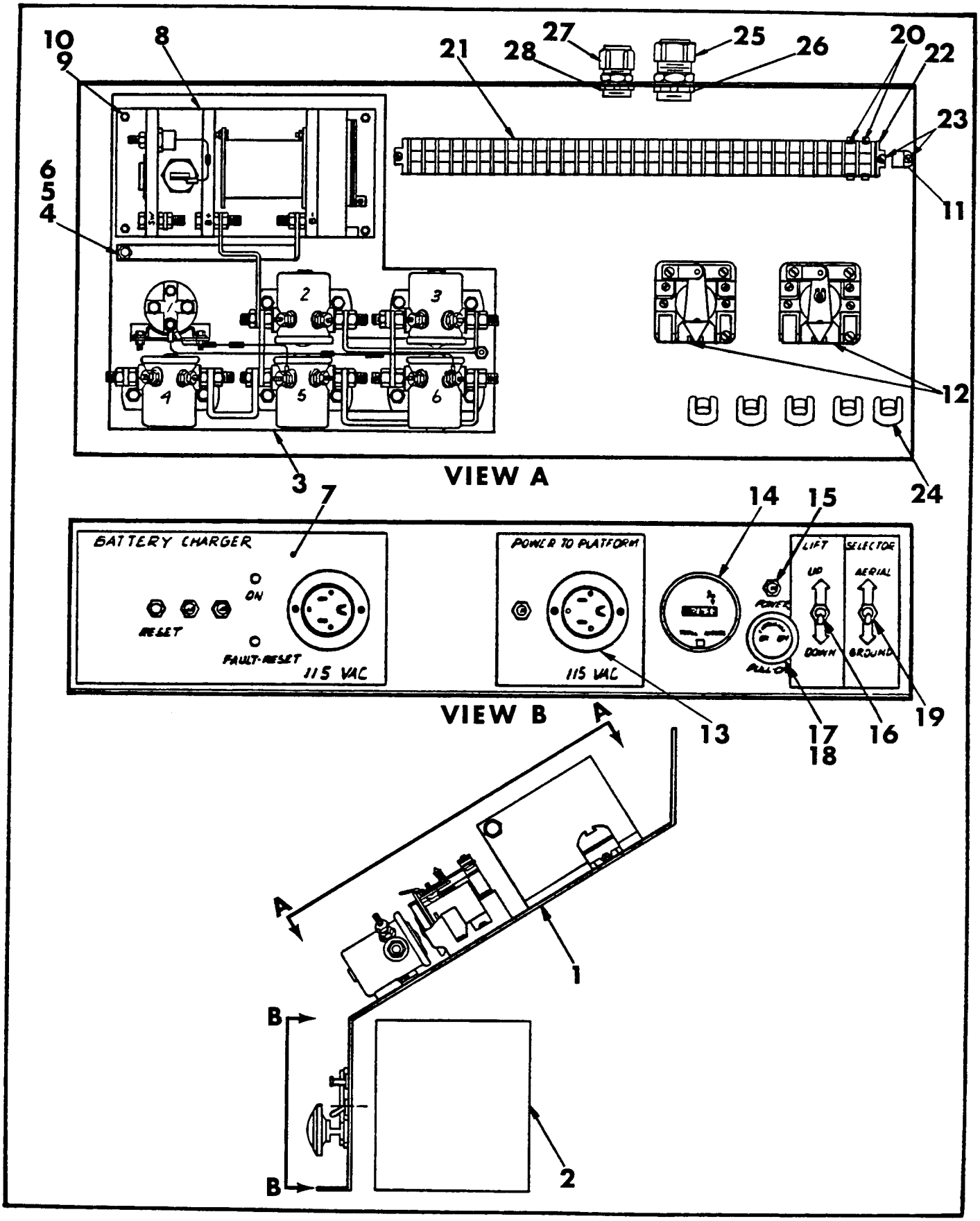
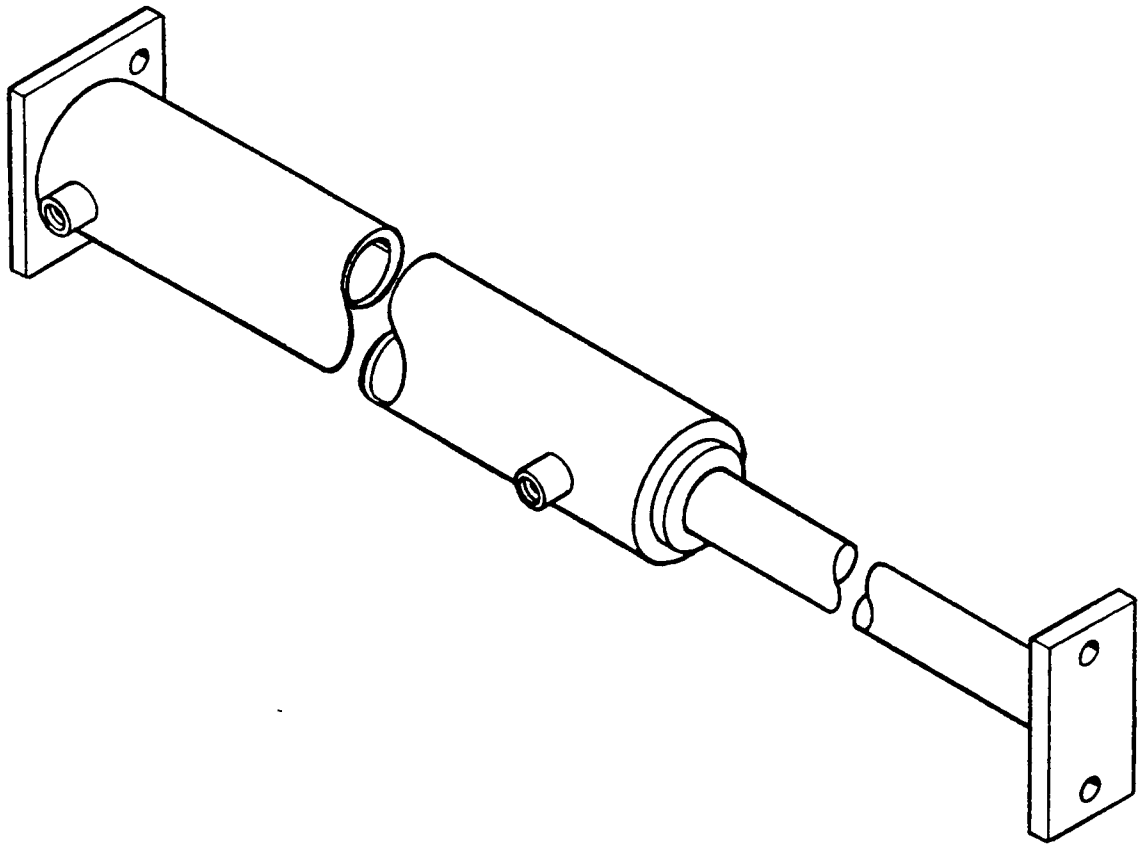


FIGURE 13 - ELECTRICAL COMPONENT PANEL ASSEMBLY

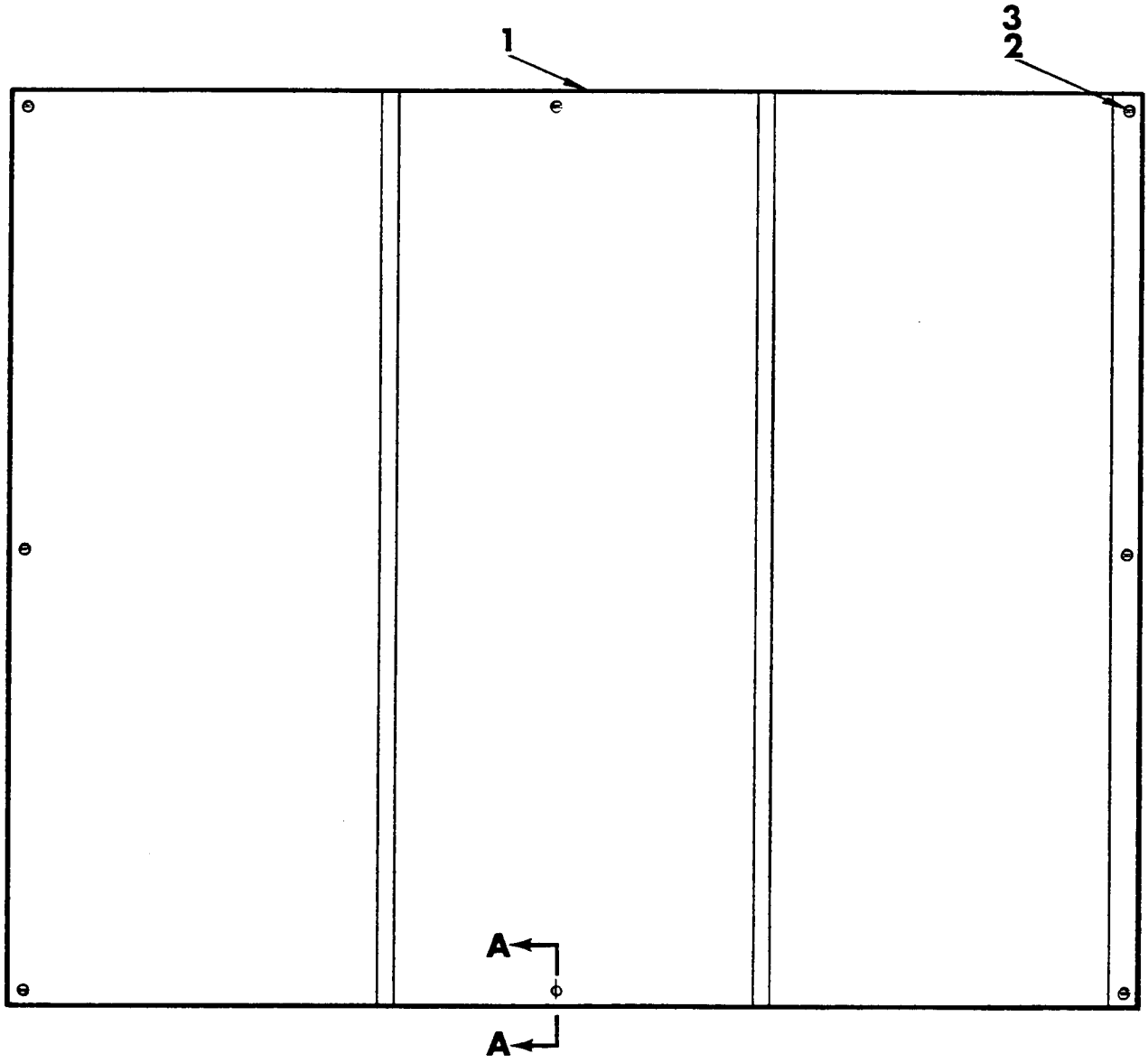
ITEM	PART NUMBER	DESCRIPTION	QTY
13-	92092	ELECTRICAL COMPONENT PANEL ASSEMBLY	1
-1	92073	ELECTRICAL COMPONENT PANEL	1
-2	92012	BATTERY CHARGER	1
-3	92201	CONTACTOR PANEL	1
-4	60131	HEX HEAD CAPSCREW - ¼-20 UNC X 1	2
-5	60701	HEX NUT - ¼-20 UNC	4
-6	63301	LOCK WASHER - ¼ MED.	2
-7	92186	DECAL - CONTROL PANEL	1
-8	92175	ELECTRICAL CONTROL	1
-9	61711	HEX HEAD SELF TAPPING SCREW - No.12 X ½ TYPE A	4
-10	63314	LOCK WASHER - No.12 MED	4
-11	70061	CABLE CLAMP	1
-12	70109	STEERING RELAY	2
-13	70050	RECEPTACLE	1
-14	20571	HOUR METER	1
-15	20562	CIRCUIT BREAKER	2
-16	20481	LIFT SWITCH	1
-17	4018	POWER SWITCH	1
-18	5300	PALM KNOB	1
-19	70125	SELECTOR SWITCH - AERIAL/GROUND	1
-20	70060	TERMINAL COVER	2
-21	4027	TERMINAL BLOCK	33
-22	117A	TERMINAL END	1
-23	61712	ROUND HEAD SELF TAPPING SCREW - No.8 X ½ - TYPE A	11
-24	70062	STRAIN RELIEF	5
-25	65197	STRAIN RELIEF	1
-26	2809	CONDUIT LOCKNUT	1
-27	2806	STRAIN RELIEF	1
-28	2808	CONDUIT LOCKNUT	1
-29	92224	RESISTOR	1

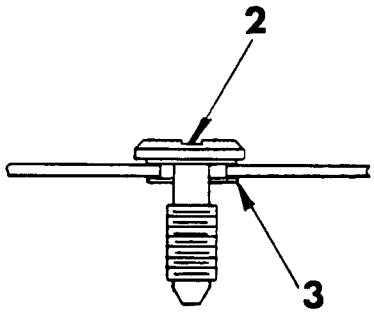
FIGURE 14 - LIFT CYLINDER



ITEM	PART NUMBER	DESCRIPTION	QTY
14-	92194	LIFT CYLINDER (SIERRA)	1
-1	66166	SEAL KIT	1

FIGURE 15 - DRIVE GEAR COVER ASSEMBLY



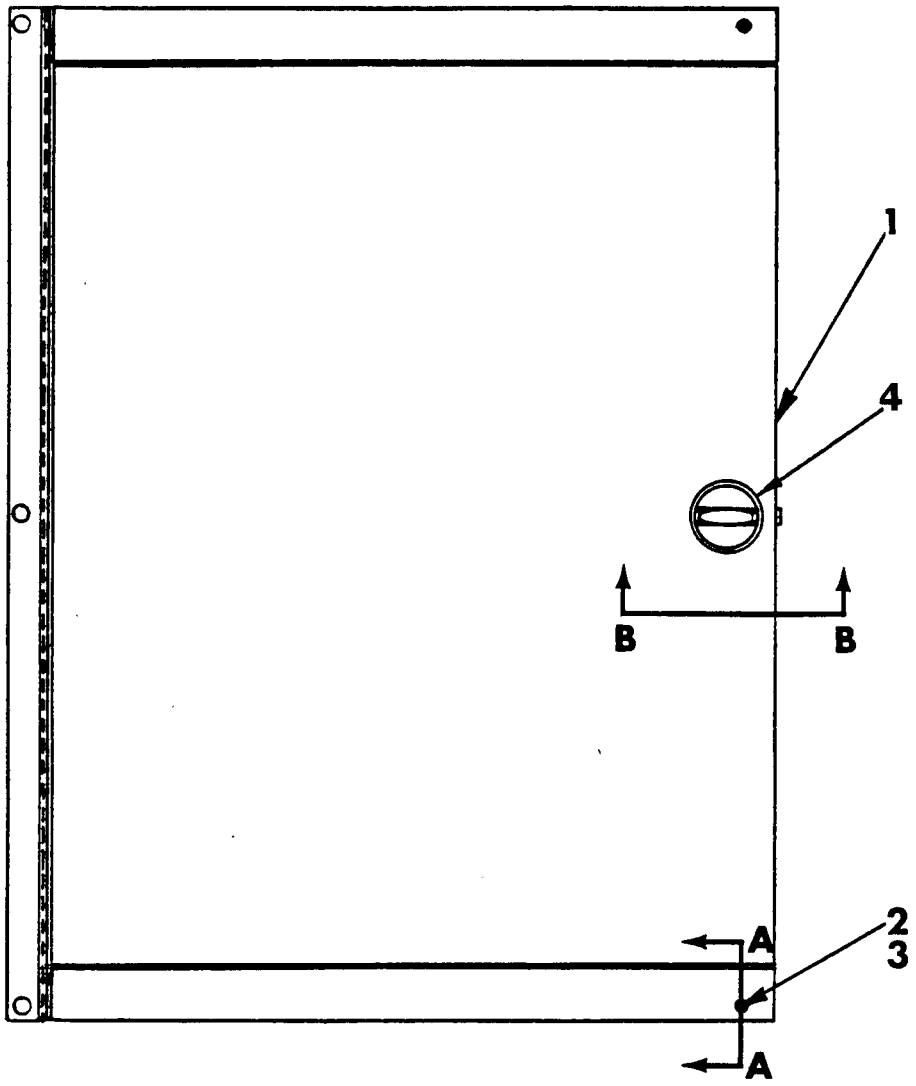


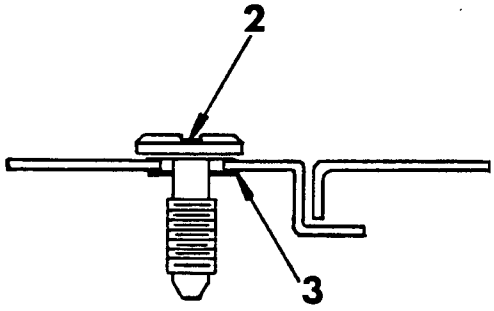
SECTION A

FIGURE 15 - DRIVE GEAR COVER ASSEMBLY

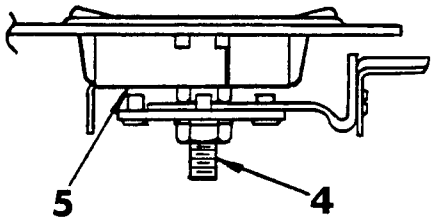
ITEM	PART NUMBER	DESCRIPTION	QTY
15-	92182	DRIVE GEAR COVER ASSEMBLY	1
-1	92148	COVER	1
-2	65179	SCREW ASSEMBLY	8
-3	65190	RETAINER	8

FIGURE 16 - REAR BATTERY COMPARTMENT COVER ASSEMBLY





SECTION A

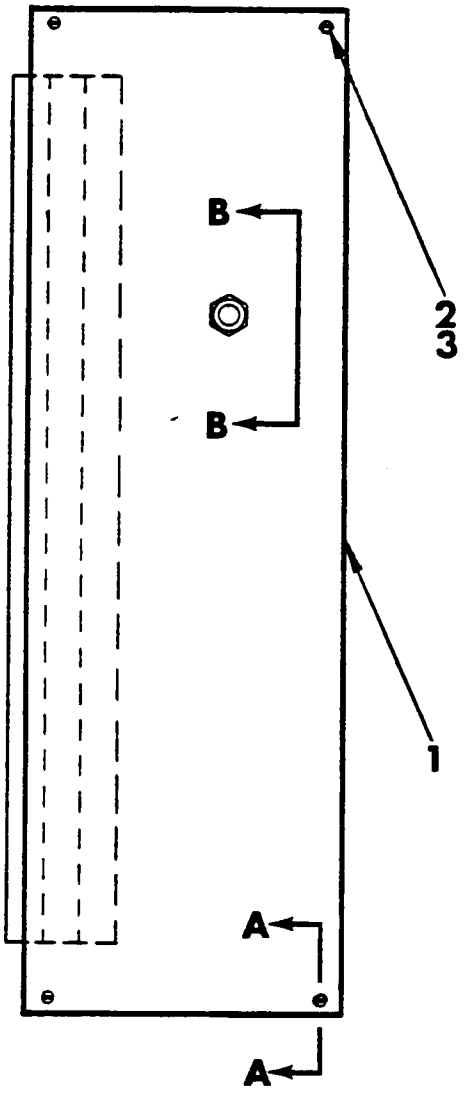


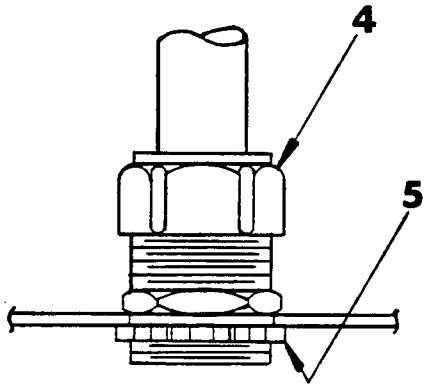
SECTION B

FIGURE 16- REAR BATTERY COMPARTMENT COVER ASSEMBLY

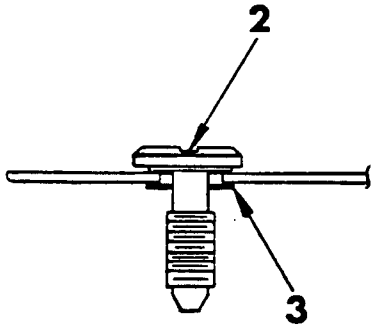
ITEM	PART NUMBER	DESCRIPTION	QTY
-16	92183	REAR BATTERY COMPARTMENT COVER ASSEMBLY	1
-1	92149	COVER	1
-2	65179	SCREW ASSEMBLY	2
-3	65190	RETAINER	2
-4	65248	RECESSED LATCH	1
-5	(REF)	HOUSING PLATE	1

FIGURE 17 - FRONT BATTERY COMPARTMENT COVER ASSEMBLY





SECTION B

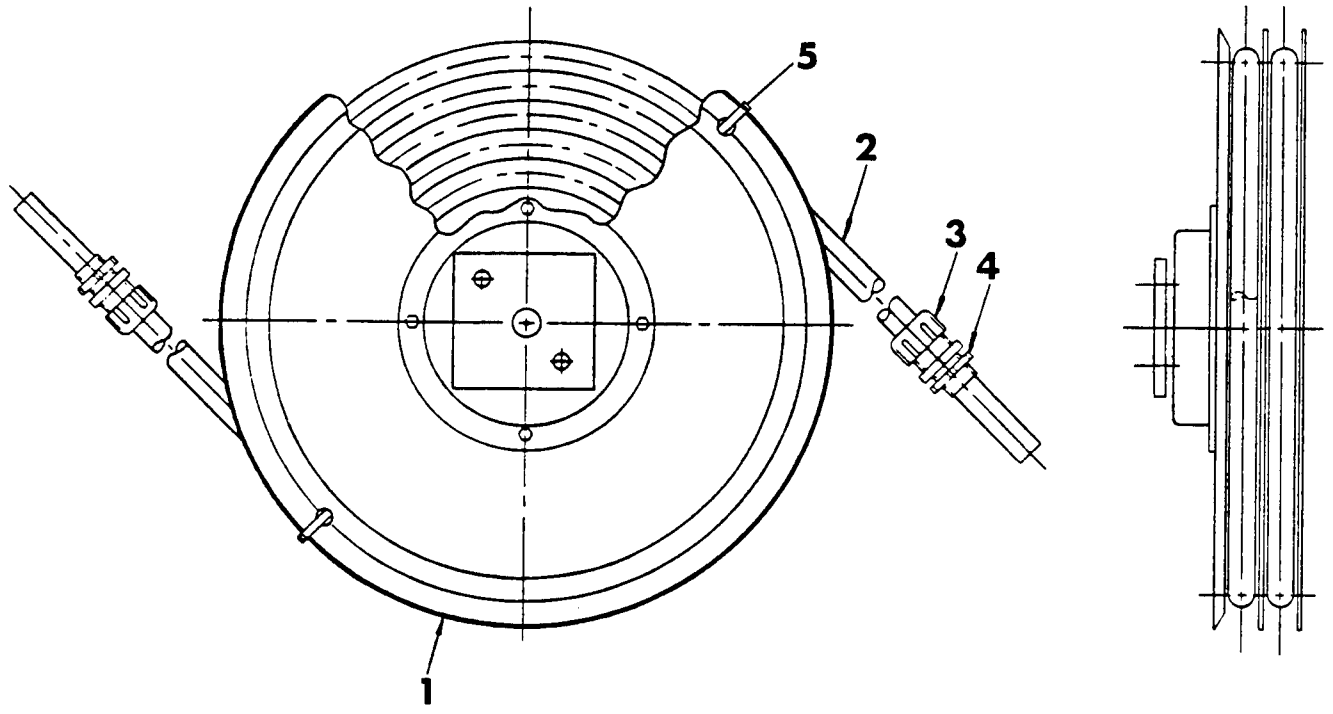


SECTION A

FIGURE 17 - FRONT BATTERY COMPARTMENT COVER ASSEMBLY

ITEM	PART NUMBER	DESCRIPTION	QTY
17-	92184	FRONT BATTERY COMPARTMENT COVER ASSEMBLY	1
-1	92150	COVER	1
-2	65179	SCREW ASSEMBLY	4
-3	65190	RETAINER	4
-4	65197	STRAIN RELIEF	1
-5	2809	CONDUIT LOCKNUT	1

FIGURE 18 - CABLE REEL ASSEMBLY



ITEM	PART NUMBER	DESCRIPTION	QTY
18-	92203	CABLE REEL ASSEMBLY	1
-1	92017	RETRACTION REEL	1
-2	92034	CONTROL CABLE	1
-3	65197	STRAIN RELIEF	2
-4	2809	CONDUIT LOCKNUT	2
-5	255	TY-WRAP	2

FIGURE 19 - HYDRAULIC SYSTEM INSTALLATION

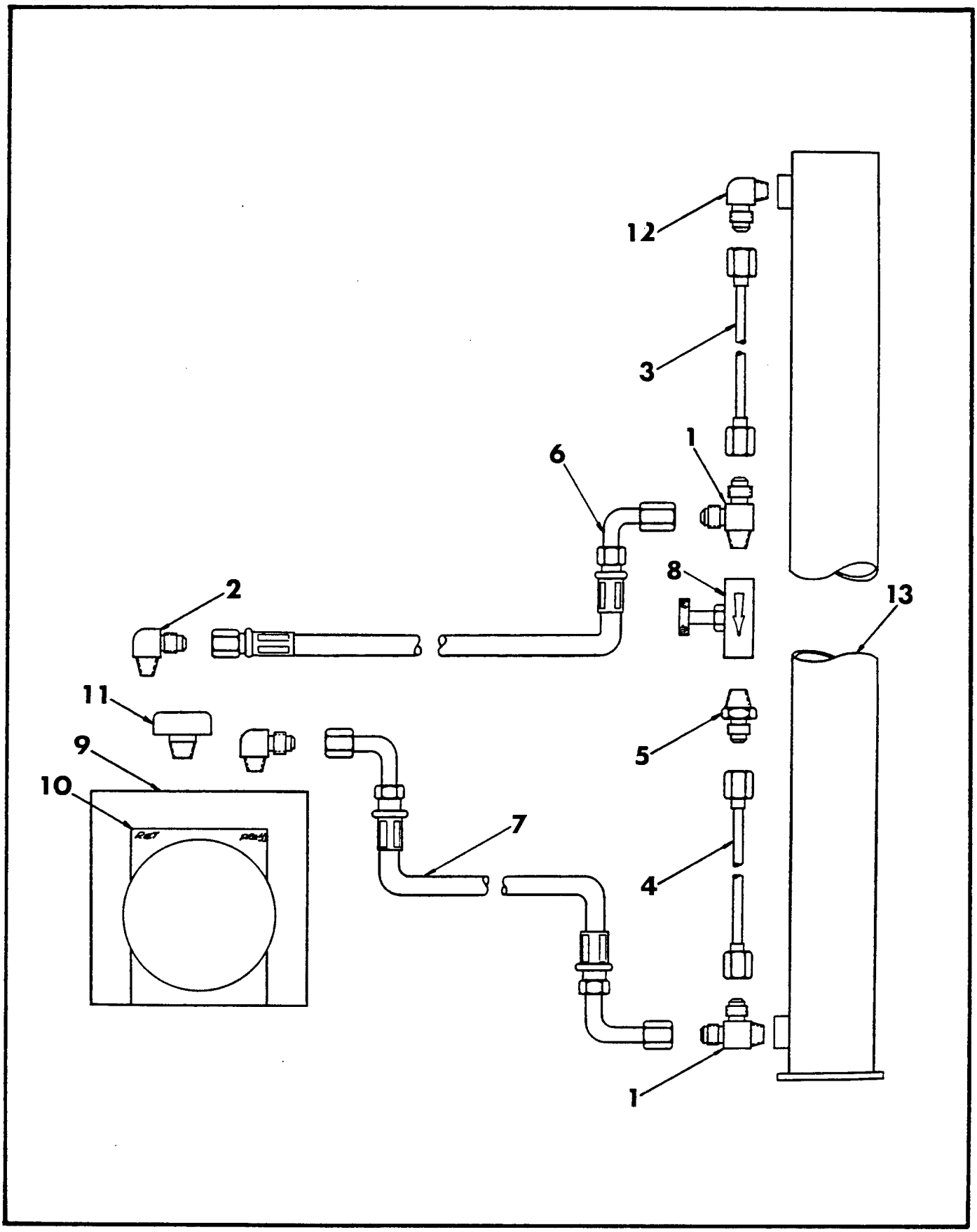
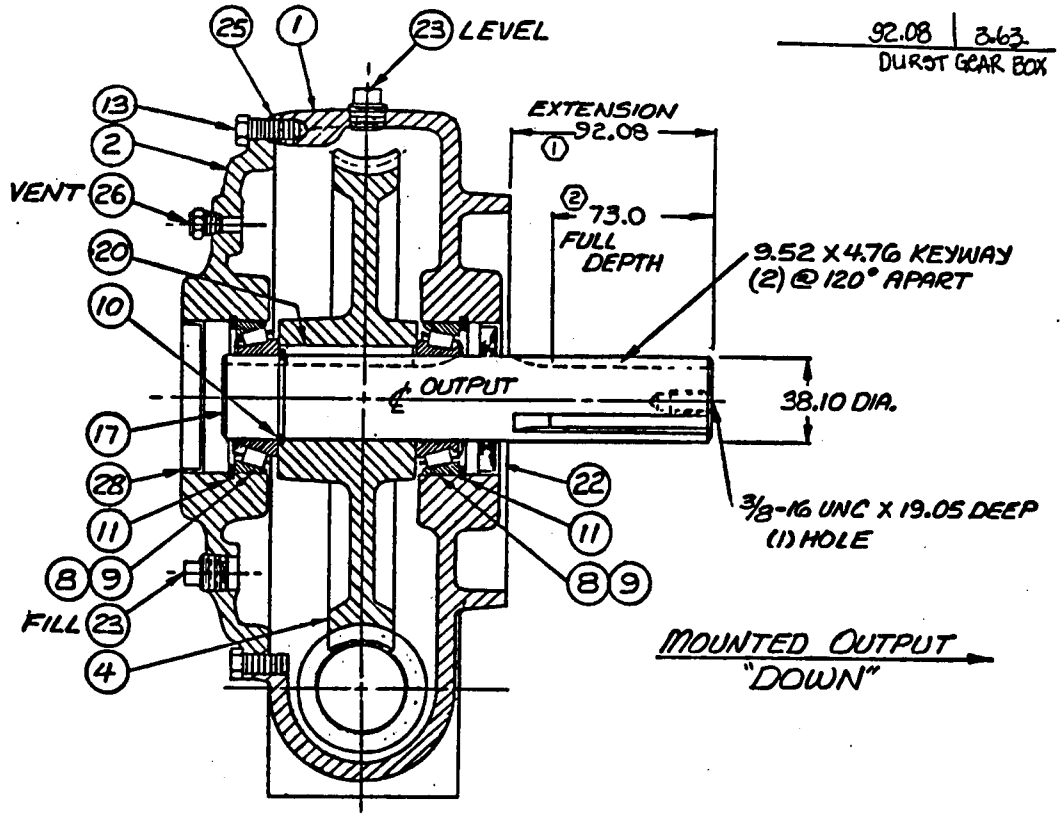


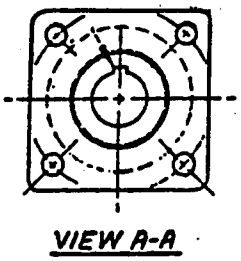
FIGURE 19 - HYDRAULIC SYSTEM INSTALLATION

ITEM	PART NUMBER	DESCRIPTION	QTY
19-	92195	HYDRAULIC SYSTEM INSTALLATION	1
-1	2425	MALE RUN TEE	2
-2	2445	90° ADAPTER ELBOW	2
-3		TUBE ASSEMBLY-3/8	1
-4		TUBE ASSEMBLY-3/8	1
-5	2476	MALE CONNECTOR	1
-6	13203-06-0160	RETURN HOSE ASSEMBLY	1
-7	13210-06-0200	PRESSURE HOSE ASSEMBLY	1
-8	92223	NEEDLE VALVE	1
-9	92205	RESERVOIR- 2 1/2 GAL.	1
-10	92167	PUMP MOTOR	1
-11	92213	FILLER CAP	1
-12	2449	MALE ELBOW	1
-13	92194	LIFT CYLINDER (SEE FIG. 14)	1

REV.1
4-82

DURST GEAR BOX





VIEW A-A

REV.1
4-82

DURST GEAR BOX

ITEM	PART NO.	NO. REQ	DWG SIZE	DESCRIPTION
1	A26-BDG	1	B	HOUSING
2	A27-5	1	A	COVER
3	A109	1	A	HYD. ADAPTER (4 BOLT)
4	B28-A316WM	1	A	WORM GEAR-SOLID
5	B31-2	1	A	WORM
6	C12	2	A	BRG.-CONE #15101
7	C13	2	A	BRG.-CUP #15245
8	C19	2	A	BRG.-CONE #13687
9	C20	2	A	BRG.-CUP #13620
10	D14	1	A	SNAP RING-OUTPUT
11	D23	2	A	SNAP RING
12	D24	2	A	SNAP RING
13	D51	12	A	CAPSCREW-3/8-16 X 1 LG.
14	D197	1	A	SNAP RING-INPUT
15	D252	1	A	SNAP RING
16	E3509	1	B	SHAFT-INPUT
17	E3990	1	B	SHAFT-OUTPUT
18	J10	1	A	"A"(807) WOODRUFF-SOFT
19	J56	1	A	"A"(807) WOODRUFF-HARD
20	J58	2	A	KEY 3/8 SQ. X 2 3/8 LG-HARD
21	K10	1	A	SEAL
22	K23	1	A	SEAL-OUTPUT
23	K36	2	A	PLUG - 3/8-18 NPT
24	K43	1	A	GREASE ZERK 1/4-28
25	K47	1	A	GASKET-COVER
26	K112	1	A	PLUG-VENT 1/8-27 NPT
27	K154	1	A	CAP-INPUT
28	K155	1	A	CAP-OUTPUT
29	P16	A/R	A	SHIM
30	P17	A/R	A	SHIM
31	P103	2	A	SPACER
32	S49-4	1	A	COUPLING
33	P145	1	A	"NO LUBE" TAG

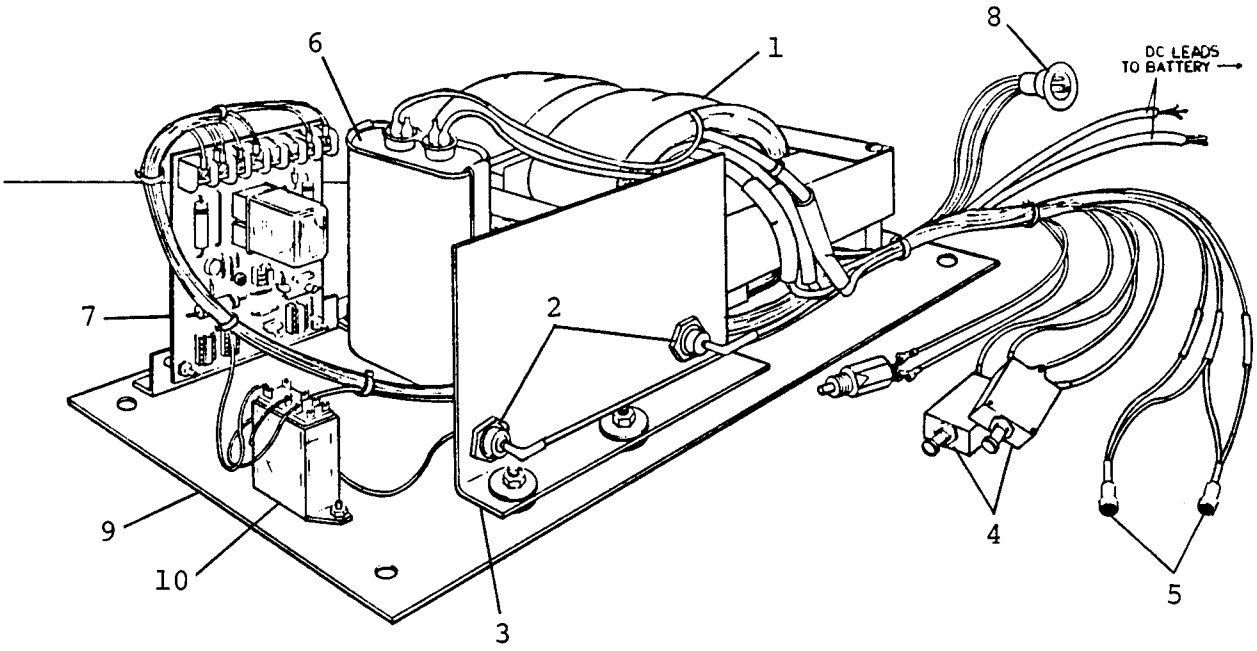
REF: 4766

NOTE: TAG WITH "NO LUBE" TAG

REV.	LINE	CHG. NO.	WAS	BY	DATE

REV.1
4-82

LESTER BATTERY CHARGER



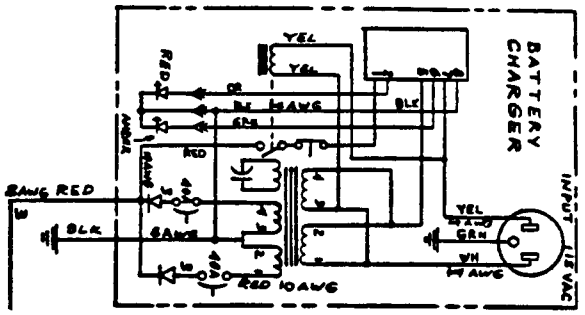
Battery Charger Specifications

Model Number: 24LC40CVRT (Mark Ind. P/N 92012)

Input Voltage: 115 volts A.C. 60 hz 1 ø

Output Voltage: 24 volts D.C. 40 amps

Watts: 1150

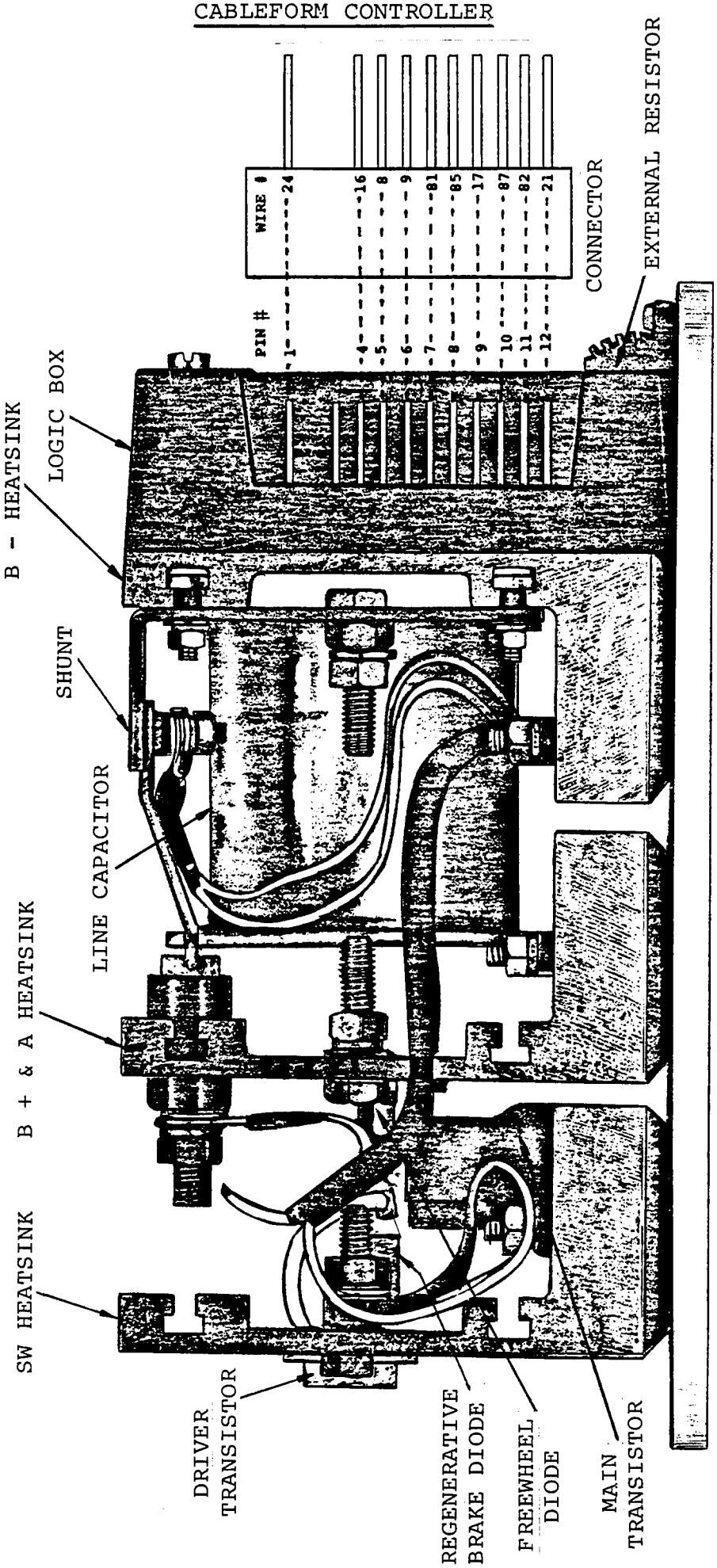


PARTS LIST

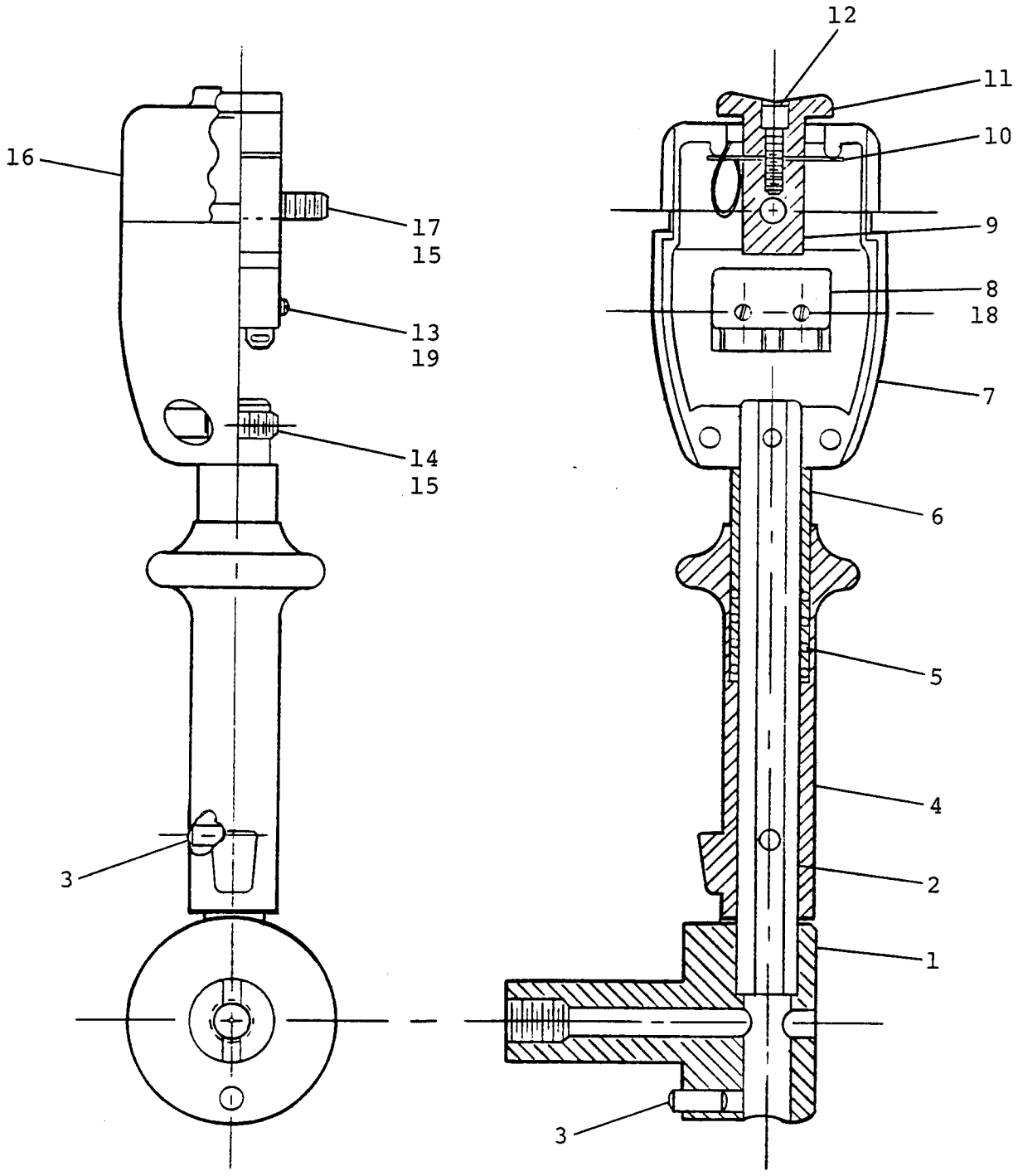
Description	Quantity	Mark Ind. Part Number	Lester Part Number
1. Transformer	1	66122	AT 1178
2. Diodes	2	66123	40HF40
3. Heatsink	1	66124	7 X 5
4. Circuit Breaker	2	66125	109-240-101
5. L.E.D. Red	1	66126	LH295WL4650
Yellow	1	66127	LH295WL4550
6. Capacitor	1	66128	20 mfd.
7. CVRT Timer Board	1	66129	24 volt
8. A.C. Receptacle	1	70050	Hubble 5278-C
9. Mounting Plate	1	66130	15 X 8
10. A.C. Relay	1	66163	RH 2B SF

REV.1
4-82

CABLEFORM CONTROLLER



P-Q Controls, Inc.



P-Q Controls, Inc.

REV.1
4-82

SWITCH IN HANDLE ARRANGEMENT ASSEMBLY

ITEM	QTY.	PQC PART NO.	MARK IND. PART NUMBER	DESCRIPTION
1	1	B-00641	66224	CONTROL HANDLE
2	1	B-00633	66225	CONTROL HANDLE EXTENSION
3	3	A-00557-01	66217	GROOVED PIN (TYPE D)
4	1	B-00635	66208	SLIDE LOCK
5	1	A-00082-06	66209	HELICAL COMPRESSION SPRING
6	1	B-00636	66210	SLEEVE
7	2	B-00695	66211	KNOB HALF
8	2	A-00667-01	66212	SWITCH
9	1	B-00630	66213	SWITCH ACTUATOR
10	1	B-00632		FLAT SPRING
11	1	B-00631	66215	THUMB BUTTON
12	1	A-00668-03		SOCKET HEAD CAP SCREW
13	2	A-00068-09		PAN HEAD MACHINE SCREW
14	2	A-00668-03		SOCKET HEAD CAP SCREW
15	3	A-00150-03		HEX NUT
16	1	B-00669		ELASTIC CAP
17	1	B-00701		MODIFIED SOC. HD. CAP SCREW
18	3	B-00238		SWITCH SPACER
19	2	A-00069-01		SPLIT LOCKWASHER

TROJAN MILEAGE MASTER BATTERIES

GROUP NUMBER	TYPE	VOLTS	REF. 20 HOUR RATE A.H.	75 AMPS TO 5.25 VOLTS AT 80 F MINUTES	OVERALL DIMENSIONS			SHIP WEIGHT
					LENGTH	WIDTH	*HEIGHT	
GC-2	J-170W	6	170	88	10 3/8	7 1/16	10 1/4	57
GC-2	J-190W	6	190	95	10 3/8	7 1/16	10 1/4	59
GC-2H	J-217W	6	217	108	10 3/8	7 1/16	11 1/2	66
GC-2H	J-244W	6	244	130	10 3/8	7 1/16	11 1/2	73

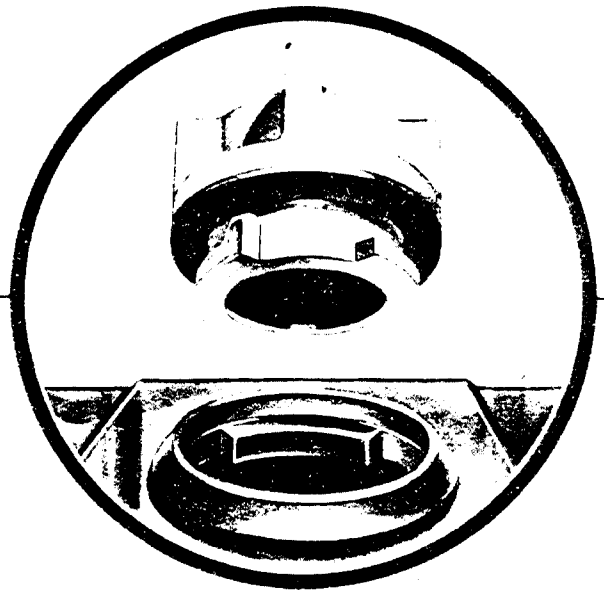
*For Universal Terminals or Angle Terminals, increase height one quarter inch.

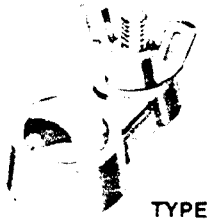
OTHER SPECIAL BATTERIES AVAILABLE TO FIT MOST TYPES OF ELECTRICAL VEHICLES.

TROJAN "MILEAGE MASTER" TYPES FEATURE QUARTER-TURN VENT CAPS REDUCING SERVICE TIME 75%

TYPE AP

STRAIGHT POST





TYPE WT

WING NUT TERMINAL
3/16 or 5/16 Stud

TYPE LT

ANGLE TERMINAL
5/16 Lead coated bolt

TYPE UT

UNIVERSAL TERMINAL

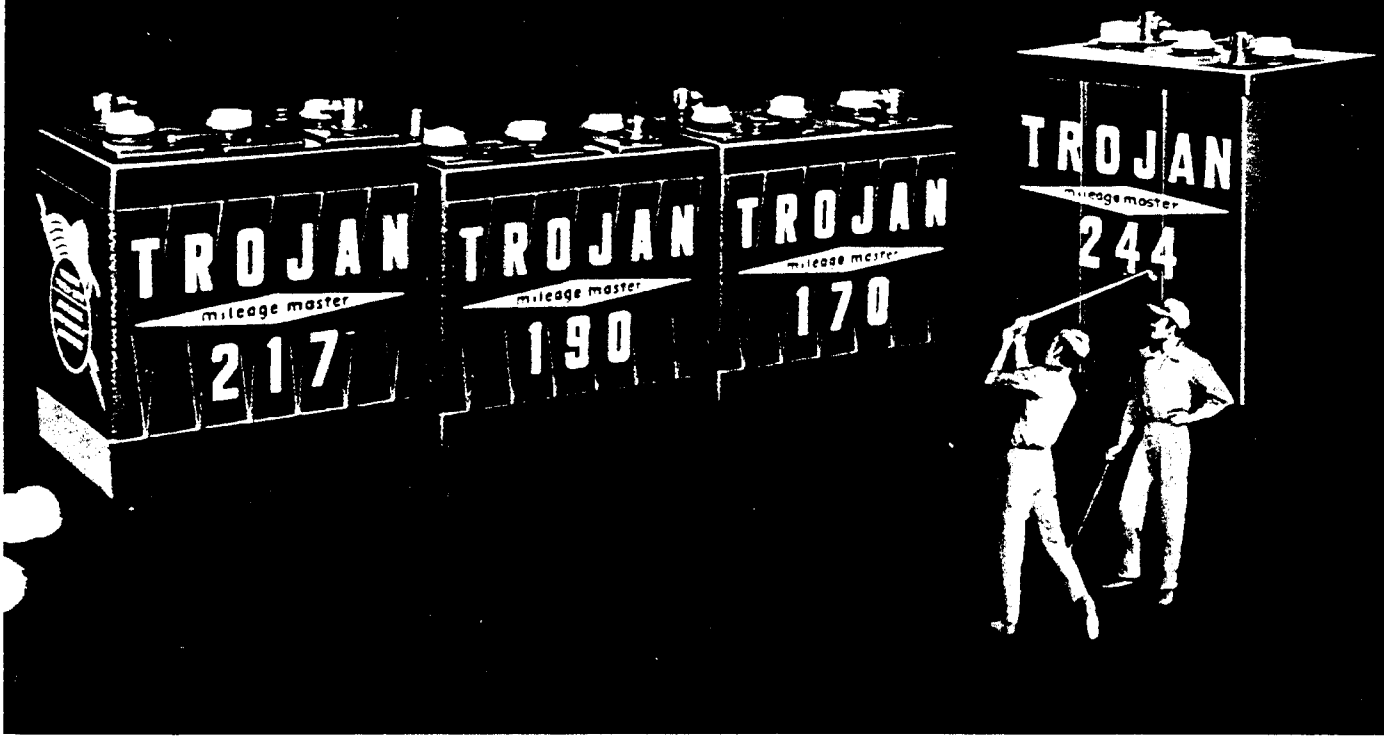
ALL BATTERIES COME WITH UNIVERSAL TERMINALS
UNLESS OTHERWISE SPECIFIED

DISTRIBUTED BY

TROJAN BATTERY COMPANY

PROPER CARE AND MAINTENANCE OF ELECTRIC VEHICLE GOLF CAR BATTERIES

THE INFORMATION INSIDE IS AN IMPORTANT CONTRIBUTION TO BETTER SERVICE AND MORE EFFICIENT USE OF ELECTRIC GOLF CARS AND WAS PREPARED BY BATTERY COUNCIL INTERNATIONAL.



proper care and maintenance of electric vehicle

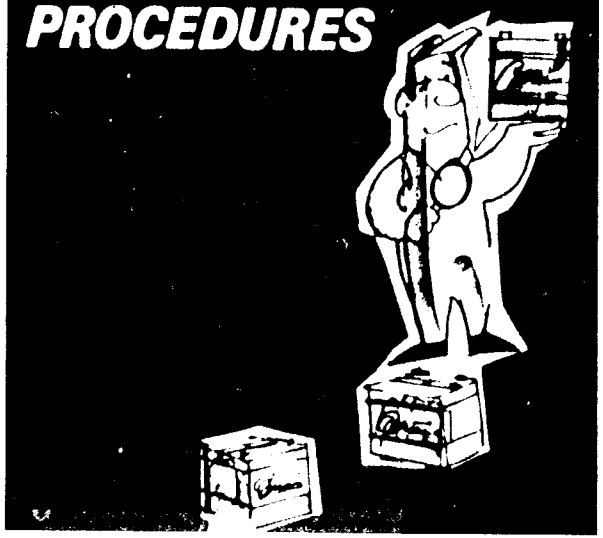
1. NEW BATTERY RECEIVAL AND INSTALLATION

1. **Always** inspect incoming shipments of batteries for damage. Look for and pay particular attention for damage to or wet spots on the shipping cartons examine those batteries for signs of breakage
2. If damaged batteries are found secure acknowledgment of the damage from the carrier's representative and file a claim against the transportation company Contact your supplier for battery replacement
3. If batteries are received wet and **not** immediately placed in service, they must be charged at regular interals as follows:

Storage Temperature	Charge
Below 40° F	None required
40° F to 60° F	Every 2 months
60° F and above	Once a month

4. Never stack one battery directly on top of another Post damage and/or container damage can occur from improper stacking If batteries are stored individually, place supporting boards between layers **Do not** stack layers more than three (3) high and rotate stock so that the oldest batteries can be used first
5. Dry charge batteries should be activated in accordance with instructions of the battery manufacturer.
6. Batteries should be installed in accordance with the vehicle manufacturer's instructions Connections should be made tight enabling good contact between connector lugs and battery terminals Always charge sets of batteries **immediately after installation** into the car.

2. MAINTENANCE-INSPECTION PROCEDURES



1. **Water batteries at least once a week.**
   - a. Add only approved water to the cells Distilled water is recommended high mineral content water must not be used Maximum allowable impurities in percent-iron (.003) chloride (.004) fixed residue (.075)
   - b. Remove vent caps and water batteries preferably after charging to prevent over flow of acid due to expansion
   - c. Fill all cells to the proper level. **Do not overfill cells.** Fill to level indicator or ½ inch over the top of the separators if there is no level indicator Do not use a hose to water batteries
   - d. Spot check cells between weekly waterings to assure electrolyte is above separators Excess water usage indicates the presence of any one or all of the following conditions which should be checked
     1. Overcharging
     2. High temperature operation
     3. Nearing end of service life
   - e. **Do not allow the electrolyte level to drop** below the top of the separators since this will lead to shortened battery life.
2. **Clean batteries after weekly watering or when washing cars.**
   - a. Wash the tops of the batteries making sure the vent caps are in place Do not allow water or other foreign matter to enter the cells
   - b. Use a solution of bicarbonate of soda and water to wash batteries if there is any accumulation of acid
3. **Inspection** to insure good conditions which will give better battery service
   - a. When watering batteries inspect battery and other terminal connections for
     1. **Corrosion** – If any exists clean connection and apply a non-metallic grease or protective spray to retard further corrosion
     2. **Loose Connections** Be sure all connections are tight and that good contact is made between terminals
     3. **Broken or Frayed Cables** Be sure all cable connections are good and that no loose or broken wires are exposed Replace any which look suspicious.
   - b. Once a week after the batteries have been charged spot check two (2) or more cells for specific gravity reading Gravity should be 1.250 - 1.280 If low readings are noted.
     1. Check charger to insure that proper charge is being returned to the batteries
     2. Check connections as specified under **inspection 3a.**
     3. Check all cells to determine if batteries are near the end of life This should be done by the same procedure as called for under **Section IV** covering "**Trouble Shooting" of batteries**.
   - c. On a regular interval check car as outlined in the instruction manual for
     1. Brake drag
     2. Proper tire pressure
     3. Proper alignment
     4. Proper lubrication
     5. Proper operation of electrical system
     6. Proper operation of drive and transmission system
     7. Condition of charger plug and receptacle in car

     Any of these conditions which are detrimental to car operation will shorten battery life

3. CHARGING PROCEDURE

1. Become familiar with instructions issued with the charger or car manual
2. Batteries are to be charged after each day's use as soon as play has been completed. Charging between rounds is permissible if it is determined feasible to do so.
3. **Do not charge batteries** if car was not used that day
4. **Do not allow batteries to sit in discharged condition** for prolonged periods of time
5. **Always be sure batteries are fully charged** each day prior to starting play

4. TROUBLE SHOOTING FOR WEAK OR BAD BATTERIES

When a car fails to operate properly performing less than one round of golf, the car is to be brought into the shop and the batteries examined as follows:

1. Check terminal connections for corrosion, loose connections and broken or frayed cables.
2. If terminal connections appear to be in good condition, check all cells with a hydrometer for variation in specific gravity among cells. A variation of .030 points or more between cells of a battery is cause for suspect. Mark the low cells.
3. Recharge the batteries as recommended by the manufacturer.
4. Read all gravities again after recharge. Be sure that batteries are fully charged at gravities of 1.250 to 1.260. If cells vary by .030 points or more it is an indication of possible trouble within that battery.
5. Connect a load tester to the set of batteries and discharge the batteries at 75 Amps and record the time to a terminal voltage of 31.5 volts. Testers are now available having an automatic Shut-Off at this voltage. New batteries should run a minimum of 75 minutes on this test.
   a. If the batteries run less than 45 minutes they have either reached the end of life or a defective battery is in the circuit. Battery replacement is then necessary.
   b. If batteries run 40-50 minutes they have lost capacity and may be nearing the end of their useful life. In golf car service one round of golf may be completed on an average golf course.
   c. If batteries run more than 50 minutes they are in good condition and satisfactory for continued service. Prior to putting the car back in service it should be checked for the existence of other trouble as outlined in the instruction manual.

5. BATTERY REPLACEMENT

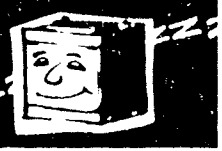
Defective Batteries (Premature Failures)

1. Defective battery can be determined either by observation of gravity variance at the end of the 75 Amp discharge (.030 or more points between cells of a battery) or by turning the discharge tester back on and pinpointing the battery or cell which is defective by use of a voltmeter.
2. Mark the defective battery.
3. Recharge the batteries with the defective battery in the circuit.
4. Remove the defective battery and replace with new battery or battery of comparable age which is fully charged.

Worn Out Batteries

1. Remove old set of batteries.
2. Clean and recondition battery trays, hold-downs and cables.
3. Inspect new batteries for broken containers and proper electrolyte level before installing in the car.
4. Install batteries in car being sure that they are properly held down firm but not too tight.
5. Replace cables, being sure terminals and connectors are clean and connections are tight.
6. Apply a light coating of non-metallic grease or protective coating.

6. WINTER STORAGE OF WET BATTERIES



1. Prior to storing car batteries should be cleaned, fully charged and properly leveled.
2. While in storage the batteries should be recharged to full charge at time intervals shown below.

Storage Temperature	Charge
Below 40° F	None required
40° F to 60° F	Every 2 months
60° F and above	Once a month

3. Check batteries after car has been removed from storage and before service begins. Follow **inspection and trouble shooting procedures** to determine the condition of the batteries.

Battery Council International

SERVICE BULLETINS

As we make improvements to the **MARKLIFTS**, we like to supply you, the customer, with updated information which applies to your machine.

This section is provided as a place to store Service Bulletins as you receive them from MARK INDUSTRIES.

No: 3360
Date: April, 1982

To: Mark Industries Distributors and Representatives

From: Service Department

Subject: Revision 1 - Self-Propelled Pal (SP19) Operation Maintenance and Parts Manual.

This revision has been prepared to incorporate recent changes that have been made on the SP19 unit.

Please use this revision package to update your Manual.

The "Chassis Electrical Wiring Diagram", (Page 44) in the schematics section, is to be discarded.

Use the "Record of Revisions", (Page iv) in the forematter section, as a guide to update the rest of your Manual.

This cover letter goes in the "Service Bulletins" section.

John Laurin
Service Manager