BESSER

LSC-100

TRANSFER CAR SYSTEM

MAINTENANCE/OPERATION MANUAL

466364F9602

JUNE 1997 • US$250

BESSER World Headquarters
801 Johnson St. • Alpena, Michigan, 49707 • U.S.A.
Phone (517) 354-4111

BESSER

COMPANY NAME: .....

SERIAL NUMBER: .....

ASSEMBLY NUMBER: .....

WIRING DIAGRAM NUMBER: .....

INSTALLATION DRAWING NUMBER: .....

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SPECIFICATIONS

TOTAL WEIGHT:

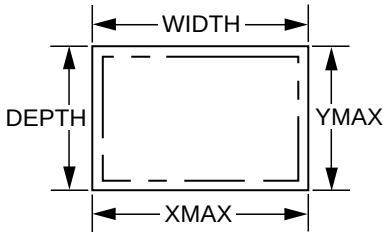
CAR:	11,300 Lbs [5130 Kg]
CRAWLER:	10,000 Lbs [4540 Kg]

MINIMUM HYDRAULIC PRESSURE: 850 psi [58 bar]

MACHINE SPEED: Up to 10 cycles per minute

PRODUCTION CAPACITY: Up to 4 bay x 9 high x 4 deep

PALLET REQUIREMENTS:



WIDTH & DEPTH = Actual size of steel pallet.

XMAX & YMAX = Maximum production area of steel pallet.

WIDTH	DEPTH	THICK	X	X	PALLET NO.
38.5" [978mm]	18.5" [470mm]	.375" [9.5mm]	37.5" [953mm]	17.625" [448mm]	470750F0012
38.5" [978mm]	20.5" [521mm]	.375" [9.5mm]	37.5" [953mm]	19.500" [495mm]	470750F0013
38.5" [978mm]	26.0" [660mm]	.375" [9.5mm]	37.5" [953mm]	25.000" [635mm]	470750F0014

Table 1.1 *Steel pallet specifications*

OPERATING CONDITIONS: Besser machinery and equipment is designed to comply with the essential health and safety regulations (EHSR) that apply to directives which are applicable to an industrial environment.
Buyer shall utilize this equipment in a manner consistent with its design and only in an industrial environment.

OPERATING RANGES: Here are the normal operating ranges for machine sensors (limit, proximity) and control devices contained within the control panels.

Ambient operating temperature range:	32° to 131°F [0° to 55°C]
Humidity range:	5 to 95% (non-condensing)
Line voltage:	85 to 132 volts – AC 50/60 Hz

LSC-100
ELECTRICAL DATA

PLANT POWER SUPPLY: 380 volt – 3 phase – 50 hertz

TOTAL ELECTRICAL CAPACITY: 20.0HP [14.92Kw]

TOTAL AMP LOAD: 41.42

Car Panel Control Transformer: 750 volt/amps

Crawler Panel Control Transformer: 500 volt/amps

BRANCH CIRCUIT

Distribution Switch Recommended: 60 amp

Fuse Recommended [FRS–R]: 50 amp

Feeder Recommended [THHN]: no. 8 AWG – 8.4 sq. mm

Feeder Conduit Recommended: .5 in. – 15 mm

SHORT CIRCUIT INTERRUPTING CAPACITY: 65,000 AIC

DEVICE (LOAD)	HORSEPOWER	KILOWATTS	AMPACITY
CAR POWER UNIT	10.0	7.46	16.95
CRAWLER POWER UNIT	10.0	7.46	16.95

Table 1.2 *Car and crawler power units*

SAFETY BULLETIN

This notice is issued to advise you that some previously accepted shop practices may not be keeping up with changing Federal and State Safety and Health Standards. Your current shop practices may not emphasize the need for proper precautions to insure safe operation and use of machines, tools, automatic loaders and allied equipment and/or warn against the use of certain solvents or other cleaning substances that are now considered unsafe or prohibited by law. Since many of your shop practices may not reflect current safety practices and procedures, particularly with regard to the safe operation of equipment, it is important that you review your practices to ensure compliance with Federal and State Safety and Health Standards.

IMPORTANT

The operation of any machine or power-operated device can be extremely hazardous unless proper safety precautions are strictly observed. Observe the following safety precautions:

- Always be sure proper guarding is in place for all pinch, catch, shear, crush and nip points.
- Always make sure that all personnel are clear of the equipment before starting it.
- Always be sure the equipment is properly grounded.
- Always turn the main electrical panel off and lock it out in accordance with published lock-out/tag-out procedures prior to making adjustments, repairs and maintenance.
- Always wear appropriate protective equipment, such as safety glasses, safety shoes, hearing protection and hard hats.
- Always keep chemical and flammable material away from electrical or operating equipment.
- Always maintain a safe work area that is free from slipping and tripping hazards.
- Always be sure appropriate safety devices are used when providing maintenance and repairs to all equipment.
- Never exceed the rated capacity of a machine or tool.
- Never modify machinery in any way without prior written approval of the Besser Engineering Department.
- Never operate equipment unless proper maintenance has been regularly performed.
- Never operate any equipment if unusual or excessive noise or vibration occurs.
- Never operate any equipment while any part of the body is in the proximity of potentially hazardous areas.
- Never use any toxic flammable substance as a solvent cleaner.
- Never allow the operation or repair of equipment by untrained personnel.
- Never climb or stand on equipment when it is operational.

It is important that you review Federal and State Safety and Health Standards on a continual basis. All shop supervisors, maintenance personnel, machine operators, tool operators, and any other person involved in the setup, operation, maintenance, repair or adjustment of Besser-Built equipment should read and understand this bulletin and Federal and State Safety and Health Standards on which this bulletin is based.

SAFETY SIGNS

To order safety decals, contact your local Besser representative or the Besser Central Order Department.
Thank you!

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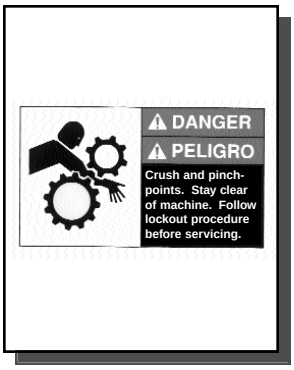

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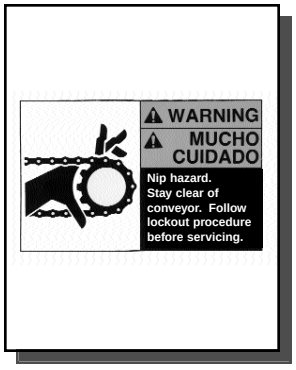

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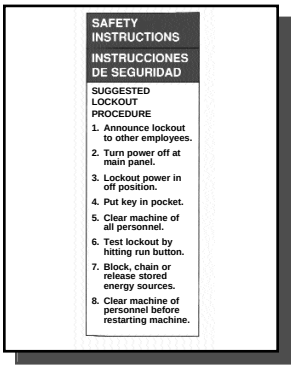

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SAFETY SIGNS

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SECTION 1
INTRODUCTION

The LSC-100 is an automated concrete product transport system. The LSC-100 transfers racks of green concrete product back and forth from the Loader/Unloader to kilns for curing. The LSC-100 consists of a rail network, two mobile vehicles, and a programmable controller system.

1.1 MECHANICAL COMPONENT OVERVIEW

Figures 1.1 through 1.3 illustrate the basic mechanical components of the LSC-100.

1.1.1 Racks

The racks hold the concrete product as they move from one area to another.

1.1.2 Loader/Unloader

The Loader loads racks of green concrete product for transport to the kilns. The Unloader unloads racks of cured concrete product following curing.

1.1.3 Rail System

There are two different rail paths and gauges. Wide gauge rails carry the car. Narrow gauge rails at right angles to the car rails carry the crawler to the loader, the unloader and into the kilns.

1.1.4 Crawler

The crawler lifts and transports racks between the car and the Loader/Unloader and kilns.

1.1.5 Car

The car carries the crawler between the Loader/Unloader and kiln area.

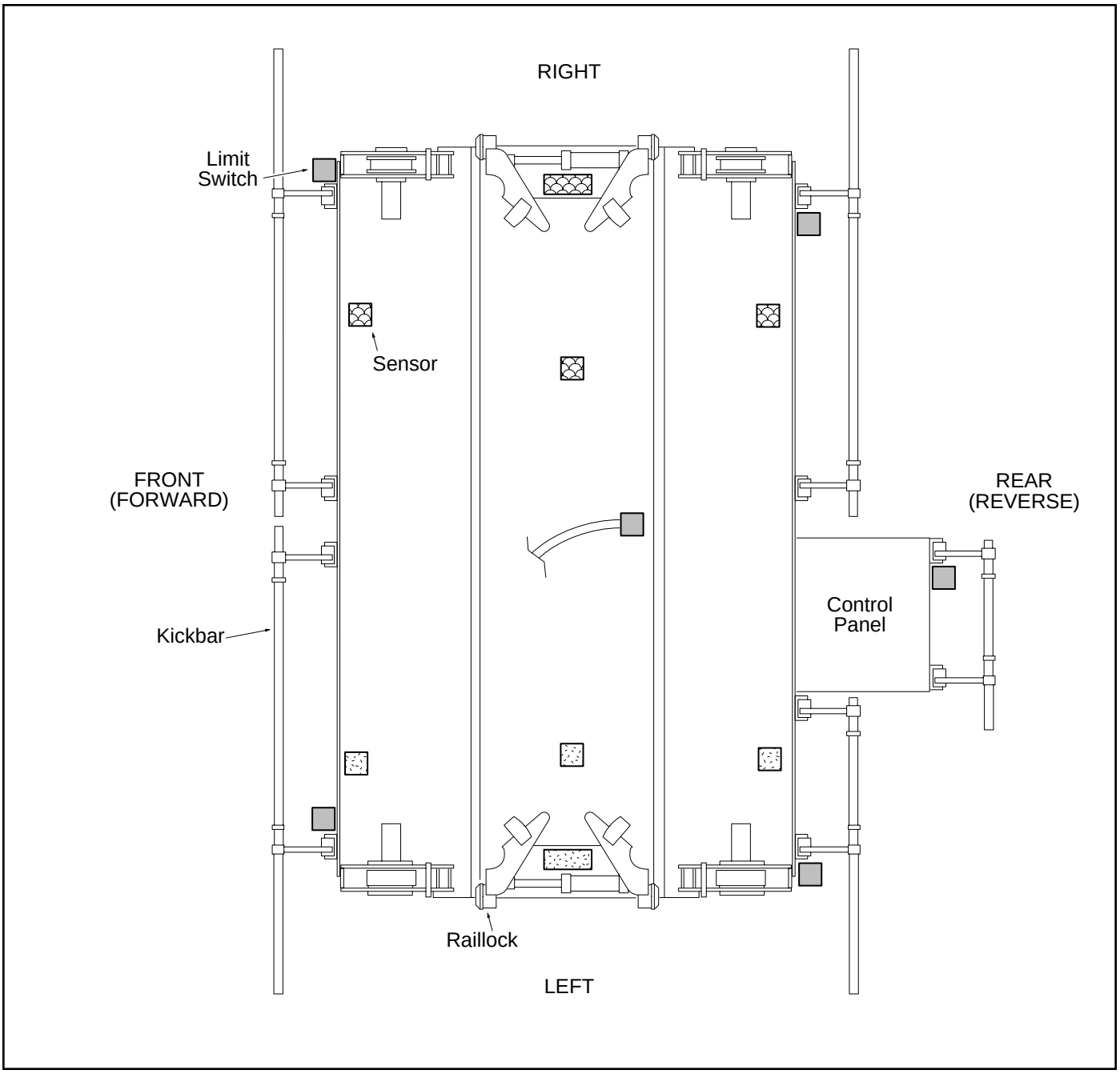

Figure 1.1 *Car Components*

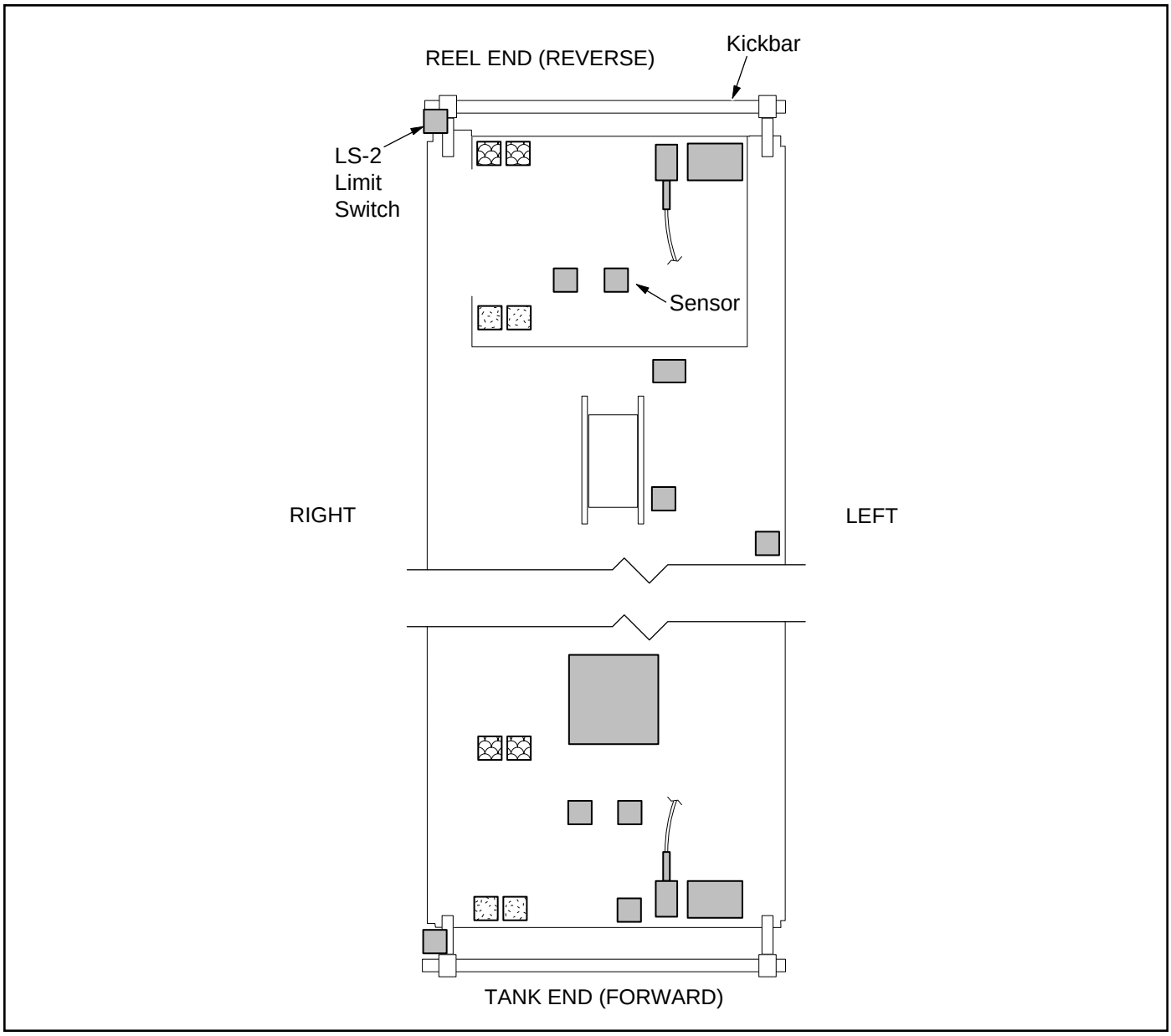

Figure 1.2 *Crawler Components*

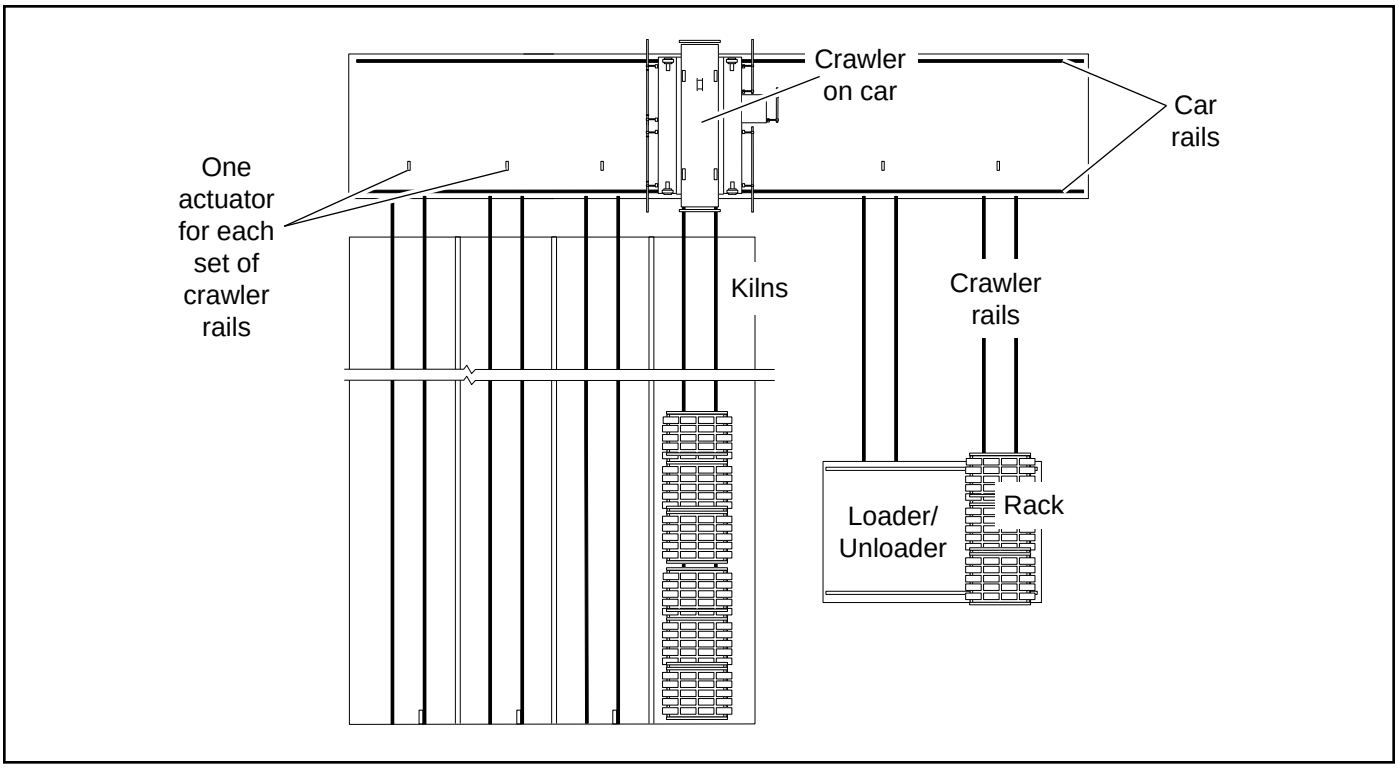

Figure 1.3 *Mechanical Components*

1.2 ELECTRONIC COMPONENT OVERVIEW

A range of electronic components monitor and control LSC-100 operation. This section provides only a brief overview of two components that are fundamental to the mechanical operation of the system: sensors and actuators. Section 3 provides a more detailed coverage of electronic components including sensor function.

1.2.1 Small Logic Controller/Graphic Control Station

Both car and crawler have Small Logic Controllers (SLC-500) which control the sequence of operations of each vehicle. The car's graphic control station operates as a man-machine interface. The crawler has two control stations located at each end of the crawler. The control stations use indicator lamps to show operational status and faults.

1.2.2 Sensors

Sensors located on the car and crawler monitor and control all mechanical operation. Sensors are also essential to the LSC-100 safety protection system. There are three types of sensors:

- Limit switches (LS) are spring-loaded, electromechanical devices that monitor the position of the crawler elevator, car raillocks and the safety bars on both the car and crawler.
- A photo-electric sensor (PER) on top of the car monitors the status of the crawler and signals the control system whether or not the crawler is in position on top of the car.
- Proximity relay sensors (PRS) on both the car and the crawler monitor a magnetic field to signal various operating conditions. For example, upward-sensing PRSs on the crawler detect the presence of a rack as part of the control process for crawler movement. Downward-sensing PRSs on the car detect floor-level actuators as part of the control process for car movement.

1.2.3 Actuators

Actuators are floor-level steel plates installed on the center line of every set of crawler rails. Downward-sensing proximity sensors on the car use the actuators to help control car movement.

1.3 START-UP PROCEDURE

1. Ensure all switches are off.
2. Turn power on. Indicator light will light.
3. Pull out the emergency stop. Press the MCR switch.
4. Turn the pump on.
5. Turn H-O-A switch to hand.
6. Manually position the car in front of any station. (Refer to Section 3.2.4.)
7. Check that screen has been properly programmed.
8. Turn H-O-A switch to auto.

CAUTION: The horn blows for 2 seconds and then car moves. In case of emergency press the emergency stop.

1.4 SHUT-DOWN PROCEDURE

1. Ensure that the machine has stopped at chosen location.
2. Turn H-O-A switch to off.
3. Depress and lock emergency stop switch.
4. If maintaining warm oil is desired, turn the oil heater switch on.
5. If warm oil is not required, turn power off.

SECTION 2
MECHANICAL OPERATION

This section is an overview of LSC-100 operation with a focus on the mechanical systems and movement of components. Section 3 covers the sensors and electronic system that controls and monitors mechanical operation. Here are the steps in a typical operating cycle:

- 2.1 Retrieve a green rack from the loader
- 2.2 Transport a green rack to a kiln
- 2.3 Retrieve a cured rack from a kiln (storage)
- 2.4 Transport a cured rack to the unloader

2.1 RETRIEVE A GREEN RACK (LOADER)

Figure 2.1 shows the sequence in retrieving a green rack.

1. The car is at the loader station with the crawler on the car.
2. The raillocks extend.
3. The Loader's emitter 101 sends a signal to PER-17 on the crawler that a green rack is in position.
4. The crawler moves off the car at a fast speed. The crawler slows when the first floor actuator triggers the leading PRS pair and stops when the second floor actuator triggers the same PRS pair.
5. The crawler elevator lifts the green rack from the rack conveyor.
6. The crawler with loaded rack reverses direction back towards the car. When front car sensors are triggered by the car raillock actuators, the crawler stops centered on the car.
7. The raillocks retract.

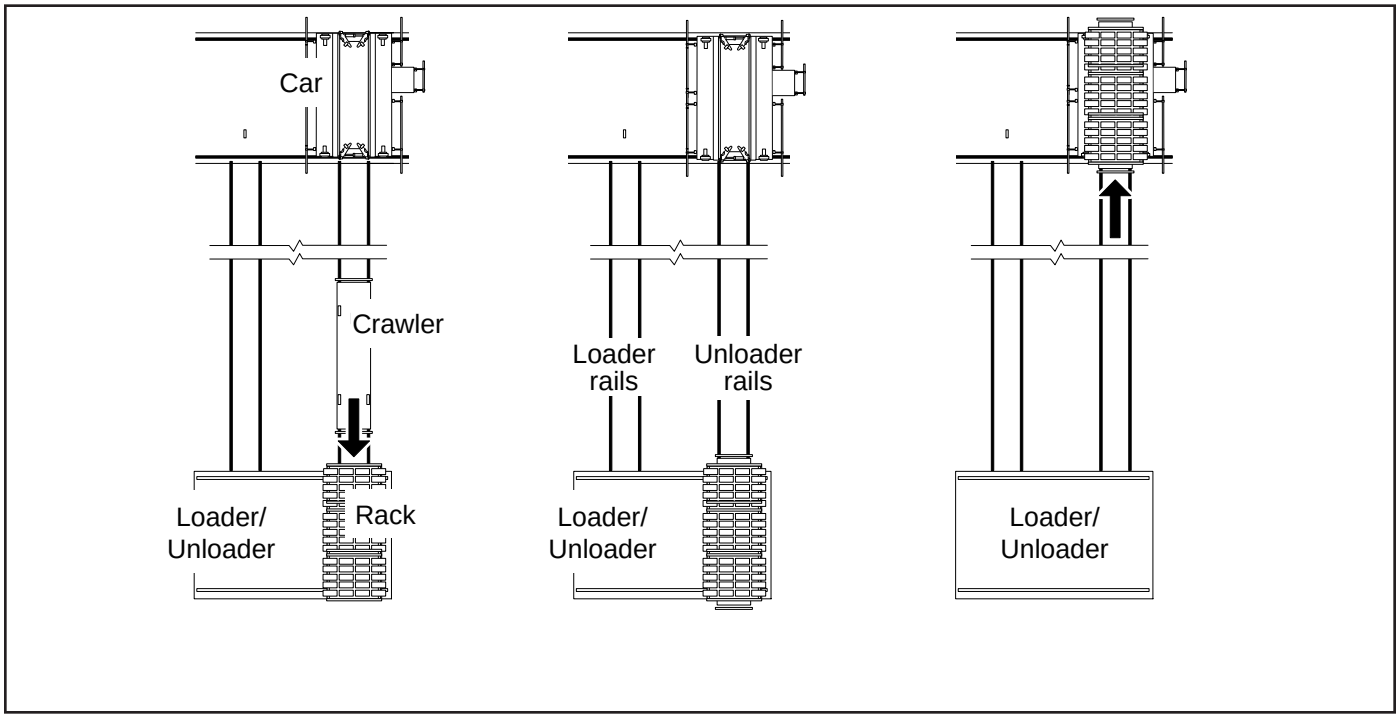

Figure 2.1 *Retrieving a Green Rack*

2.2 TRANSPORT GREEN RACK (KILN)

Figure 2.2 shows the sequence for placing a rack of green product in the kiln for curing.

1. The car moves along the car rails at a fast speed. The car slows when the selected kiln actuator triggers the first downward-sensing PRS and stops when the same actuator triggers the center downward-sensing PRS.
2. The raillocks extend.
3. The loaded crawler moves off the car onto the kiln rails at slow speed.
4. The crawler stops when the upward-sensing PRS pair come under the edge of the first rack. If there is no rack inside the kiln, an end-of-kiln safety stop simulates the presence of a rack and causes the crawler to stop.
5. The crawler lowers the green rack onto curbs that are elevated above the kiln rails.
6. The empty crawler starts in reverse direction at fast speed. The crawler slows when sensors are triggered by the car raillock actuators and stops when the crawler centers on the car.
7. The raillocks retract.

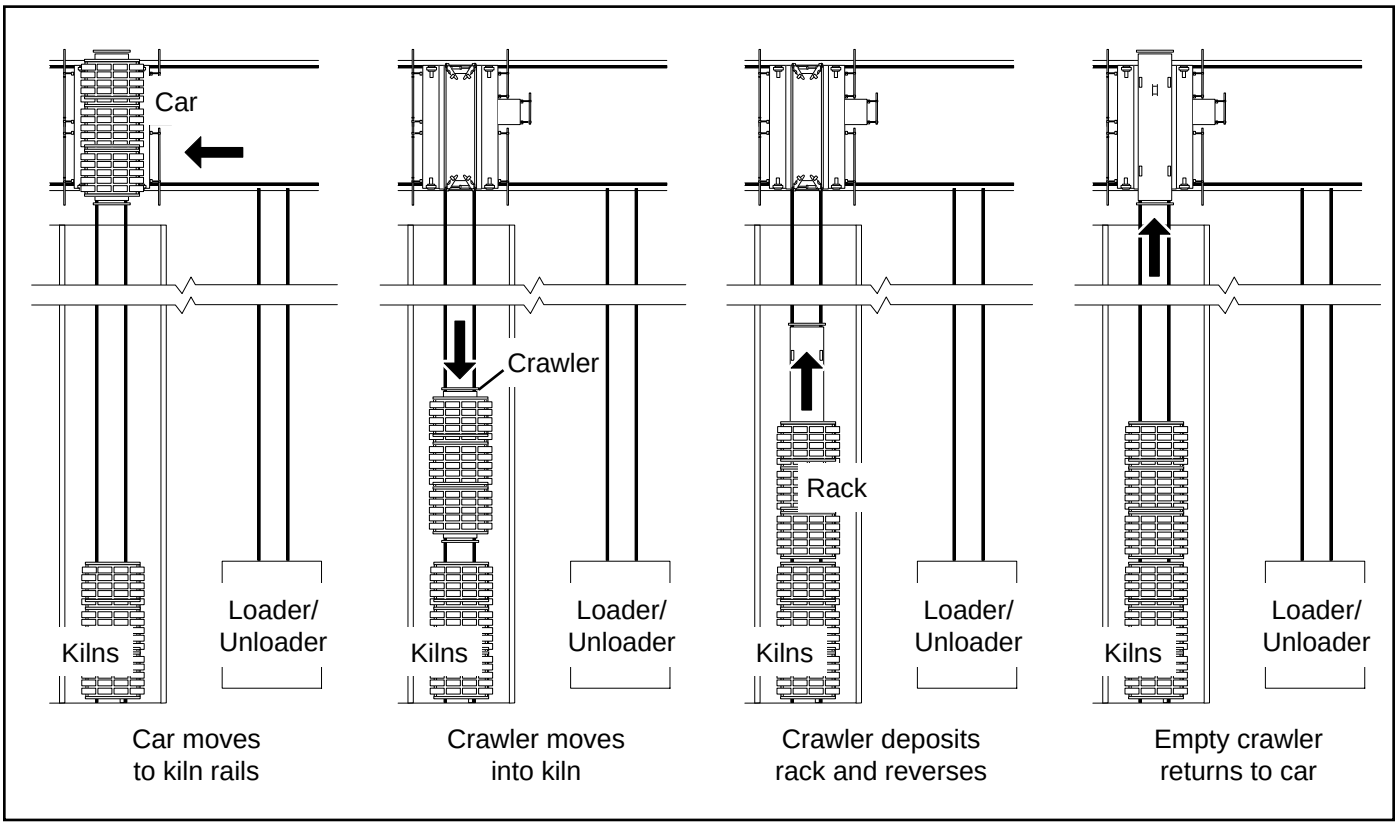

Figure 2.2 *Transporting a Green Rack*

2.3 RETRIEVE CURED RACK (STORAGE)

Figure 2.3 shows the sequence in retrieving a cured rack from a kiln.

1. The car moves along the car rails at fast speed. The car slows when the selected kiln actuator triggers the first downward-sensing PRS and stops when the same actuator triggers the center downward-sensing PRS.
2. The raillocks extend.
3. The empty crawler moves off the car onto the kiln rails at fast speed.
4. The crawler slows when the rack triggers the leading PRS pair on top of the crawler and stops when the rack triggers the trailing PRS pair.
5. The crawler elevator lifts the cured rack up from the kiln curbs.
6. The loaded crawler starts in reverse direction at fast speed. The crawler slows when sensors are triggered by the car raillock actuators and stops when the crawler centers on the car.
7. The raillocks retract.

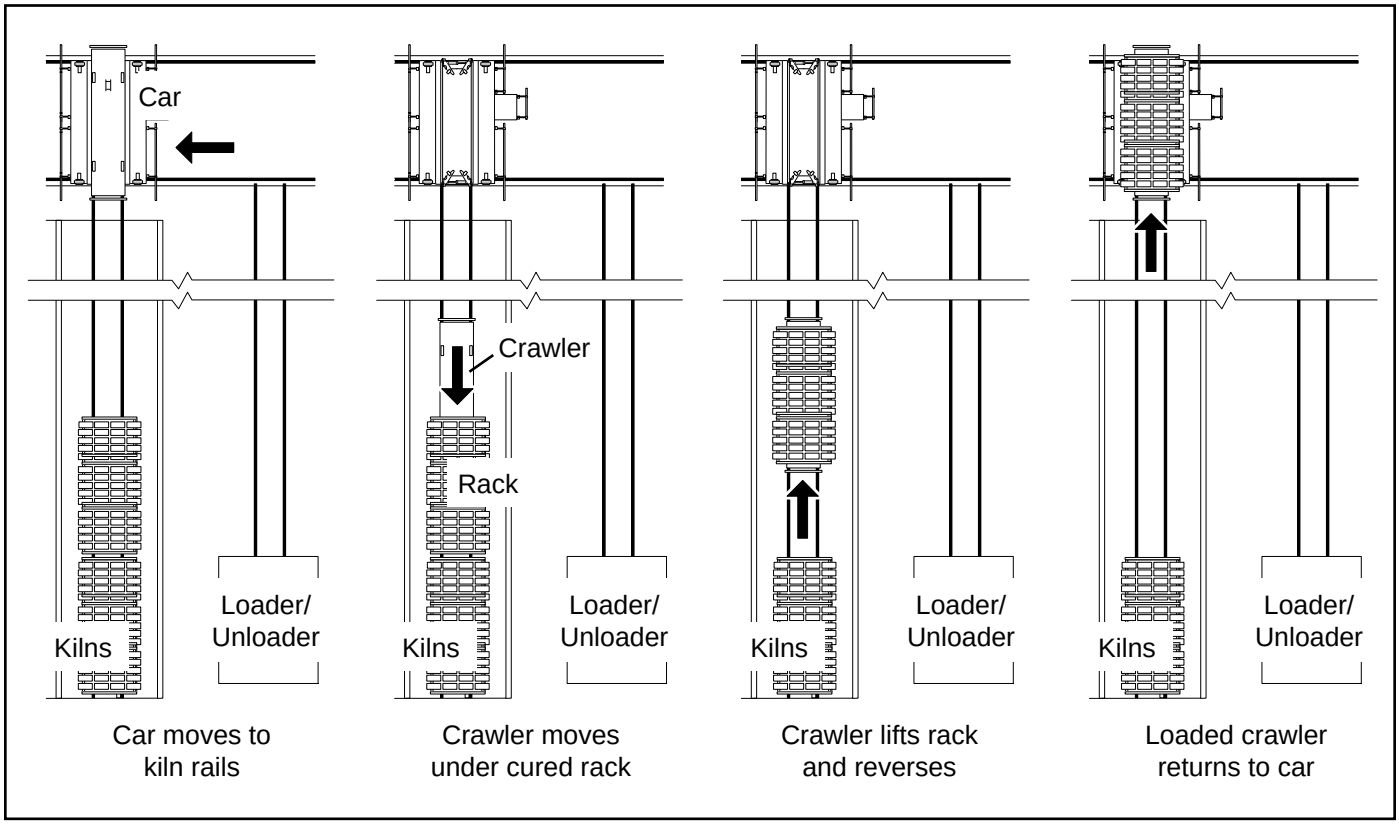

Figure 2.3 *Retrieving a Cured Rack*

2.4 TRANSPORT CURED RACK (UNLOADER)

Figure 2.4 shows the sequence required to transport a cured rack to the unloader.

1. The loaded car and crawler move at a fast speed along the car rails, slowing when the unloader actuator triggers the first PRS and stopping when the actuator triggers the center PRS.
2. The raillocks extend.
3. The Unloader's emitter 100 sends a signal to PER-17 on the crawler that the Loader/Unloader is ready to receive the cured rack.
4. The crawler moves off the car at fast speed. The crawler slows when the first floor actuator triggers the leading PRS pair and stops when the second floor actuator triggers the leading PRS pair.
5. The crawler elevator lowers the rack onto the rack conveyor.
6. The empty crawler moves back onto the car at fast speed. The crawler slows when sensors are triggered by the car raillock actuators and stops when the crawler centers on the car.
7. The raillocks retract.
8. Car proceeds to loader for another cycle.

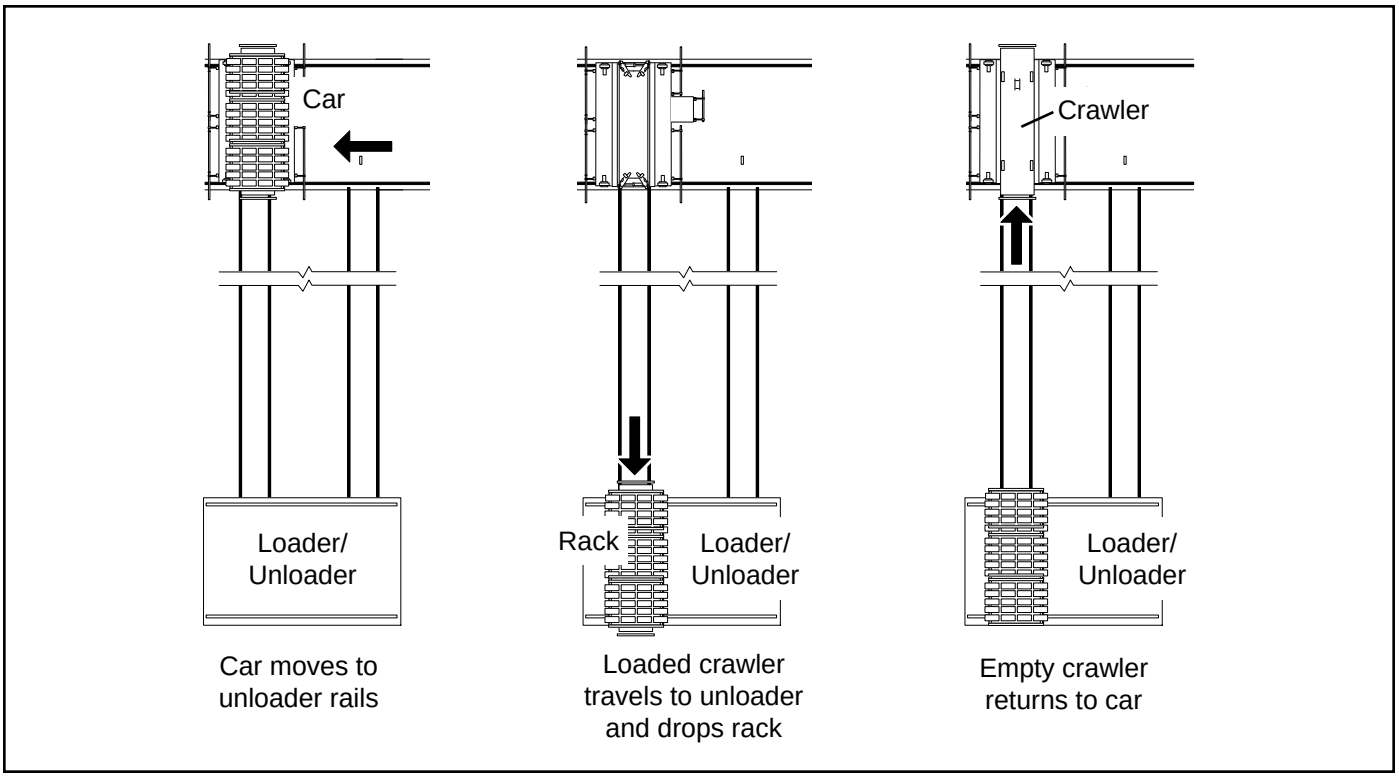

Figure 2.4 *Transporting a Cured Rack*

SECTION 3
CAR CONTROL SYSTEMS

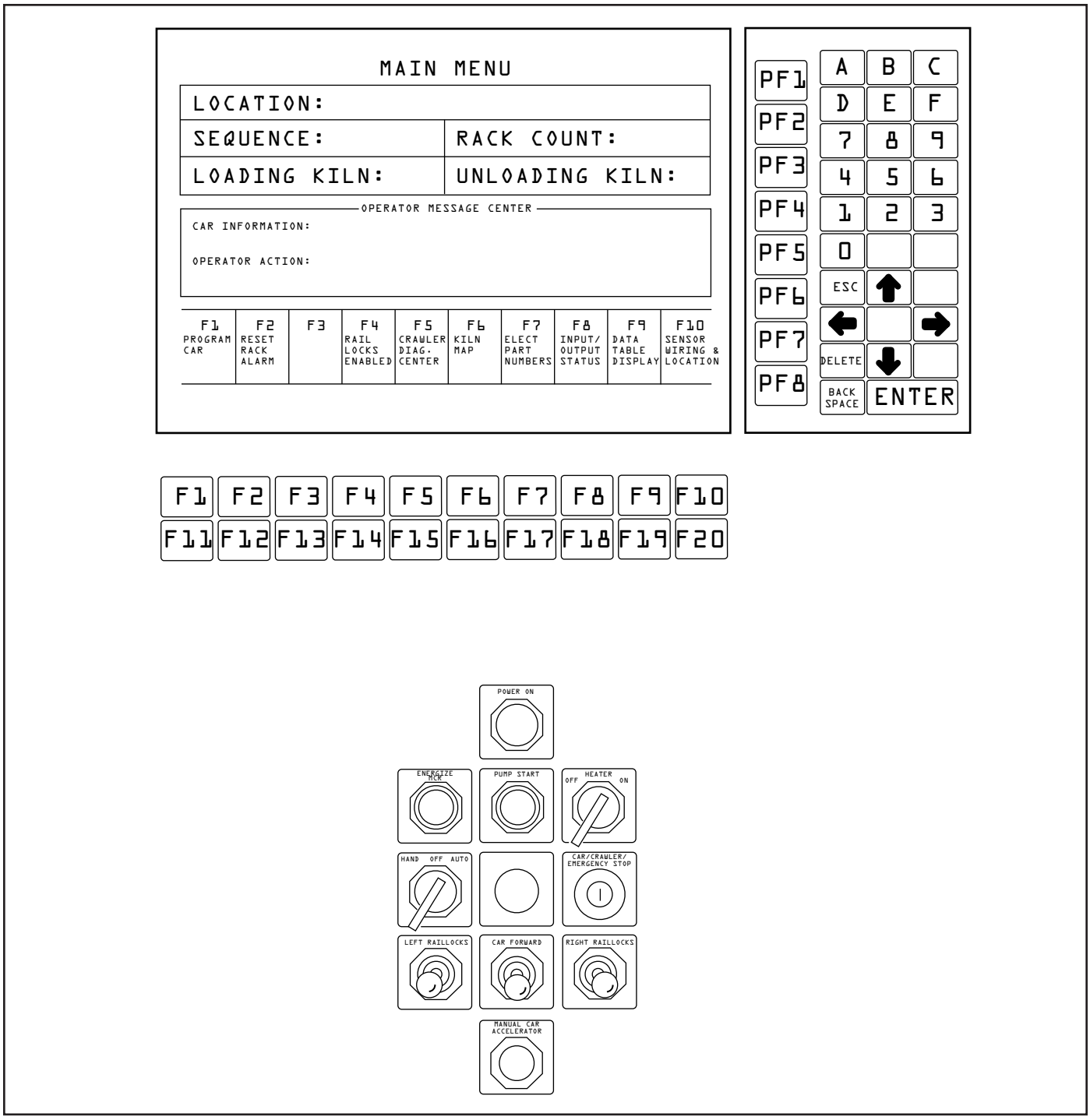

Figure 3.1 *Car Control Panel*

Figure 3.1 on the preceding page shows the complete car control panel with the graphic control screen on top and the manual controls below. This section discusses the man/machine interface of the LSC-100 car control systems.

3.1 CAR MANUAL CONTROLS

Figure 3.2 shows the hand operated section with the function of all manual controls.

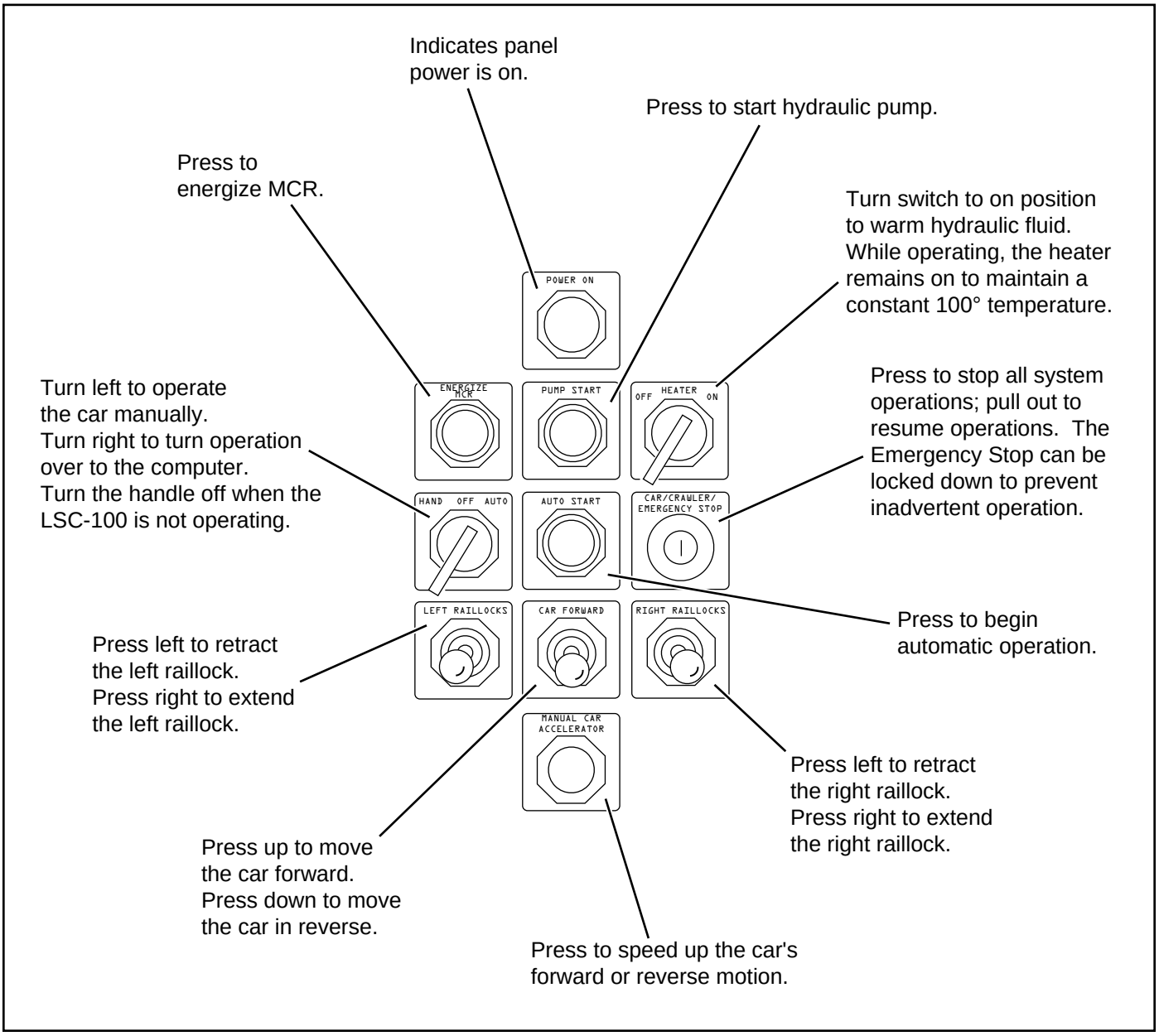

Figure 3.2 *Car Manual Control Panel*

3.2 CAR GRAPHIC CONTROLS SCREEN

A Small Logic Controller (SLC) located on the car control panel runs the LSC-100. Figure 3.3 calls out each of the elements in the graphic control station.

All computer functions are accessible from the Main Menu screen or one of its subscreens. This section contains an illustration and function table for each screen used in operation:

- 3.2.1 Main Menu Screen
- 3.2.2 Car Program Screen
- 3.2.3 Crawler Fault Diagnostic Screen
- 3.2.4 Rack Shuttle Program Screen
- 3.2.5 Kiln Sequence Table Screen
- 3.2.6 Kiln Map Screen
- 3.2.7 Electrical Part Numbers Screen
- 3.2.8 Transfer Car Switch Locations Screen
- 3.2.9 Input/Output Status Screen

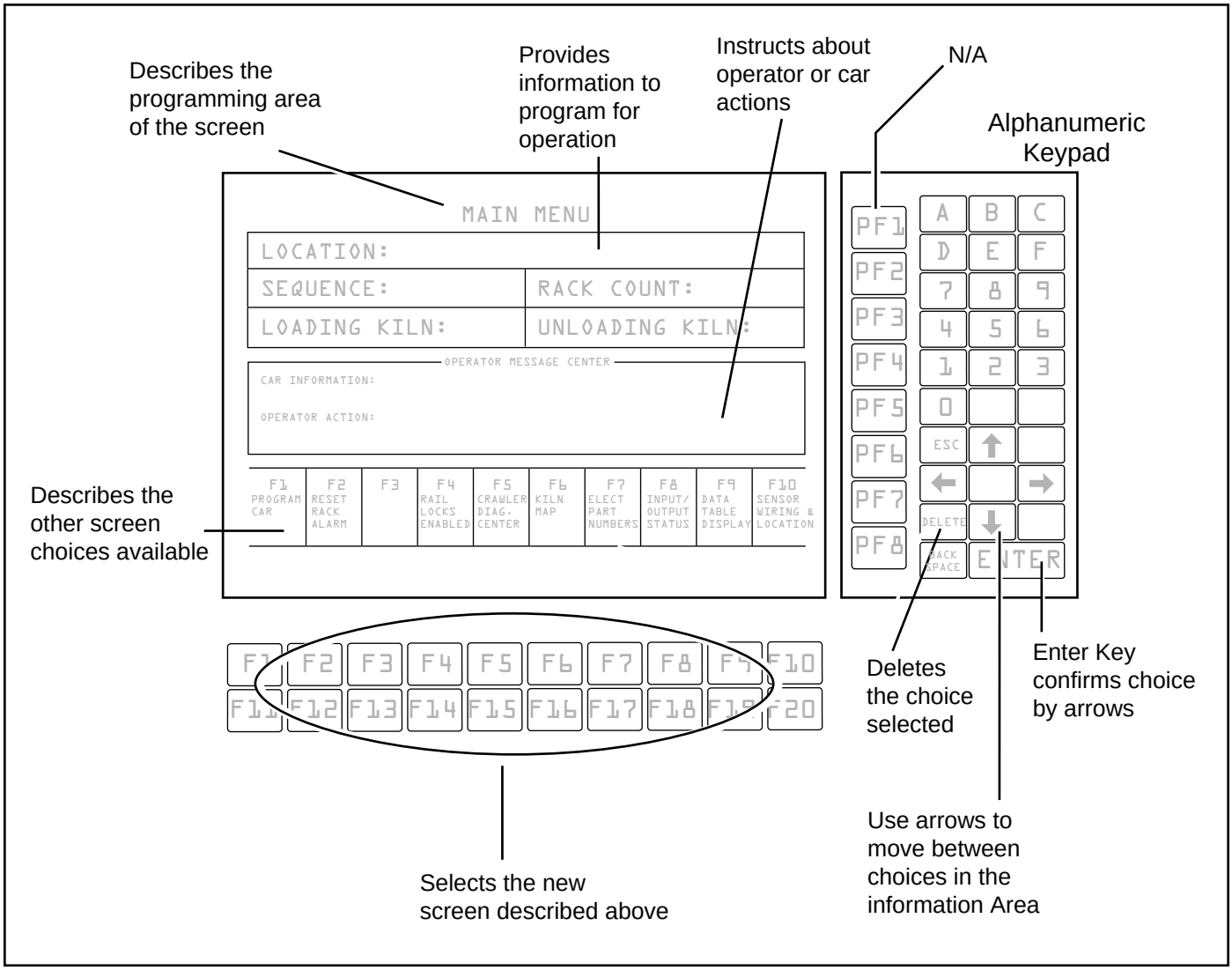

Figure 3.3 *Car Graphic Control Panel*

3.2.1 Main Menu Screen

The Main Menu Screen gives an overview of programming options. The screen provides information about the car, such as its location, but this screen cannot program the car's action. If any of the information shown, such as Location, Sequence, Rack Count, Loading and Unloading Kiln, is incorrect, the Main Menu Screen allows the operator access to other screens to modify the choices or correct a problem. Press the function key and the corresponding screen will appear. Make changes on that screen and then return to the Main Menu when completed.

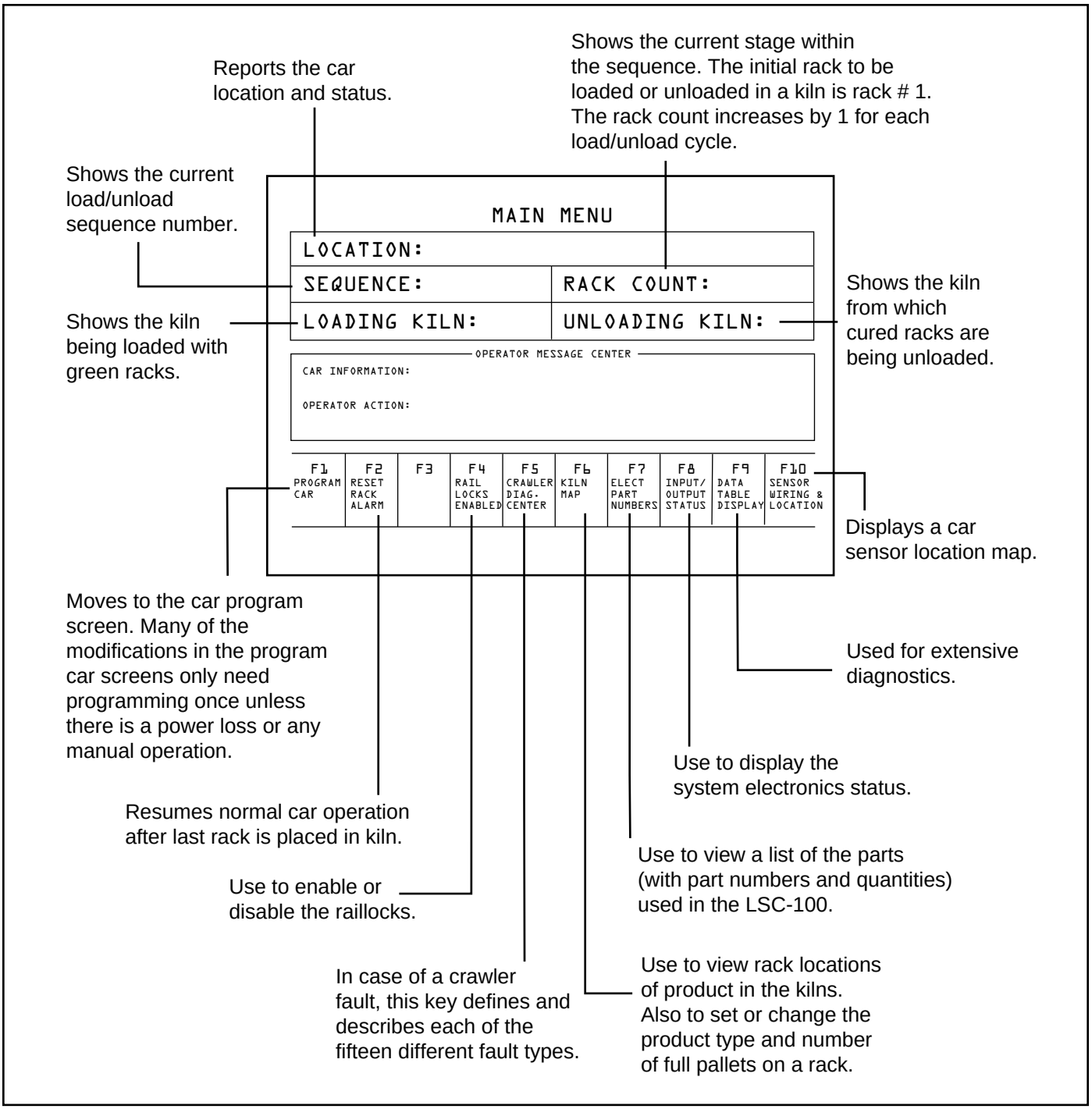

Figure 3.4 *Main Menu Screen*

3.2.2 Car Program Screen

The Car Program Screen programs and modifies the actions of the car. In the Operator Message Center, "CAR INFORMATION" tells the operator what the car is doing. If a problem occurs, “OPERATOR ACTION” will instruct the appropriate response needed. Press the corresponding function key to program. The cursor will start to flash and the choice may be altered by using the arrows and keys on the alphanumeric keyboard. After reaching the desired setting, press enter to register the change on all screens. If the operator needs more information prior to altering a selection, return to the Main Menu and select the corresponding screen.

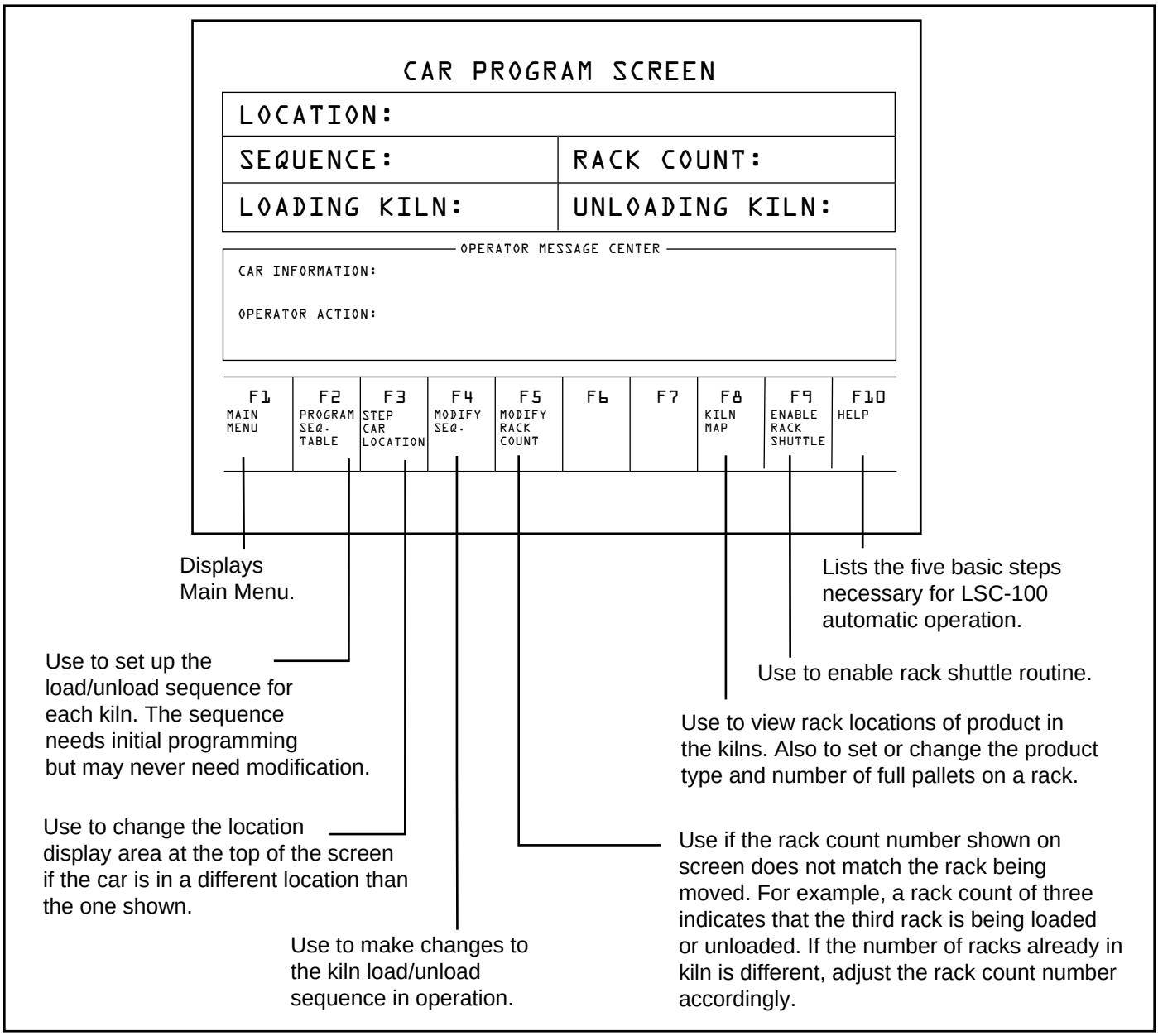

Figure 3.5 *Car Program Screen*

3.2.3 Crawler Fault Diagnostic Screen

The Crawler Fault Diagnostic Screen identifies the problems indicated on the crawler by the combination of flashing lamps. The four lamps are numbered 1, 2, 3 and 4. Once the combination is identified, find the combination in the list and identify the correct fault number. Use the function key to change the crawler fault number indicated. The cursor will start to flash and the choice may be altered by using the keyboard. Press enter to view fault screen. Along with the fault number, each fault screen displays the name of the suspected device, the I/O number, and operator action.

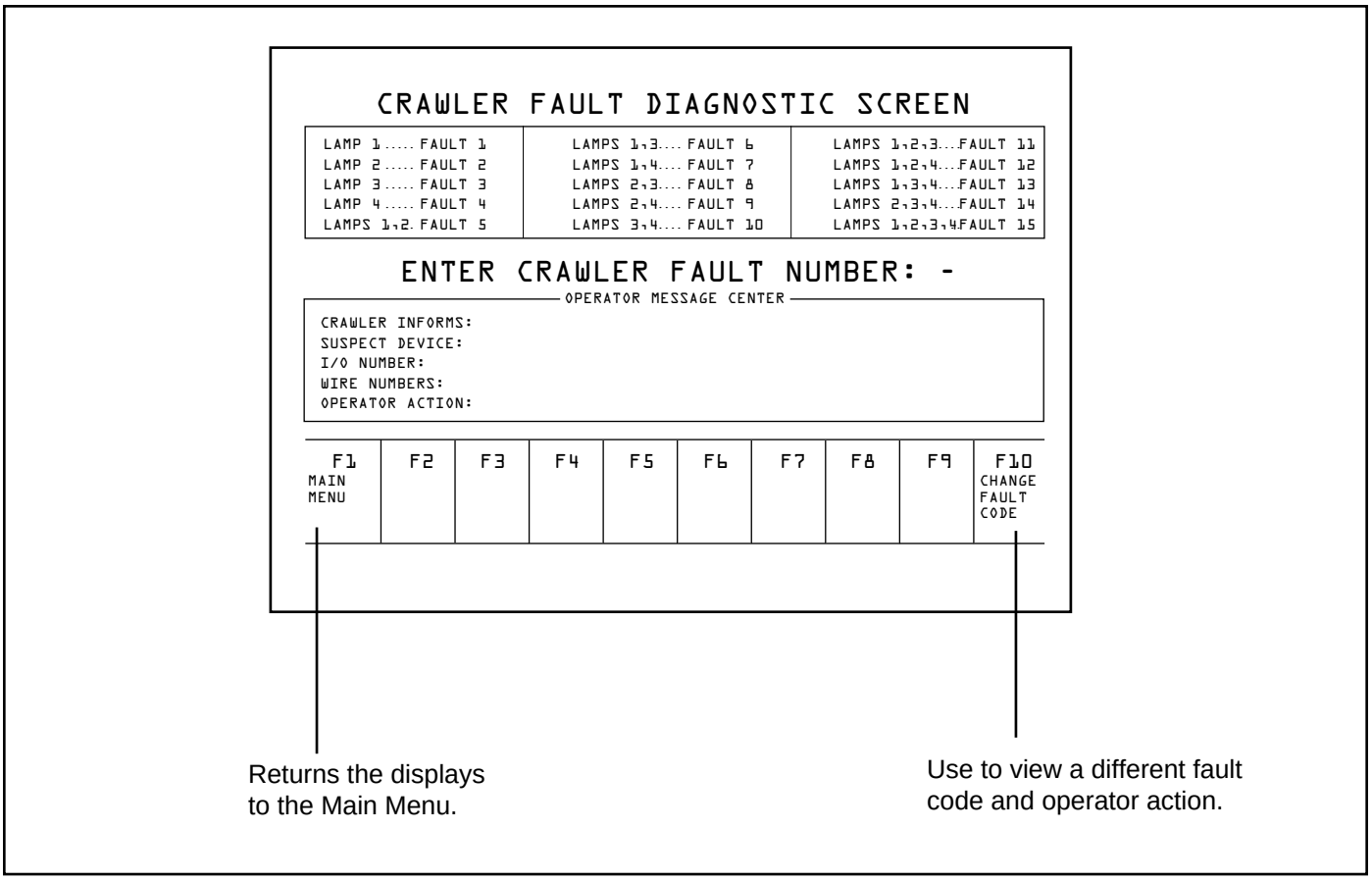

Figure 3.6 *Crawler Fault Diagnostic Screen*

CRAWLER FAULT DIAGNOSTIC

Fault	Lamps				Crawler Informs	Suspect Device	I / O No.	Wire No.	Operator Action
	1	2	3	4					
1	●				Oil level low fault	Float switch	I:1/14	2, 6	Add oil until correct level is obtained.
2		●			Kickbar is tripped	LS-1,LS-2	I:1/13	6, 5, 2	Check for mechanical binding or switch adjustment/failure.
3			●		Cable reel underspeed fault	PRS-14	I:1/3	2,12	Check for mechanical binding or switch adjustment/failure.
4				●	Elevator position error	PRS-3A, PRS-3B	I:0/3, I:0/4	2, 24 or 2, 23	Check elevator position or switch adjustment/failure.
5	●	●			Crawler is not off car, can't elevate	PRS-4, PRS-5 PRS-6, PRS-7	I:0/9, I:0/10, I:0/11, I:1/0	2 & 35, 34, 33, 32	Check for kiln full of racks or switch adjustment/failure.
6	●		●		Raillock prox stuck on fault	PRS-4, PRS-5 PRS-6, PRS-7	I:0/0, I:0/10, I:0/11, I:1/0	2 & 35, 34, 33, 32	Check raillocks proxes for fault.
7	●			●	Only one raillock was detected	PRS-4, PRS-5 PRS-6, PRS-7	I:0/9, I:0/10, I:0/11, I:1/0	2 & 35, 34 33, 32	Check switch adjustment or switch failure.
8		●	●		Elevator up fault	PRS-3B, 11CB & elevator up solenoid	I:0/4, 0:2/0	2 & 23 or 57 & 7	Check for mechanical binding or switch adjustment/failure.
9		●		●	Elevator down fault	PRS-3A, 12CB & elevator down solenoid	I:0/3, 0:2/1	2 & 24 or 46 & 7	Check for mechanical binding or switch adjustment/failure.
10			●	●	Decel & stop look-down prox stuck on fault	PRS-4, PRS-5 PRS-6, PRS-7	I:0/9, I:0/10, I:0/11, I:1/0	2 & 27 28, 25, 26	Check each prox for switch failure.
11	●	●	●		Look up prox stuck on fault	PRS-15 thru PRS-23	Consult wiring diagram	Consult wiring diagram	Check each prox for switch failure.
12	●	●		●	Forward look up prox fault	PRS-20 thru PRS-23	I:1/8, I:1/9 I:1/10, I:1/11	2 & 42, 44 30, 31	Check each prox for proper operation.
13	●		●	●	Reverse look up prox fault	PRS-15, PRS-16 PRS-18, PRS-19	I:1/4, I:1/5, I:1/6, I:1/7	2 & 37, 39, 15, 17	Check each prox for proper operation.
14		●	●	●	Reserved for future diagnostics				
15	●	●	●	●	Reserved for future diagnostics				

Table 3.1 *Crawler Fault Diagnostics*

3.2.4 Rack Shuttle Program Screen

The Rack Shuttle Program Screen programs and modifies the movement of racks between kilns. In the Operator Message Center, the “CAR INFORMATION” tells the operator what the car is doing. If a problem occurs, “OPERATOR ACTION” will instruct the appropriate response needed. Press the corresponding function key to program. The cursor will start to flash and the choice may be altered by using the arrows and keys on the alphanumeric keyboard. After reaching the desired setting, press enter to register the change on all screens. If the operator needs more information prior to altering a selection, return to the Main Menu and select the corresponding screen.

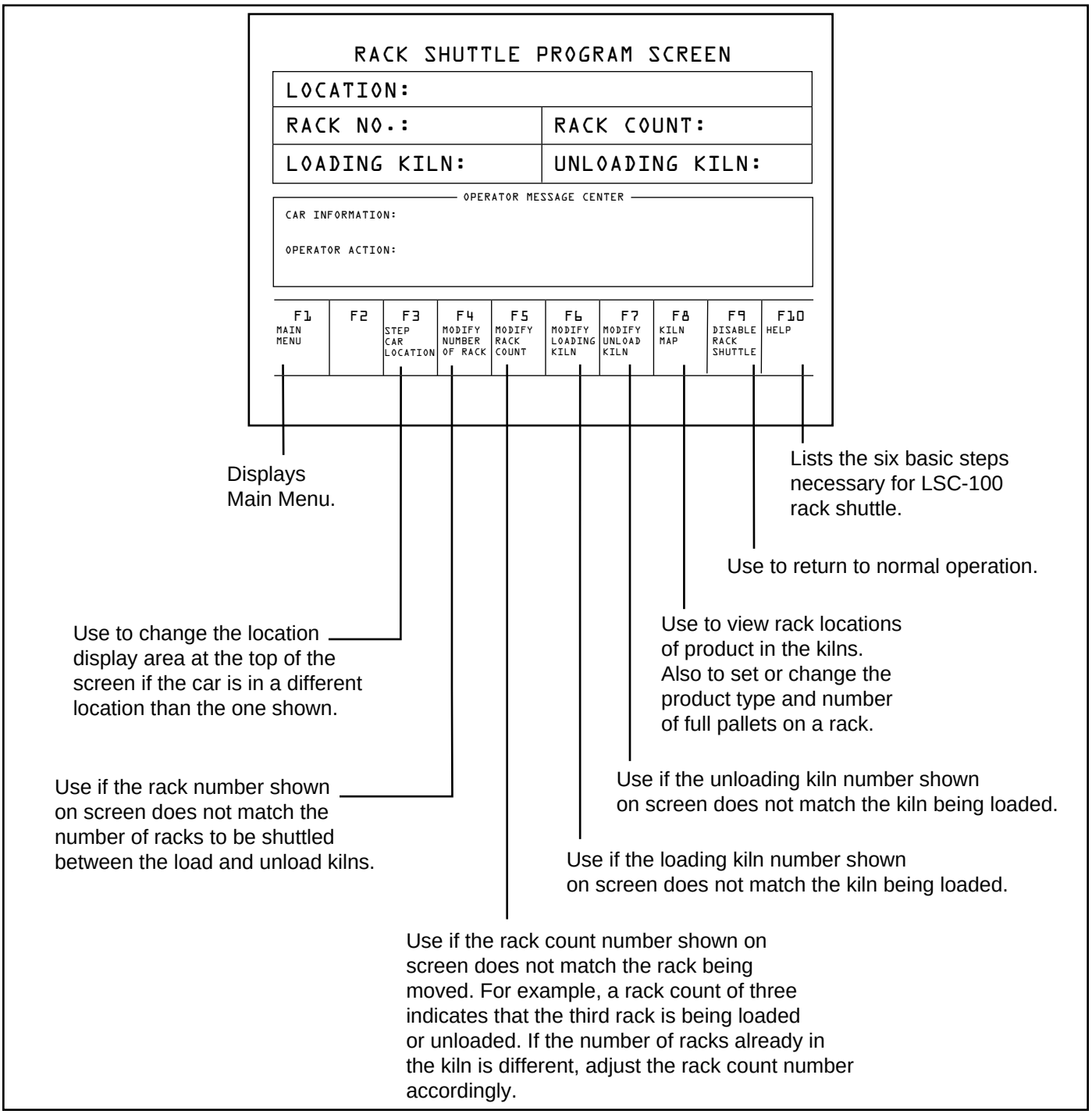

Figure 3.7 *Rack Shuttle Program Screen*

3.2.5 Kiln Sequence Table Screen

The Kiln Sequence Table programs the sequence of kiln loading and unloading. The operation cycles vary with the number of rack locations per kiln. The sequence of loading and unloading may be altered to fill or unload a certain kiln, but the Sequence Number column does not change.

When programming the sequence, keep the following in mind:

- The sequence always begins with the loading of the empty kiln.
- To repeat the sequence from the top, enter zeros in the sequence number row at the end of the sequence.
- The load kiln number for any sequence should be the same as the unload kiln number of the previous sequence number.

Press the function key to modify the sequence. The cursor becomes a flashing red box in the upper left corner when the modification mode is active. Modify the number in the flashing box or use the arrow keys to move the box to another row or column for modification. Press enter when complete. The new sequence will register on <u>all</u> screens.

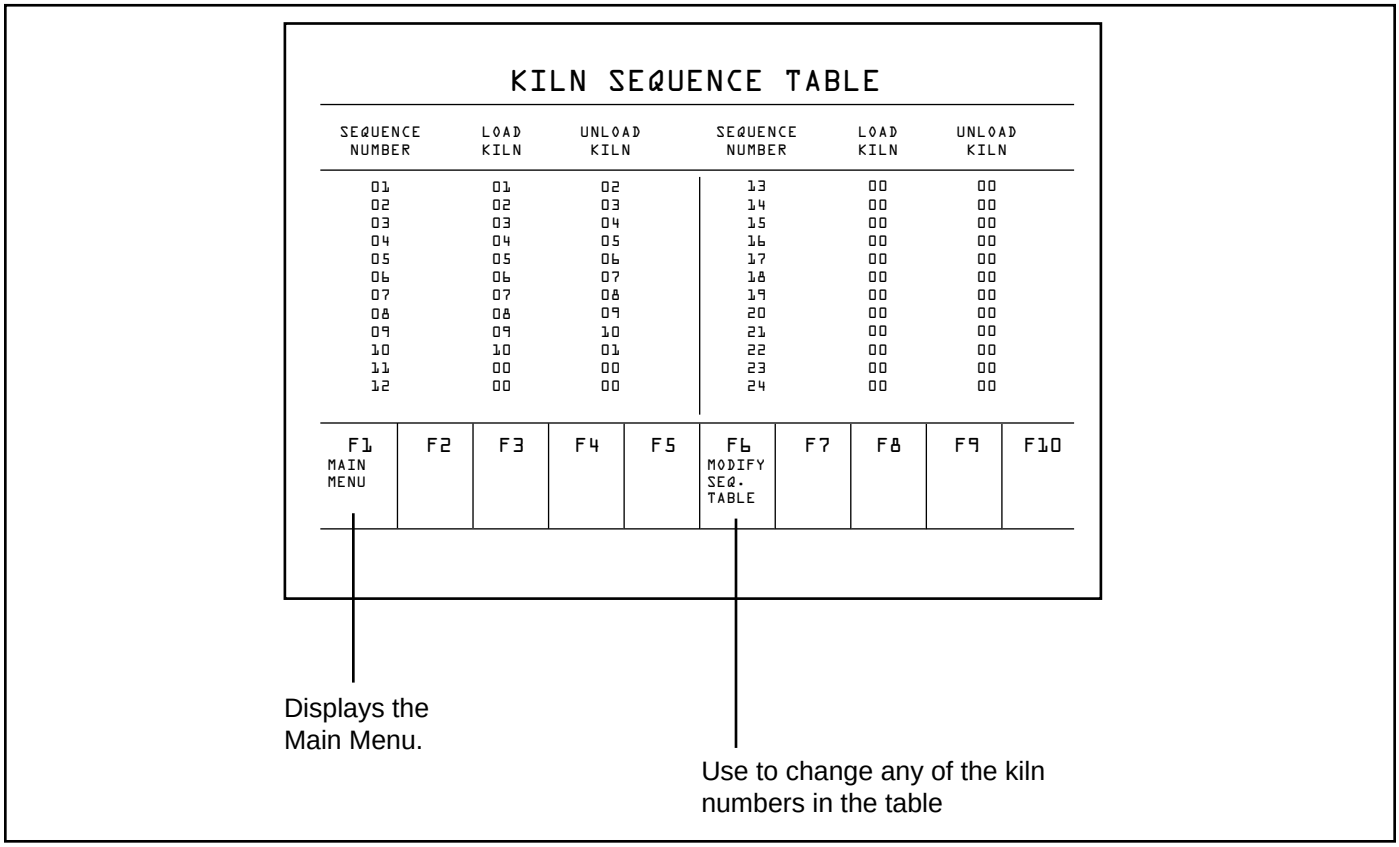

Figure 3.8 *Kiln Sequence Table Screen*

3.2.6 Kiln Map Screen

The Kiln Map Screen is a grid where each column represents a rack location (kiln depth) and each row represents a kiln number (Kiln). For each rack location used in operation, the operator assigns or edits the product number code and the number of pallets of that product that fit on each rack. Press the function key to modify the sequence. The cursor becomes a flashing red box in the upper left corner when the modification mode is active. Modify the number in the flashing box or use the arrow keys to move the box to another row or column for modification. Press enter when complete. Racks may be added or deleted using the function keys. As well, the product numbers and pallets can be modified.

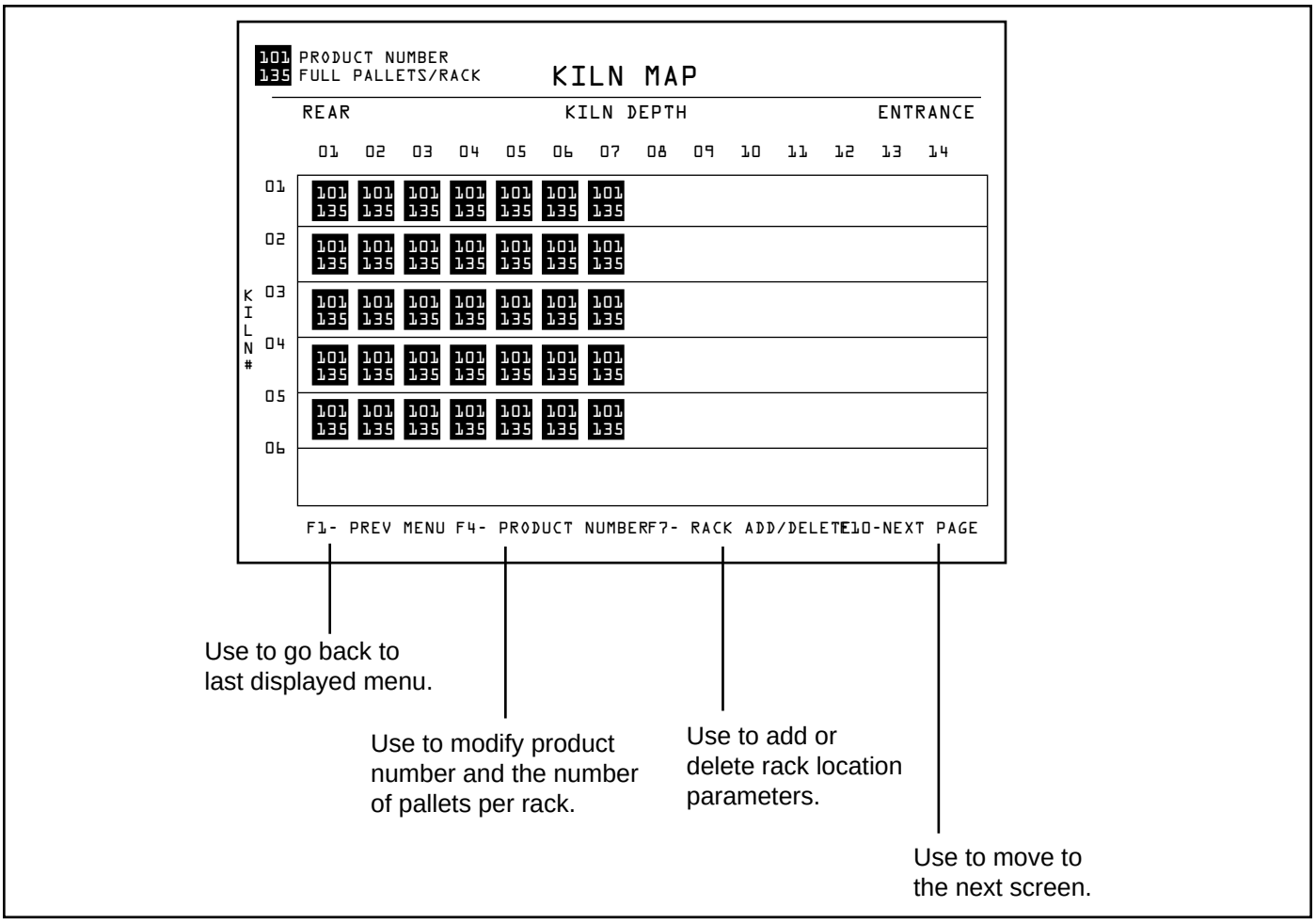

Figure 3.9 *Kiln Map Screen*

3.2.7 Electrical Part Numbers Screen

The Electrical Part Numbers for replacement are listed here to simplify ordering.

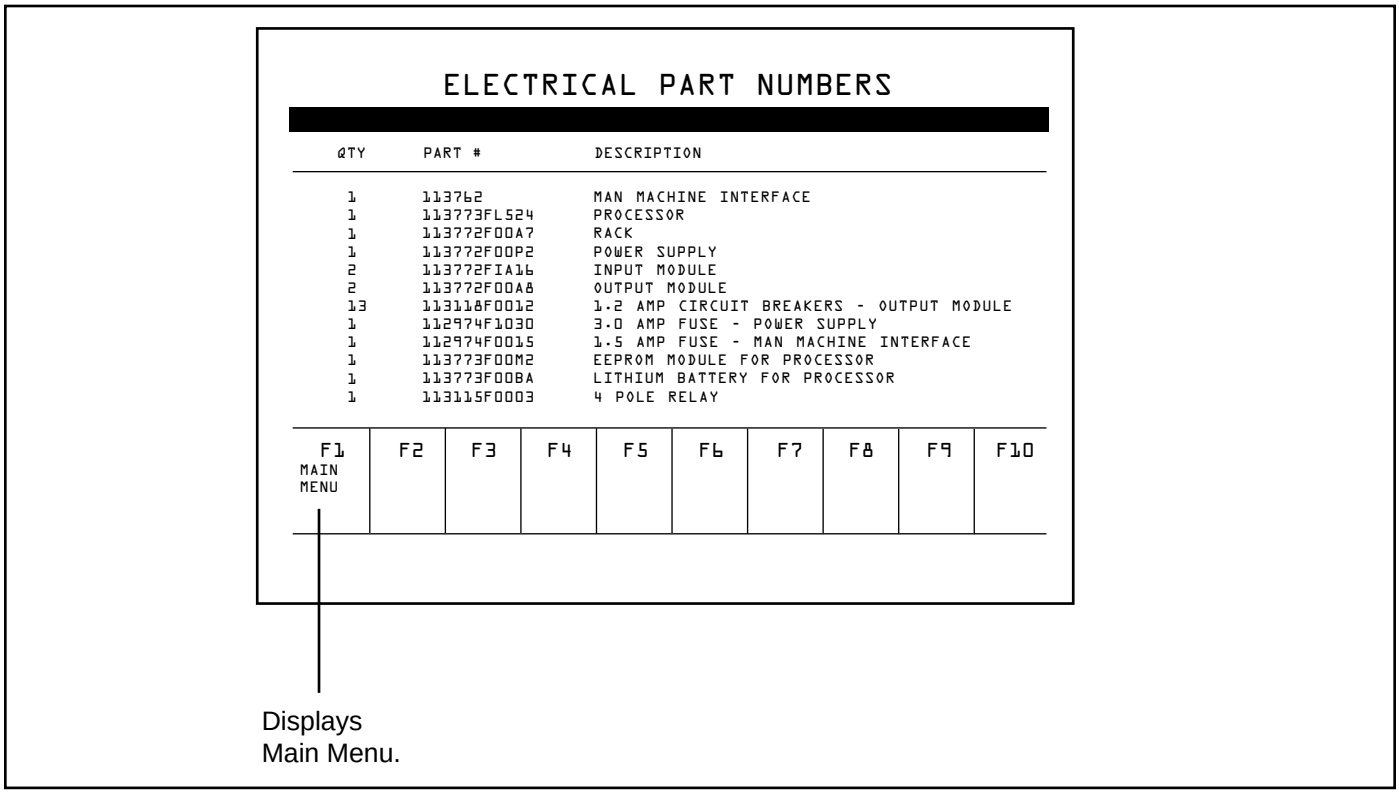

Figure 3.10 *Electrical Part Numbers Screen*

3.2.8 Transfer Car Switch Locations Screen

The Transfer Car Switch Locations Screen shows switch problems. When a switch faults, this switch flashes on this screen.

The Operator Message Center displays information about the faults along with the appropriate action required by the operator.

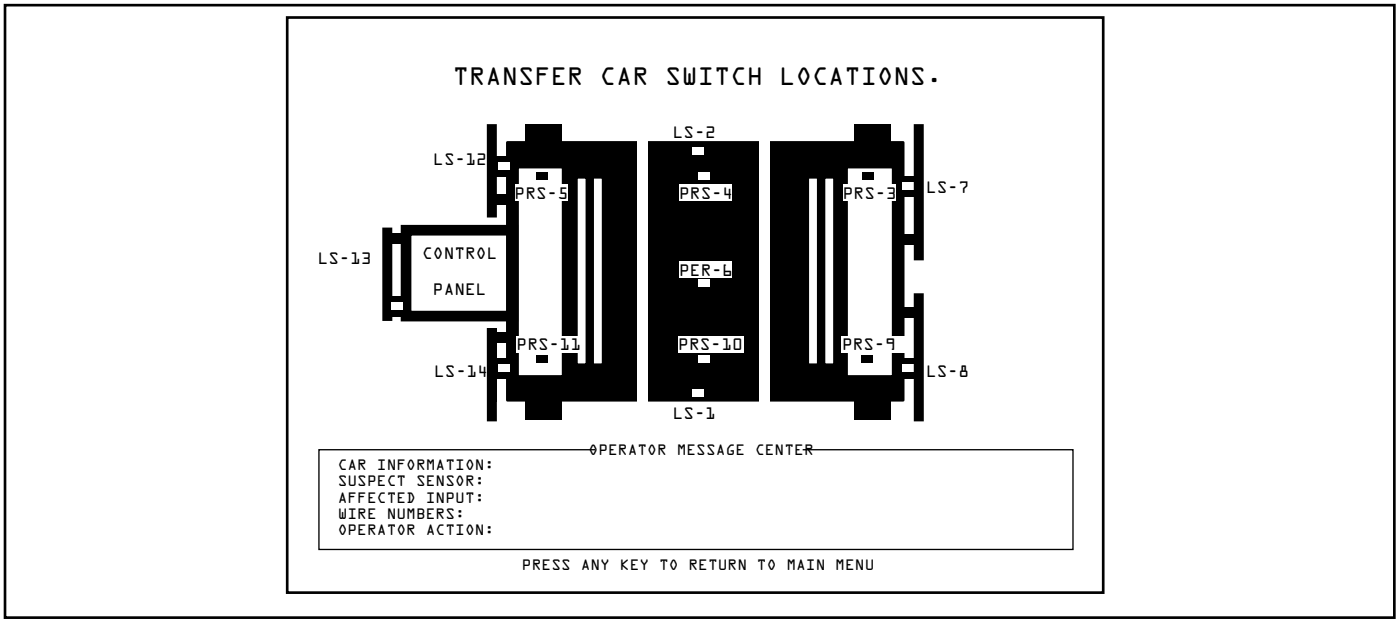

Figure 3.11 *Transfer Car Switch Locations Screen*

TRANSFER CAR FAULT DIAGNOSTIC

Fault	Car Information	Suspect Sensor	Affected Input	Wire No.	Operator Action
1	LS-7 on the kickbar is not tripped.	LS-7	I:2/3	11, 13	Check for mechanical binding or switch adjustment/failure.
2	LS-8 on the kickbar is not tripped.	LS-8	I:2/4	11, 12	Check for mechanical binding or switch adjustment/failure.
3	LS-12, LS-13 or LS-14 on the reverse kickbars is not tripped.	LS-12, LS-13 or LS-14	I:2/5	12, 24, 25 26 and 61	Check for mechanical binding or switch adjustment/failure.
4	The car is not centered on the actuator in front of station.	PRS-4	I:1/5	2, 41	Place car on actuator or check PRS-4 adjustment/failure.
5	The car is not centered on the actuator in front of station.	PRS-10	I:1/9	2, 38	Place car on actuator or check PRS-10 adjustment/failure.
6	The left raillock must be retracted before car movement.	LS-2	I:1/3	2, 34, 35	Check for mechanical binding or switch adjustment/failure.
7	The right raillock must be retracted before car movement.	LS-1	I:1/2	2, 33, 35	Check for mechanical binding or switch adjustment/failure.

Table 3.2 *Transfer Car Fault Diagnostics*

TRANSFER CAR FAULT DIAGNOSTIC

Fault	Car Information	Suspect Sensor	Affected Input	Wire No.	Operator Action
8	PRS-5 missed a count.	PRS-5	I:1/6	2, 40	Check PRS-5: adjustment, wiring or failure.
9	PRS-4 missed a count.	PRS-4	I:1/5	2, 41	Check PRS-4: adjustment, wiring or failure.
10	PRS-3 missed a count.	PRS-3	I:1/4	2, 42	Check PRS-3: adjustment, wiring or failure.
11	PRS-11 missed a count.	PRS-11	I:1/10	2, 37	Check PRS-11: adjustment, wiring or failure.
12	PRS-10 missed a count.	PRS-10	I:1/9	2, 38	Check PRS-10: adjustment, wiring or failure.
13	PRS-9 missed a count.	PRS-9	I:1/8	2, 39	Check PRS-9: adjustment, wiring or failure.
14	Crawler is not on home switch.	PER-6	I:1/7	2, 36	Check PER-6: adjustment, wiring or failure.
15	The car is not on the actuator in front of station.	PRS-4 and PRS-10	I:1/5, I:1/9	2, 41 or 2, 38	Adjust car speed or check PRS-4 and PRS-10 adjustment/failure.
16	The crawler has left the car and has not returned.	PER-6	I:1/7	2, 36	Check PER-6 adjustment, wiring and sensor failure.
17	Right raillock extend fault.	LS-1	I:1/2	2, 33	Check LS-1, 14CB tripped or right raillock extend solenoid.
18	Right raillock retract fault.	LS-1	I:1/2	2, 33	Check LS-1, 13CB tripped or right raillock retract solenoid.
19	Left raillock extend fault.	LS-2	I:1/3	2, 35	Check LS-2, 6CB tripped or left raillock extend solenoid.
20	Left raillock retract fault.	LS-2	I:1/3	2, 35	Check LS-2, 5CB tripped or left raillock retract solenoid.
21	The crawler has failed to leave the car.	PER-6	I:1/7	2, 36	Ensure crawler in auto, check raillock for binding, or PER-6

Table 3.2 *Transfer Car Fault Diagnostics*

3.2.9 Input/Output Status Screen

The Input/Output Status Screen shows the current status and provides a description of each signal.

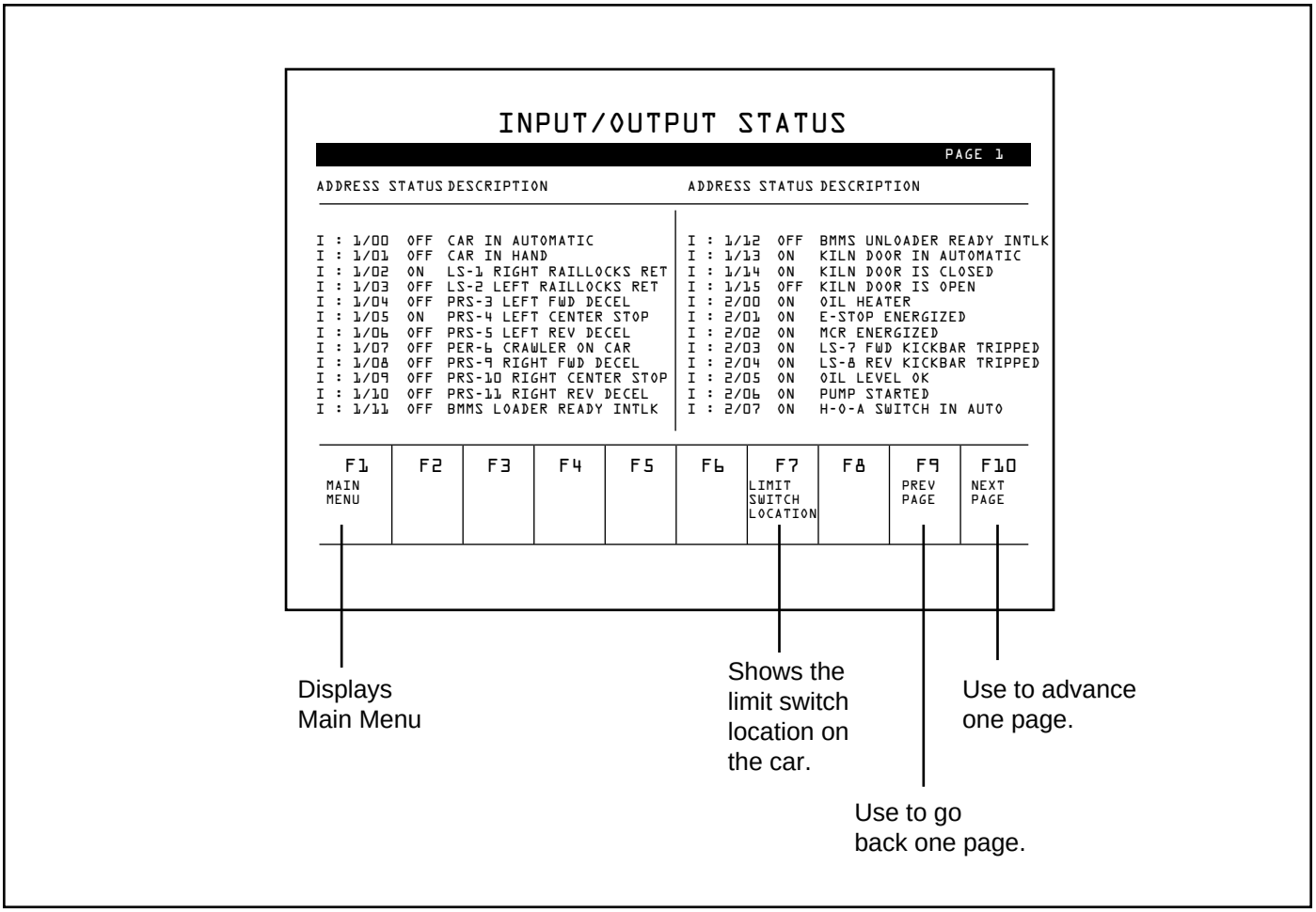

Figure 3.12 *Input/Output Status Screen*

3.3 SENSOR TYPES

LSC-100 sensors monitor, report and control all system operations. There are three types of sensors in the LSC-100 system: limit switches (LS), photo-emitting relays (PER) and proximity relay sensors (PRS).

- Limit switches (LS) are electromechanical devices that open and break a circuit based on mechanical actions. On the LSC-100, limit switches signal movement of the safety bars, raillocks and elevator operation.
- Photo-emitting relays (PER) contain two elements: the transmitter and the receiver. The PER signal is based on whether or not a receiver receives the emitted beam. PER-30 on the crawler emits a signal when the crawler is in place on the car. PER-6 on the car signals when the crawler is in position. Emitters installed at the entrance of the loader and unloader tracks signal the crawler to move on to the tracks for rack pick-up or drop-off.
- Proximity relay sensors (PRS) monitor a magnetic field and signal when the field encounters metal. The face of the PRS must be within 1/4 inch [6mm] of the metal for the sensor to activate. On the LSC-100, PRS triggers are floor-level actuators that guide car movement and the underside of racks that guide crawler movement.

Sensor function and location are covered further under the separate equipment items.

3.4 SAFETY BARS

Safety Bars protect plant personnel and equipment from any inadvertent or accidental contact with LSC-100 equipment. Safety bars are on the leading faces of both the car and crawler. When a safety bar meets any obstacle, a fail-safe limit switch (LS) signals the control system. Immediately:

- Car movement stops
- Hydraulic pump stops
- Horn signal blasts (crawler only)

There is one LS for each safety bar. There are five safety bars on the car and two safety bars on the crawler. Each LS provides independent safety signals to the LSC-100 control center.

3.5 CAR SENSORS

This section covers the function of the following car sensors:

- 3.5.1 Motion control sensors
- 3.5.2 Crawler location sensor
- 3.5.3 Raillock position
- 3.5.4 Kiln Door Interface

Figure 3.13 shows the location of all car sensors. Table 3.3 lists all car sensors along with the corresponding function and input/output terminals.

3.5.1 Motion Control Sensors

PRS-3, 4, 5, 9, 10 and 11 are “look down” sensors installed on car frame. If an LSC-100 installation has kilns on both sides of the car rail, all six sensors are installed and active as shown in Figure 3.13. If an installation has kilns on only one side of the car rails, sensors will be installed and active on that side only.

Floor-mounted actuators are positioned on the centerline of each set of crawler rails. A PRS triggers when it comes within 1/4 inch [6 mm] of an actuator. The leading sensor signals the car to change to slow speed. The center sensor signals the car to stop.

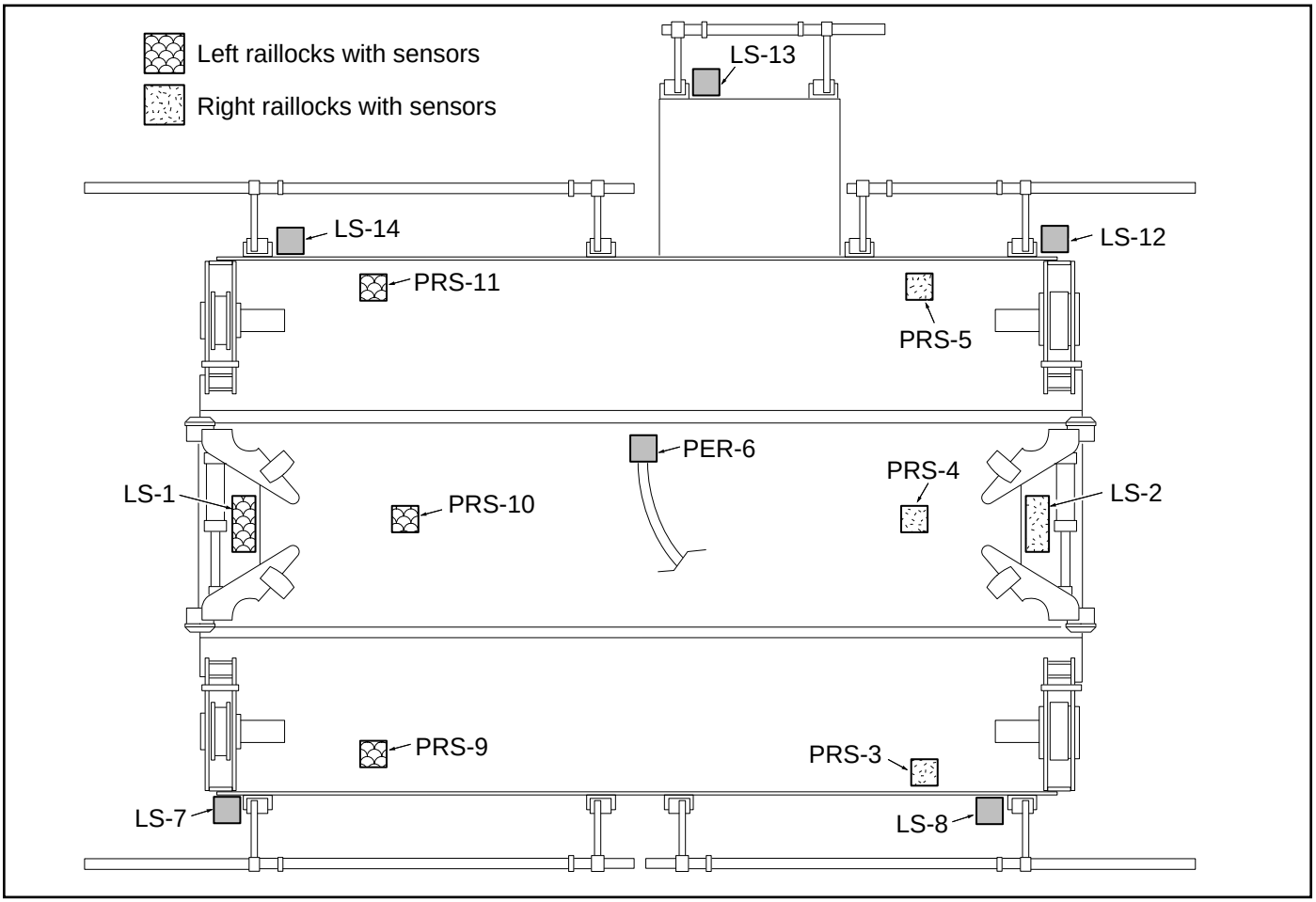

Figure 3.13 *Car Sensor Locations*

Car Sensors

Sensor	Function	Input/Output	
		Module	Terminal
Emitter 101	BMMS Loader Ready For Crawler/Car Travel	I-1	11
Emitter 100	BMMS Unloader Ready for Crawler/Car Travel		12
LS-1	Right Raillock Retracted *		2
LS-2	Left Raillock Retracted *		3
LS-7	Kickbar Tripped	I-2	3
LS-8			4
LS-12			15
LS-13			15
LS-14			15
PER-6	Crawler On Car	I-1	7
PRS-3	Left Forward Decelerate *		4
PRS-4	Car Stop On Center - Left *		5
PRS-5	Left Reverse Decelerate *		6
PRS-9	Right Forward Decelerate *		8
PRS-10	Car Stop On Center - Right *		9
PRS-11	Right Reverse Decelerate *		10

* If Used

Table 3.3 *Car Sensor Functions*

3.5.2 Crawler Location Sensor

PER-6 is a photo sensor that reports crawler status. The sensor receives a photo beam that is matched with an emitter installed on the underside of the crawler. When PER-6 receives a beam from the emitter, it signals that the crawler is in position. If there is no beam, the system reports that the crawler is not in position on the car. A broken or obscured emitter will cause PER-6 to report an incorrect status.

3.5.3 Raillock Position

LS-1 and LS-2 are limit switches that report the position of the raillocks. If raillocks are installed on only one side of the car, only one LS will be installed and active. Figure 3.14 shows raillock operation. When the car raillocks extend, the top-of-car rails match crawler rails and the crawler can move on and off the car. When the crawler is on the car, the raillocks are retracted.

The LS signals whether the raillocks are extended or retracted. The crawler can move on and off the car only when the raillocks are extended; car movement requires the raillocks to be retracted.

3.5.4 Kiln Door Interface

The center sensors PRS-4 and PRS-10 trigger the interface with the kiln door. When the center sensor on the car reaches the actuator closest to the kiln door, the car signals the door to open. When the door opens, the car receives a signal from the door. The car enters the kiln. When the car center sensor reaches the actuator at kiln 1, the car sends a signal to the kiln door to close.

When the car leaves the kiln for the unloader, the car stops at the actuator at kiln 1 and sends a signal to open the kiln door. After receiving the signal that the kiln door is open, the car proceeds out of the kiln area. When the center sensor of the car reaches the first actuator outside of the kiln, it sends a signal to the kiln door to close.

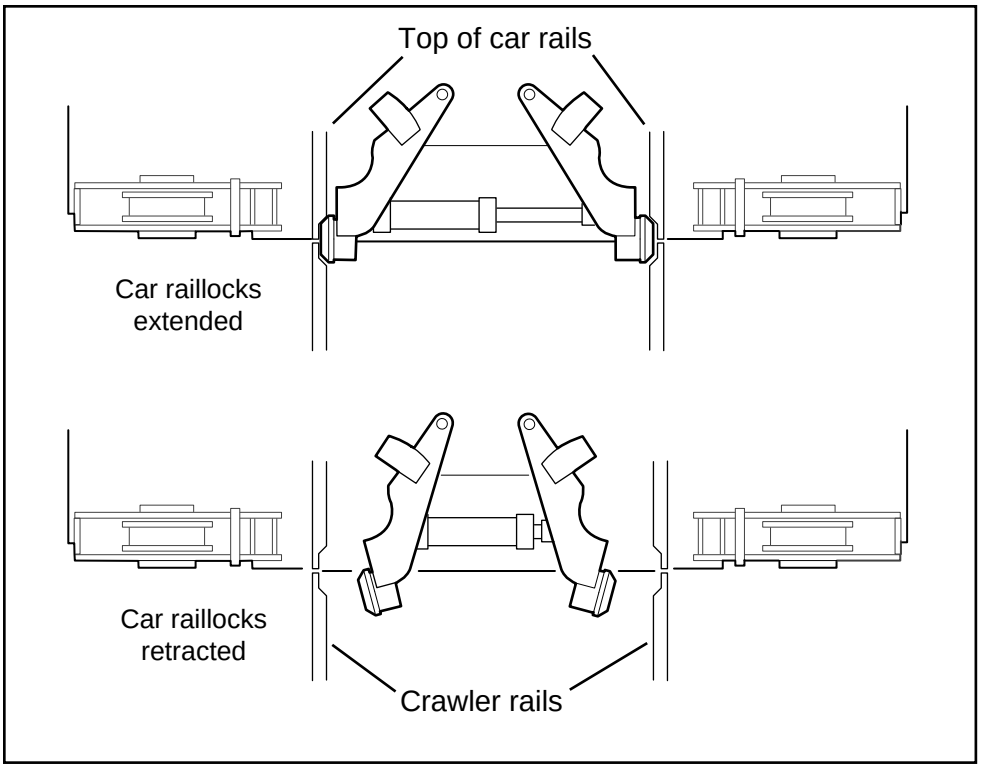

Figure 3.14 *Raillock Operation*

3.6 CAR INPUT/OUTPUT MODULES

Figure 3.15 shows the configuration of the SLC-500 Processor which is located inside the car control panel. Table 3.4 lists all car I/O signals identified by module, terminal and function. Table 3.3 also notes the related sensor for I/O signals that correspond to an installed sensor.

The input module contains sixteen identical solid-state input circuits to accept the on/off status of user devices such as push buttons, limit switches and photocells. Each input has a red status indicator visible from the front of the module which lights when the corresponding input is turned on by an external device. If the status indicator will not light when power is applied to the input, replace the input module.

The output module contains eight identical solid-state output circuits to control the on/off status of user devices such as indicator lights or solenoids. Each output has a red load side status indicator visible from the front of the module, which lights when the corresponding output is turned on by the PLC.

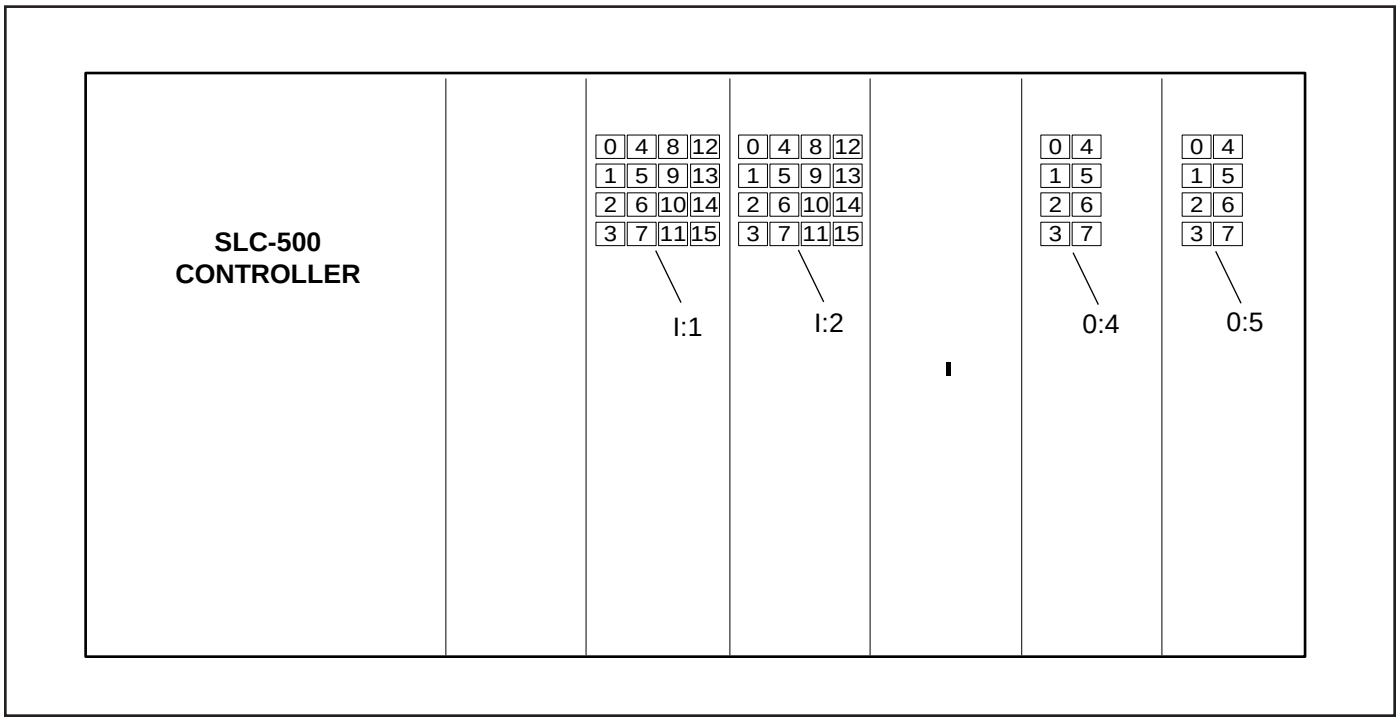

Figure 3.15 *Car SLC-500 Processor*

Car Input/Output Signals

Module	Terminal	Function	Sensor
I-1	0	Automatic	
	1	Manual	
	2	Right Raillock Retract *	LS-1
	3	Left Raillock Retract *	LS-2
	4	Left Forward Decelerate *	PRS-3
	5	Car Stop On Center - Left *	PRS-4
	6	Left Reverse Decelerate *	PRS-5
	7	Crawler On Car	PER-6
	8	Right Forward Decelerate *	PRS-9
	9	Car Stop On Center - Right *	PRS-10
	10	Right Reverse Decelerate *	PRS-11
	11	BMMS Loader Ready	
	12	BMMS Unloader Ready	
	13	Kiln Door in Automatic *	
	14	Kiln Door is Closed *	
	15	Kiln Door is Open *	
I-2	0	Heater On	
	1	Emergency Stop Energized	
	2	MCR Energized	
	3	Kickbar Tripped	LS-7
	4	Kickbar Tripped	LS-8
	5	Oil Level O.K.	
	6	Pump Started	
	7	Hand/Off/Auto In Automatic	
	8	Manual Left Raillock Extend	
	9	Manual Left Raillock Retract	
	10	Manual Right Raillock Extend	
	11	Manual Right Raillock Retract	
	12	Manual Car Forward	
	13	Manual Car Reverse	
	14	Pump Overload Tripped	
	15	Kickbar Tripped	LS-12, LS-13, LS-14
O-4	0	Unlock Left Raillock	
	1	Lock Left Raillock	
	2	Forward Slow	
	3	Forward Medium	
	4	Forward Fast	
	5	Reverse Slow	
	6	Reverse Medium	
	7	Reverse Fast	
O-5	0	Unlock Right Raillock	
	1	Lock Right Raillock	
	2	Alarm Horn	
	3	Car is Now in Front of BMMS *	
	4	Open Kiln Door *	
	5	Close Kiln Door *	
*If used	6		
	7		

Table 3.4 *Car Input/Output Signals*

SECTION 4
CRAWLER CONTROL SYSTEMS

4.1 CRAWLER CONTROL STATION

The crawler has two control panels that allow independent operation from either end. Both crawler control panels consist of a button center, but only the control panel on the oil tank end has an oil heater light and a speed control center. Figure 4.1 shows the crawler control panel with the function of all manual crawler controls.

This section covers the location and operation of LSC-100 control devices.

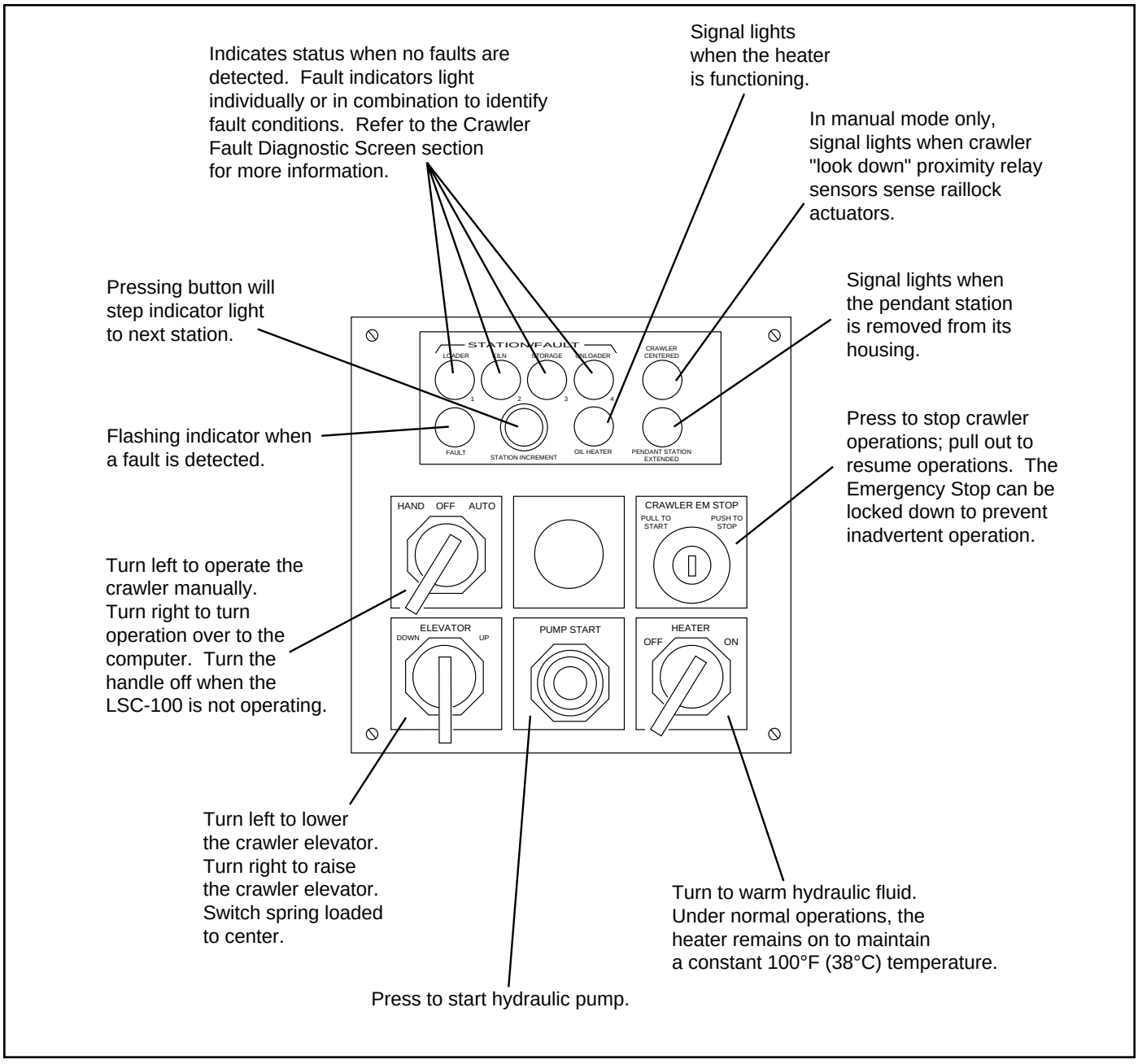

Figure 4.1 *Crawler Control Station*

4.2 SENSOR TYPES

LSC-100 sensors monitor, report and control all system operations. There are three types of sensors in the LSC-100 system: limit switches (LS), photo-emitting relays (PER), proximity relay sensors (PRS).

- Limit switches (LS) are electromechanical devices that open and break a circuit based on mechanical actions. On the LSC-100, limit switches signal movement of the safety bars, rail locks and elevator operation.
- Photo-emitting relays (PER) contain two elements: the transmitter and the receiver. The PER signal is based on whether or not a receiver receives the emitted beam. PER-30 on the crawler emits a signal when the crawler is in place on the car. PER-6 on the car signals when the crawler is in position. Emitters installed at the heads of the loader and unloader tracks signal the crawler to move on to the tracks for rack pick-up or drop-off.
- Proximity relay sensors (PRS) monitor a magnetic field and signal when the field encounters metal. The face of the PRS must be within 1/2 inch [13mm] of the metal for the sensor to activate. On the LSC-100, PRS triggers are floor-level actuators that guide car movement and the underside of racks that guide crawler movement.

Sensor function and location are covered further under the separate equipment items.

4.3 SAFETY BARS

Safety Bars protect plant personnel and equipment from any inadvertent or accidental contact with LSC-100 equipment. Safety bars are on the leading faces of both the car and crawler. When a safety bar meets any obstacle, a fail-safe limit switch (LS) signals the control system. Immediately:

- Car movement stops
- Hydraulic pump stops
- Horn signal blasts (crawler only)

There is one LS for each safety bar. There are five safety bars on the car and two safety bars on the crawler. Each LS provides independent safety signals to the LSC-100 control center.

4.4 CRAWLER SENSORS

This section covers location and operation of the following crawler sensors:

- 4.4.1 Raillock sensors
- 4.4.2 Motion control sensors
- 4.4.3 Crawler location sensor
- 4.4.4 Pendant control station sensors
- 4.4.5 Elevator position sensors
- 4.4.6 Cable reel sensors

Figure 4.2 shows the location and type of all crawler sensors. Table 4.1 lists all crawler sensors along with the corresponding function and input/output terminals.

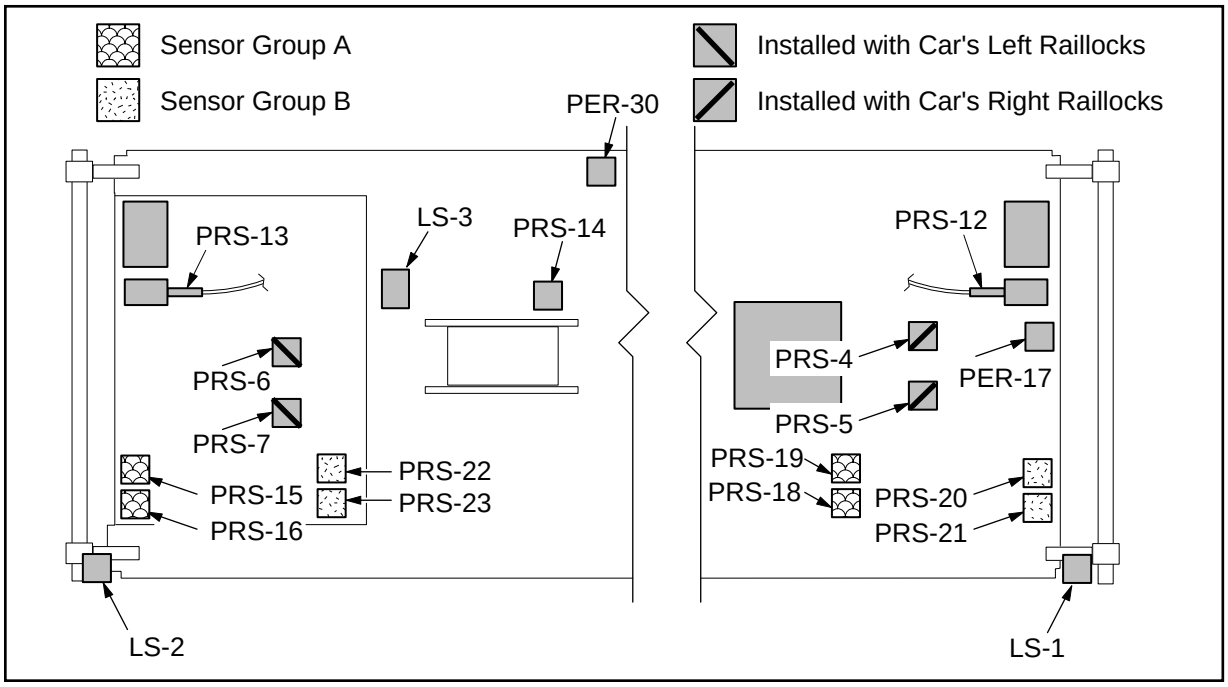

Figure 4.2 *Crawler Sensor Locations*

Crawler Sensors

Sensor	Function	Input/Output	
		Module	Terminal
LS-1	Kickbar Safety		
LS-2	Kickbar Safety		
LS-3A	Elevator Down	I-0	3
PER-17	Enter Loader Emitter 100 or Enter Unloader Emitter 101	I-1	12
LS-3B	Elevator Up	I-0	4
PRS-4	Left Front Look Down Sensor		9
PRS-5	Right Front Look Down Sensor		10
PRS-6	Left Rear Look Down Sensor		11
PRS-7	Right Rear Look Down Sensor	I-1	0
PRS-12	Pendant Control Station Retracted		
PRS-13	Pendant Control Station Retracted		
PRS-14	Reel Motion Detector	I-1	3
PRS-15*	(Used with Reverse Plant) Stops Crawler in Kiln and Decelerates Crawler in Storage	I-1	4
PRS-16*	Safety for PRS-15		5
PRS-18*	(Used with Reverse Plant) Stops Crawler in Storage		6
PRS-19*	Safety for PRS-18		7
PRS-20*	(Used with Forward Plant) Stops Crawler in Kiln and Decelerates Crawler in Storage		8
PRS-21*	Safety for PRS-20		9
PRS-22*	(Used with Forward Plant) Stops Crawler in Storage		10
PRS-23*	Safety for PRS-22		11
PER-30	Signals Crawler on Car	I-0	

*If Used

Table 4.1 *Crawler Sensor Functions*

4.4.1 Raillock Sensors

PRS-4, 5, 6 and 7 on the crawler monitor the car raillocks. Only two of these sensors will be installed and active for LSC-100 systems with kilns on one side of the car rails.

The two PRSs on each end of the crawler correspond with the raillocks on the car. The crawler can move on and off the car only when both sensors are triggered by the extended raillocks.

4.4.2 Motion Control Sensors

Eight PRSs on top of the crawler monitor crawler motion in relation to rack position. As shown in Figure 4.3, PRS-15, 16, 18, 19, 20, 21, 22 and 23 are paired and each one of the sensors has an independent signal. As an LSC-100 fail-safe safety feature, both PRSs in the pair must report an identical signal. A fault condition occurs if the signals from either sensor in a pair do not match.

The function of these eight sensors is controlled by system logic and depends both on crawler travel direction and whether or not the crawler is carrying a rack.

4.4.3 Crawler Location Sensor

PER-30 is a photo sensor that monitors the crawler's position on the car. When the crawler moves into correct position, PER-30 emits a signal to the car. When PER-30 is broken or obscured, the system will report an incorrect status.

4.4.4 Pendant Control Station Sensors

PRS-13 and PRS-12 signal when the pendant control is removed from the holder. In this state, LSC-100 stops automatic operation and the pendant control buttons become active. When a pendant is removed, the Pendant Station Extend signal light on the crawler control panel will be lighted.

4.4.5 Elevator Position Sensors

Two different sensors monitor elevator position. LS-3A reports when the elevator is down. LS-3B reports when the elevator is up.

4.4.6 Cable Reel Sensors

PRS-14 monitors cable reel motion.

4.5 LOADER/UNLOADER INTERFACE

Emitters 100 and 101 are floor-level sensors installed at the lead end of the Loader (100) and Unloader (101) tracks. These controls receive signals from the Loader/Unloader to regulate crawler movement based on the ready state of the Loader/Unloader.

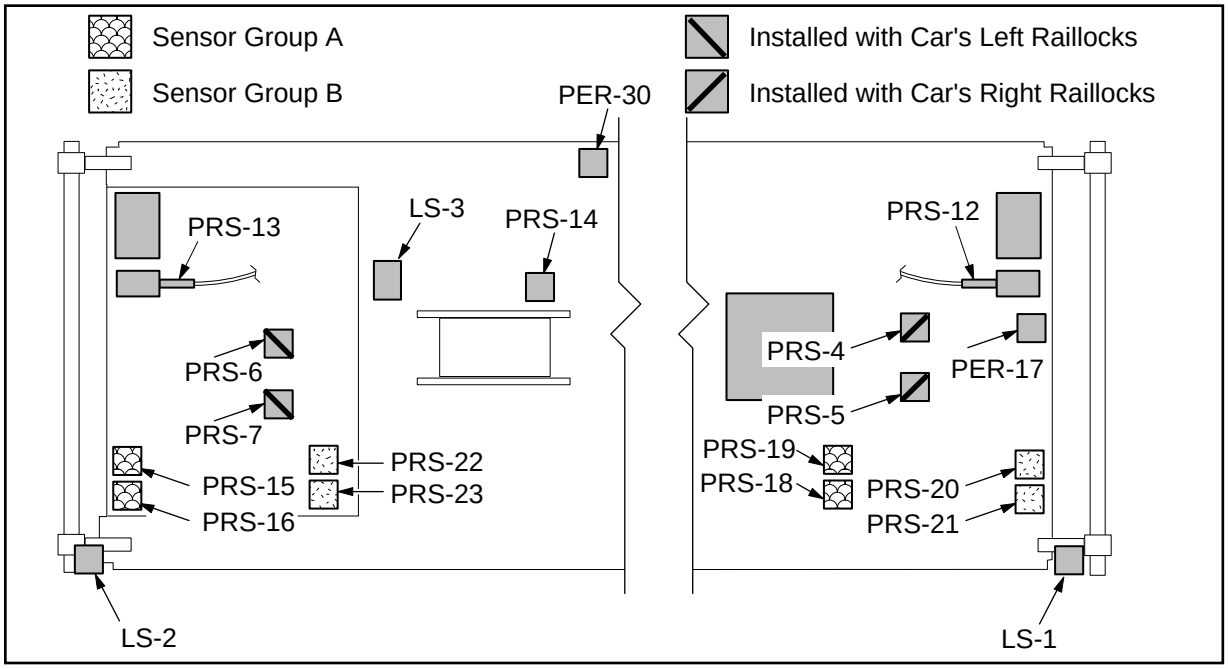

Figure 4.3 *Crawler Sensor Locations*

4.6 CRAWLER INPUT/OUTPUT MODULES

Figure 4.4 shows the configuration of the SLC-500 Processor which is located under the doors on the floor of the crawler. Table 4.2 lists all crawler I/O signals identified by module, terminal and function. Table 4.2 also notes the related sensor for I/O signals that correspond to an installed sensor.

The input module contains sixteen identical solid-state input circuits to accept the on/off status of user devices such as push buttons, limit switches and photocells. Each input has a red status indicator visible from the front of the module which lights when the corresponding input is turned on by an external device. If the status indicator will not light when power is applied to the input, replace the input module.

The output module contains eight identical solid-state output circuits to control the on/off status of user devices such as indicator lights or solenoids. Each output has a red load side status indicator visible from the front of the module which lights when the corresponding output is turned on by the PLC.

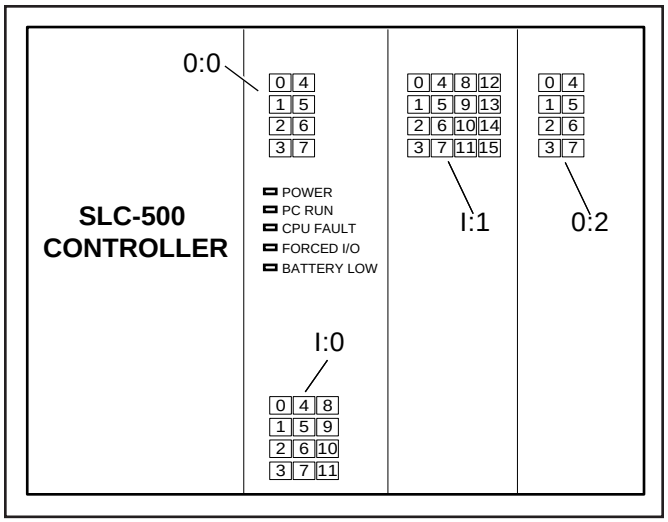

Figure 4.4 *Crawler SLC-500 Processor*

Crawler Input/Output Signals

Module	Terminal	Function	Sensor
I-0	0	Automatic	
	1	Manual	
	2	Station Increment	
	3	Elevator Down	LS-3A
	4	Elevator Up	LS-3B
	5		
	6		
	7		
	8		
	9	Left Front Look Down Sensor	PRS-4
	10	Right Front Look Down Sensor	PRS-5
	11	Left Rear Look Down Sensor	PRS-6
I-1	0	Right Rear Look Down Sensor	PRS-7
	1	Manual Crawler Reverse	
	2	Manual Crawler Forward	
	3	Reel Motion Detector	PRS-14
	4	(Used With Reverse Plant) Stops Crawler in Kiln and Decelerates Crawler in Storage	PRS-15
	5	Safety for PRS-15	PRS-16
	6	(Used With Reverse Plant) Stops Crawler in Storage	PRS-18
	7	Safety for PRS-18	PRS-19
	8	(Used With Forward Plant) Stops Crawler in Kiln and Decelerates Crawler in Storage	PRS-20
	9	Safety for PRS-20	PRS-21
	10	(Used With Forward Plant) Stops Crawler in Storage	PRS-22
	11	Safety for PRS-22	PRS-23
	12	Enter Loader/Unloader	PER-17
	13	Kickbars Not Tripped	
	14	Pump Start	
	15		
O-0	0	Loader/Fault 1	
	1	Kiln/Fault 2	
	2	Storage/Fault 3	
	3	Unloader/Fault 4	
	4	Alarm Horn	
	5	Crawler On Center	
	6	Fault Indicator	
	7		
O-2	0	Elevator Up	
	1	Elevator Down	
	2	Forward Slow	
	3	Reverse Slow	
	4	Forward Medium	
	5	Reverse Medium	
	6	Forward Fast	
	7	Reverse Fast	

Table 4.2 *Crawler Input/Output Signals*

SECTION 5
MAINTENANCE

WARNING:
Unless specified, always follow Lockout/Tagout procedures before servicing electrical components or injury to personnel or change to equipment may result. Always keep electrical equipment clean and dry.

5.1 MAINTENANCE OVERVIEW

When properly installed and operating according to Besser guidelines, the LSC-100 can be expected to deliver efficient long-term performance. In order to obtain the long-term productivity benefits that Besser designed into the LSC-100, the customer must provide the modest maintenance services outlined in this section. Of particular importance is the regular inspection and servicing of the car and crawler hydraulic systems.

This section provides guidelines for all routine system maintenance. The maintenance time table listed in Section 5.8 provides a general guide to scheduled service.

5.2 SENSOR MAINTENANCE

For LSC-100 operation, all sensors must be in proper position and in good working order. The fail-safe system logic will not allow equipment to move unless the sensor signals correspond with what the program expects. In case of a sensor fault, both the car and crawler diagnostics will help identify the target sensor. Regular sensor cleaning and inspection can be effective in preventing problems from stopping operations.

5.2.1 Sensor Position

Section 5.2 explains the importance of sensor position in LSC-100 operations. Vibration or accidental jarring could dislodge a sensor mounting bracket from the proper position. Figure 5.1 shows how to make vertical and horizontal adjustments of both “look up” and “look down” sensors.

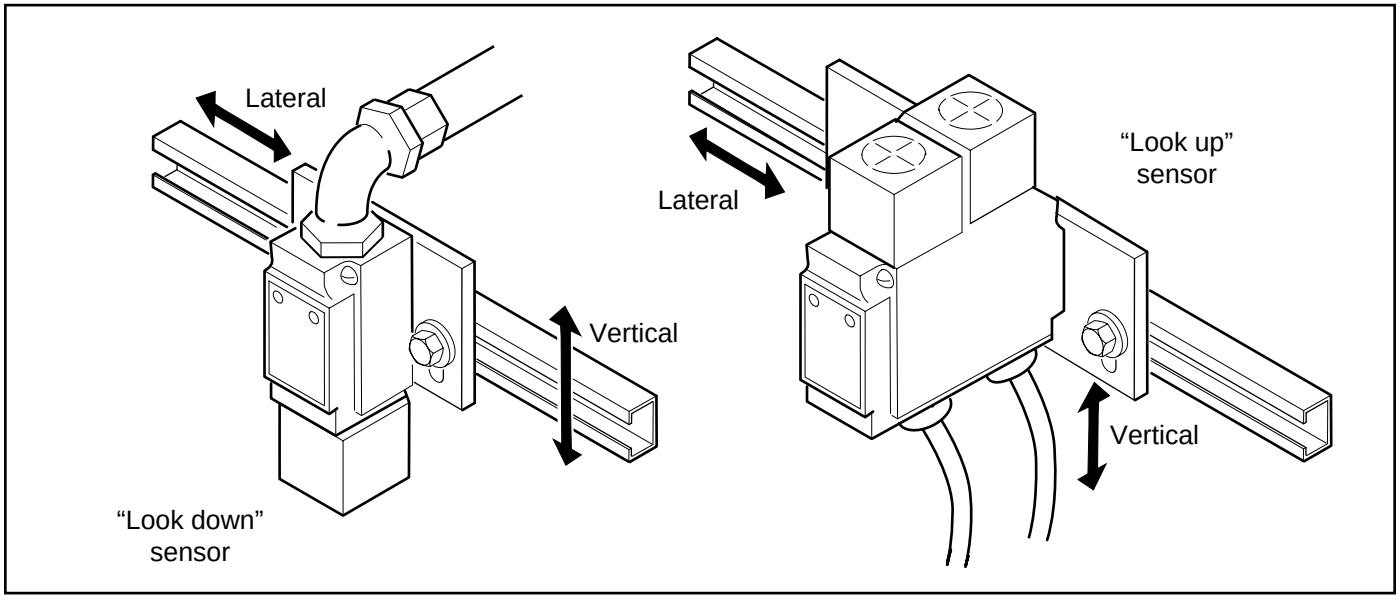

Figure 5.1 *Sensor Adjustments*

5.2.2 Sensor Cleaning

Accumulated dust on a sensor face could prevent sensor function. Both proximity and photo sensors need to be kept free of excessive dirt build-up.

5.2.3 Under-Crawler Emitter

PER-6 is a photo receiver relay on the car that requires a light beam from the emitter installed on the underside of the crawler. An obscured emitter could prevent the car from reporting correct crawler position.

5.3 SAFETY DEVICES

For protection of plant personnel, make sure that LSC-100 safety devices are checked regularly and maintained in good working order. In particular, the following devices and components require scheduled safety checks:

- Car safety bars
- Crawler safety bars
- Car rail safety stops
- End-of-kiln safety stops
- Signal light
- Signal horn

Any safety component that is not in proper working order must be replaced immediately. See the Parts Manual for replacement information of safety devices.

5.4 HYDRAULIC SYSTEMS

The car and crawler hydraulics are heavy duty systems that are designed to be operated with minimal maintenance. However, any hydraulic oil will break down over extended usage, particularly under extremely dusty conditions. Both car and crawler hydraulic systems are protected with an in-line filter. Regular filter inspection and replacement is essential for effective service life of hydraulic oil.

5.4.1. No Leaks

Leaking hydraulic fluid is never acceptable. Any drips, leaks or accumulations of fluid anywhere along the equipment paths must be corrected. A fluid leak can result from a range of different causes:

- a damaged hose
- a faulty motor
- a loose fitting
- a broken valve

To prevent further problems, trace the cause of a leak and make immediate repairs.

5.4.2 Hydraulic Filters

Figure 5.2 shows a hydraulic in-line filter that is located near the oil tanks on both the car and crawler. Remove the filter canister from the stationary cap by unscrewing the canister counterclockwise.

During initial operation of an LSC-100, inspect the filter weekly. Replace the filter when there is significant contamination. After several weeks' adjustment to plant conditions, monthly filter inspection should be satisfactory.

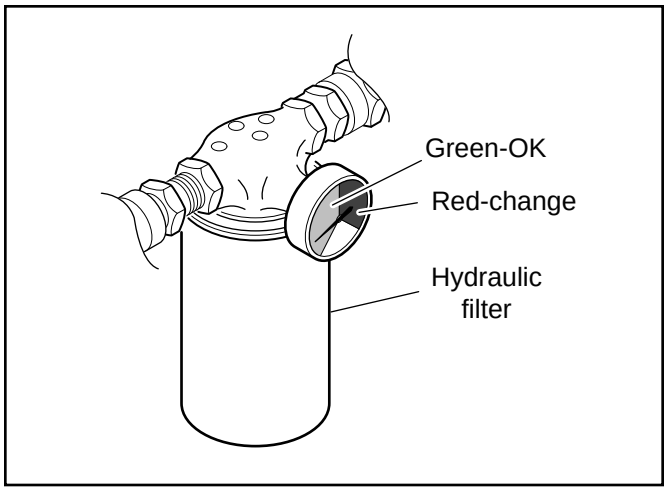

Figure 5.2 *Hydraulic Filter*

5.4.3 Fluid Condition

Separately from contamination, hydraulic fluid can undergo physical and chemical changes that reduce its effectiveness. Resulting problems from using broken-down fluid include accelerated pump wear, reduced motor power and slower movement.

Besser Company offers an inspection kit (Besser Part No. 114546) to analyze hydraulic fluid condition. The kit analyzes the last four fluid samples and provides a data comparison of particle counts, presence of water, viscosity, and wear metal and additive content. A diagnostic statement provides a layman's explanation of the test and its results regarding the condition of the equipment and the hydraulic fluid. The information is graphed against ISO (International Standards Organization) standards to show the overall cleanliness of the system.

5.5 RAILS

LSC-100 equipment is sufficiently heavy that normal levels of concrete dust should not hinder movement. As often as required by plant conditions, clean out the grooves along the car rails to prevent a build-up of debris. Also, make sure that the top surface of the actuators are kept clear.

5.6 CABLE REEL

This section covers two cable reel service procedures:

- Cable replacement
- Spring replacement

The cable is subjected to surface wear and fatigue from continual unwinding and winding. There are two internal cable reel springs. Indications of the need for spring replacement will be a loose or floppy cable that rewinds with reduced spring tension.

5.6.1 Cable Replacement – Unmounted Reel

Replace the working cable by removing the reel and mounting bracket assembly from the crawler and securing the assembly in a bench vise. Before disconnecting any wires, note and record wire colors, circuit numbers and terminal numbers. This precaution will help ensure accurate reconnection. See Figures 5.3 and 5.4.

To prepare the reel for new cable:

1. Shut off and lock out main system power.
2. Disconnect the working cable at the car control panel.
3. Wind the old cable onto the reel and allow the reel springs to lose tension.

CAUTION:
Do not allow the cable to freely rewind onto the reel. Hold the cable end as it rewinds or control reel speed as the cable rewinds.

4. Disconnect the cable reel sensor wire from the back of the mounting bracket. Leave the sensor installed in the bracket.
5. Disconnect the crawler power wires at the crawler control panel.
6. Remove the reel from the crawler by unbolting the mounting bracket from the base of the crawler. Secure the reel and bracket assembly in a bench vise.
7. Remove the slip ring cover and disconnect the working cable conductors from the non-rotating terminals.
8. Remove the old working cable from the reel by pulling it sideways off the reel. Make sure that the removal process does not tension the spring.
9. Loosen the tension relief clamp and pull the end of the old cable out of the cable entrance.

To install the new cable:

1. Place the storage reel with the new working cable on its side and unroll the new cable in a straight line. Straighten any twists in the working cable before winding the cable on the reel.
2. Thread the new working cable through the cable entrance on the reel.
3. Tighten the tension relief clamp.
4. Install terminals on the ends of the working cable conductors. Reconnect the working cable conductors to the non-rotating terminals.
5. Begin winding the new working cable onto the reel.
6. After winding the new cable, tape or tie down the loose cable end to keep it from interfering with reel installation.
7. Install the reel in the crawler and reconnect the crawler power wires at the crawler control panel.

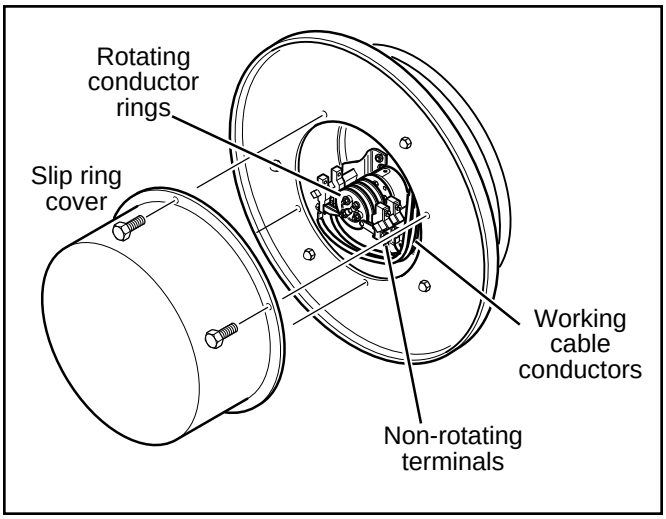

Figure 5.3 *Cable Reel Assembly*

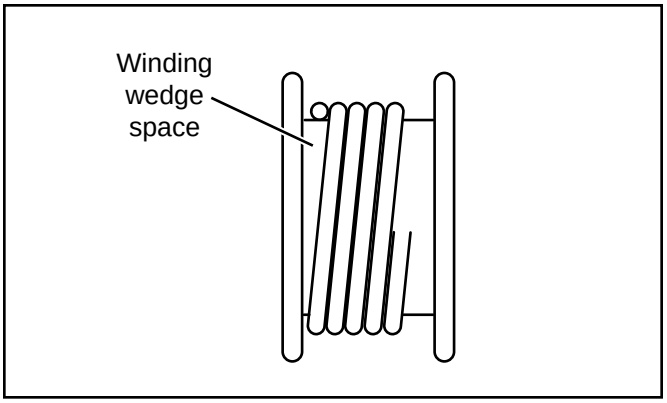

Figure 5.4 *Cable Winding*

To complete cable installation:

1. Pre-tension cable reel spring by turning reel seven times in direction of arrow.
2. Pull cable off reel from underside and route cable through crawler guide rollers.
3. Feed cable through pivot fitting on car and into the car control panel.
4. Make terminal connections inside car junction box.
5. Restore system power.

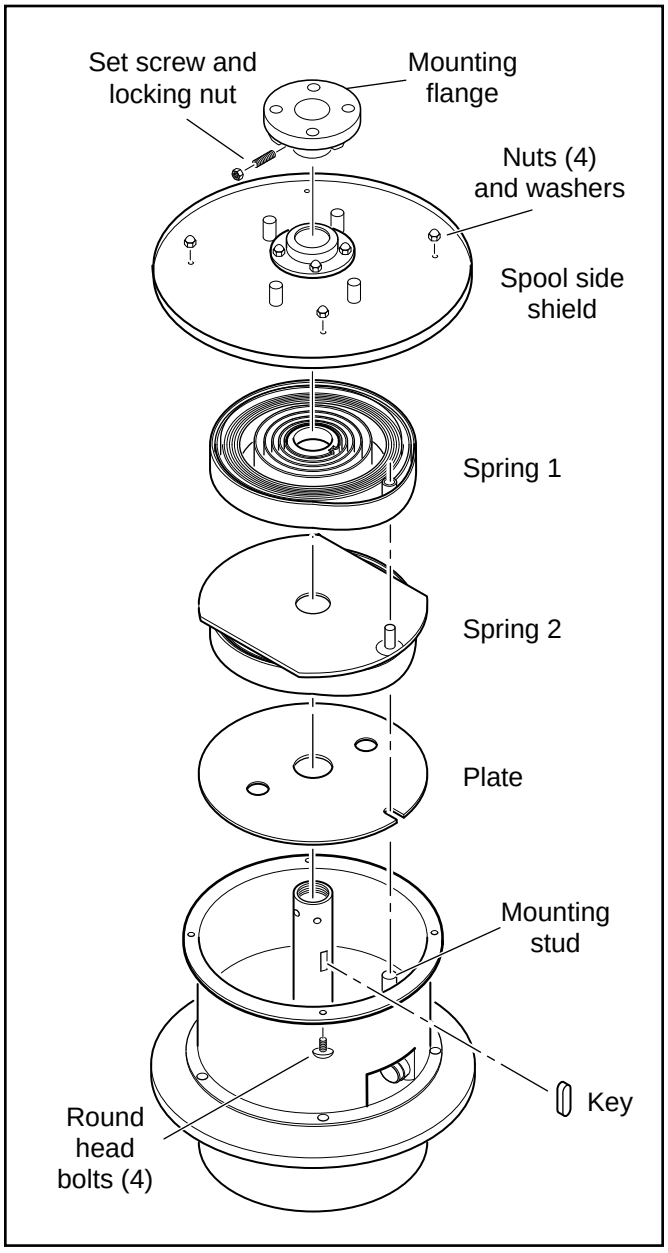

Figure 5.5 *Spring Replacement*

5.6.2 Spring Replacement

See Figure 5.5. There are two internal cable reel springs. If one spring breaks, the working cable will rewind slowly with reduced tension or may not rewind fully. In case of a single broken spring, it is important to replace both springs. The unbroken spring is likely to be operating at reduced efficiency and could also be close to failure. To prepare the reel for new springs:

1. Shut off and lock out main system power.
2. Disconnect the working cable at the car control panel.
3. Wind the cable onto the reel and allow the reel springs to lose tension.

CAUTION:
Do not allow the cable to freely rewind onto the reel. Hold the cable end as it rewinds, or control reel speed as the cable rewinds.

4. Disconnect the crawler power wires at the crawler control panel.
5. Disconnect the cable reel sensor wire.
6. Remove the reel from the crawler housing. The spring removal and assembly sequence can be observed from Figure 5.5.

Some points to note:

- Before starting disassembly, make sure there is no tension on the springs. The outer mounting flange should turn freely.

WARNING:
Be careful and cautious when working with cable reel springs. A spring under tension is dangerous and could cause serious injury.

- Unless a new working cable is being replaced at the same time, it is not necessary to remove the slip ring cover or disconnect the working cable conductors.
- Spring 2 includes a tack welded face plate with mounting stud. This face plate is the only difference between spring 1 and spring 2. During operation, the face plate could have come loose.
- When installing new springs, pay close attention to the assembly sequence of the plate and springs.
- The plate and spring 2 must fit over the mounting stud in the base of the housing.

To put cable reel back in service:

1. Install the reel in the crawler and reconnect the crawler power wires and the cable reel sensor wire.
2. Pre-tension cable reel spring by turning reel seven times in direction of arrow.
3. Pull cable off reel from underside and route cable through crawler guide rollers.
4. Feed cable through pivot fitting on car and into the car control panel.
5. Make terminal connections inside car control panel.
6. Restore system power.

5.7 LITHIUM BATTERIES

Each SLC-500 Controller contains a lithium battery that maintains system memory when power is off. Figure 5.6 shows the shape and position of the battery which installs under the front panel of the SLC-500. Both batteries should be replaced annually, or sooner if BATTERY GOOD indicator does not light. Failure to do so will result in loss of PC memory.

To change a battery:

1. Insure power is on. Changing battery with power off may result in memory loss.
2. Open battery door located on front of PLC.
3. Remove battery from PLC.
4. Insert new battery (Besser Part No. 113773FOOBA).
5. Close battery door.

If memory loss does occur due to a dead battery, install the EEPROM.

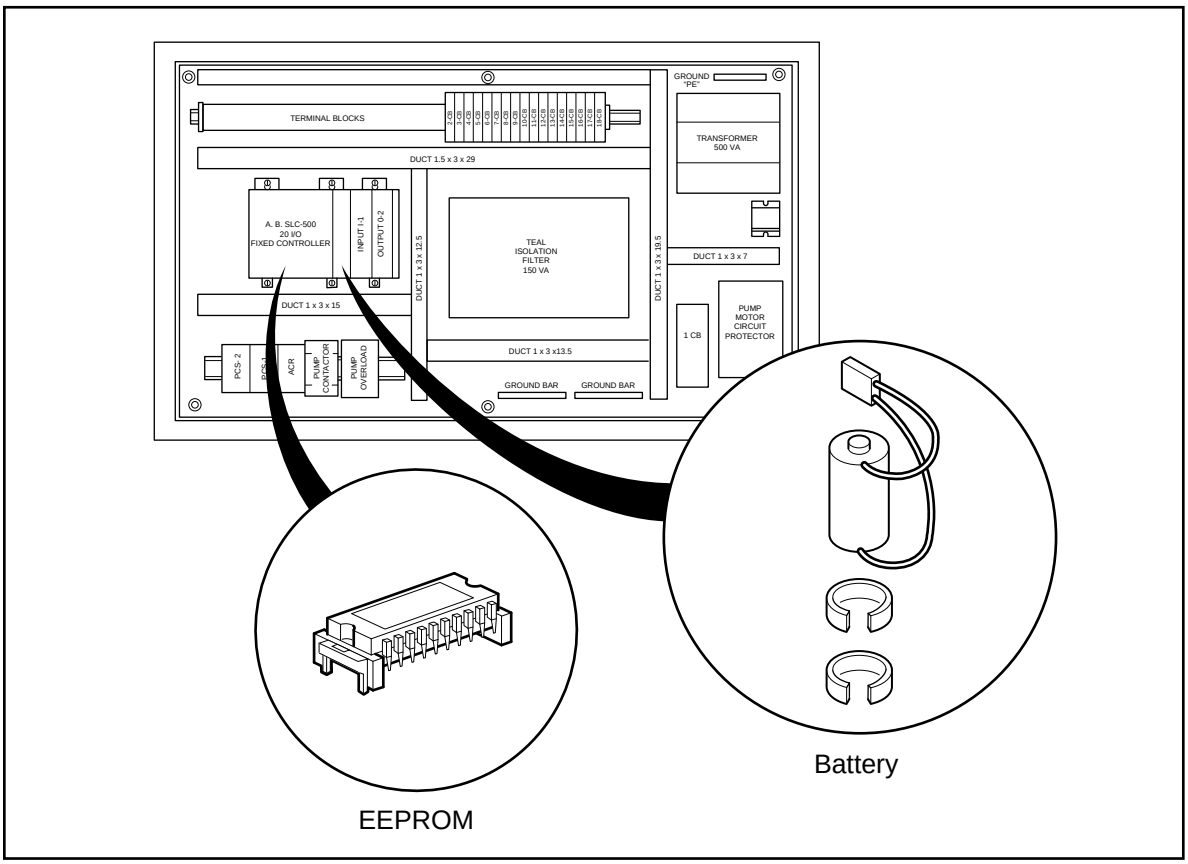

Figure 5.6 *Lithium Battery and EEPROM*

5.8 MAINTENANCE TIME TABLE

Table 5.1 shows the suggested schedule for preventative maintenance of the LSC-100. The service intervals shown are intended to apply under normal operating conditions. In case of adverse conditions, such as excessive dust or very high temperatures, maintenance should be performed at more frequent intervals.

Equipment	Scheduled Maintenance
Car safety bars	Check daily
Crawler safety bars	
Signal light	
Signal horn	
Sensors	
Clean safety labels	
Actuators	
Hydraulic Filter	Change every 3 months
Hydraulic Fluid	
Cable	Check every 6 months
Cable Springs	
Lithium Batteries	Change annually

Table 5.1 *Maintenance Time Table*

SECTION 6
TROUBLESHOOTING

Most troubleshooting is handled by the computer messages in the car and crawler diagnostics. Here are some common problems:

- 6.1 Car diagnostics
- 6.2 Crawler diagnostics
- 6.3 Other diagnostic checks

6.1 CAR DIAGNOSTICS

If an error originates with the car, the Operator Message Center on the Car Program Screen displays an error message and the required operator action.

6.2 CRAWLER DIAGNOSTICS

If an error originates with the crawler, one or more lamps on the crawler control panel illuminate to identify the error condition. Use the Crawler Fault Diagnostic Charts to determine error and proper action.

6.3 OTHER DIAGNOSTIC CHECKS

6.3.1 Battery

The car and the crawler each have power supplied by a lithium battery.The batteries are located in the power supply inside the car control panel and in the power supply in the floor of the crawler. Refer to maintenance to replace if the low battery signal activates. See Figures 6.1 and 6.2.

6.3.2 Fuses

A burned out fuse may cause the power supply indicator light to illuminate in controller. Check the two fuses, located behind the lithium batteries. The batteries are located in the SLC-500 control panel and in the power supply in the floor of the crawler. Replace burned-out fuses with new fuses. See Figures 6.1 and 6.2.

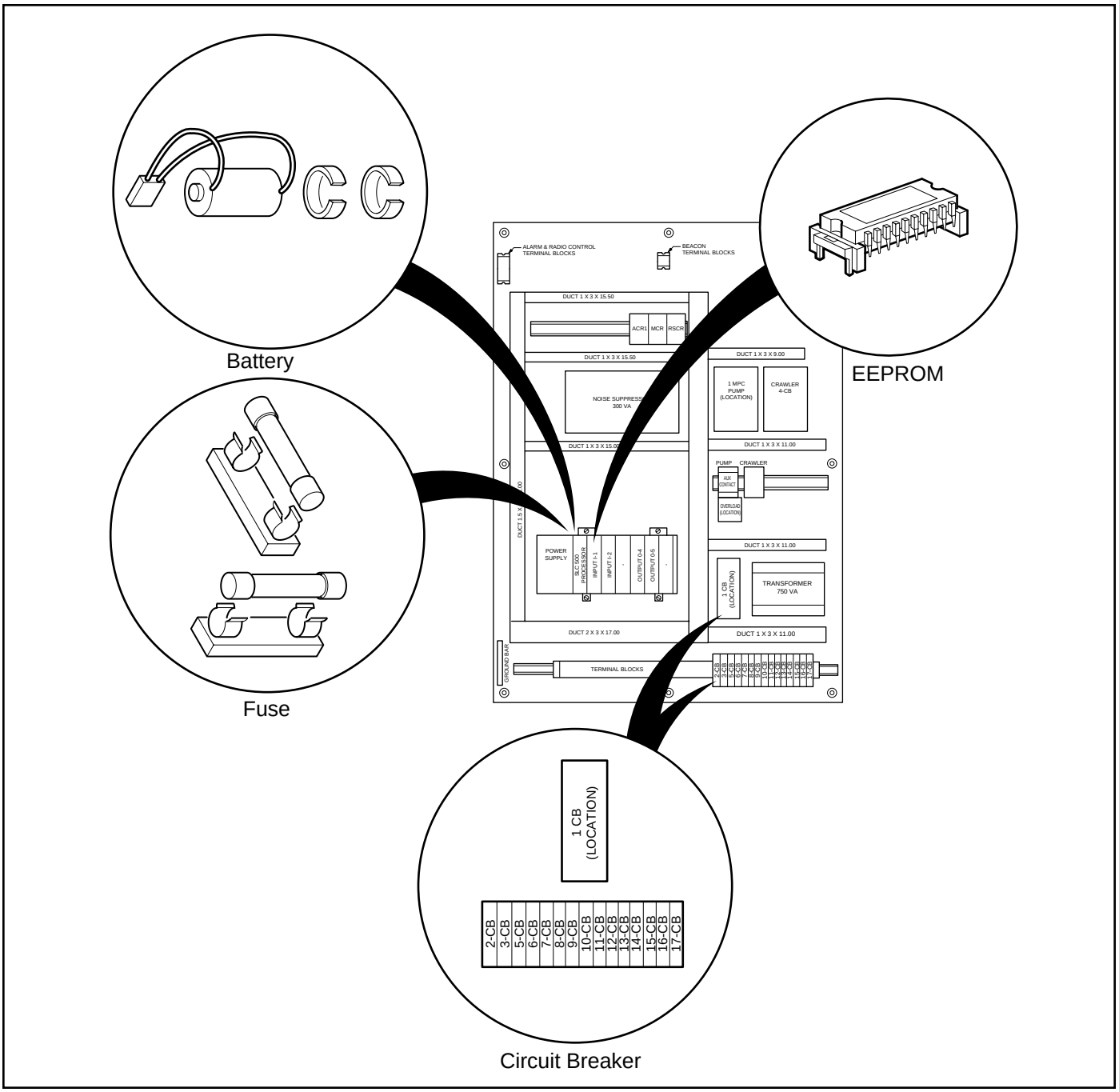

Figure 6.1 *Car Battery, Fuses, EEPROM and Circuit Breakers*

6.3.3 Circuit Breakers

A tripped circuit breaker may result for no apparent reason. Check the circuit breakers, located in the car and crawler control panels, and reset any tripped circuit breakers. See Figure 6.2.

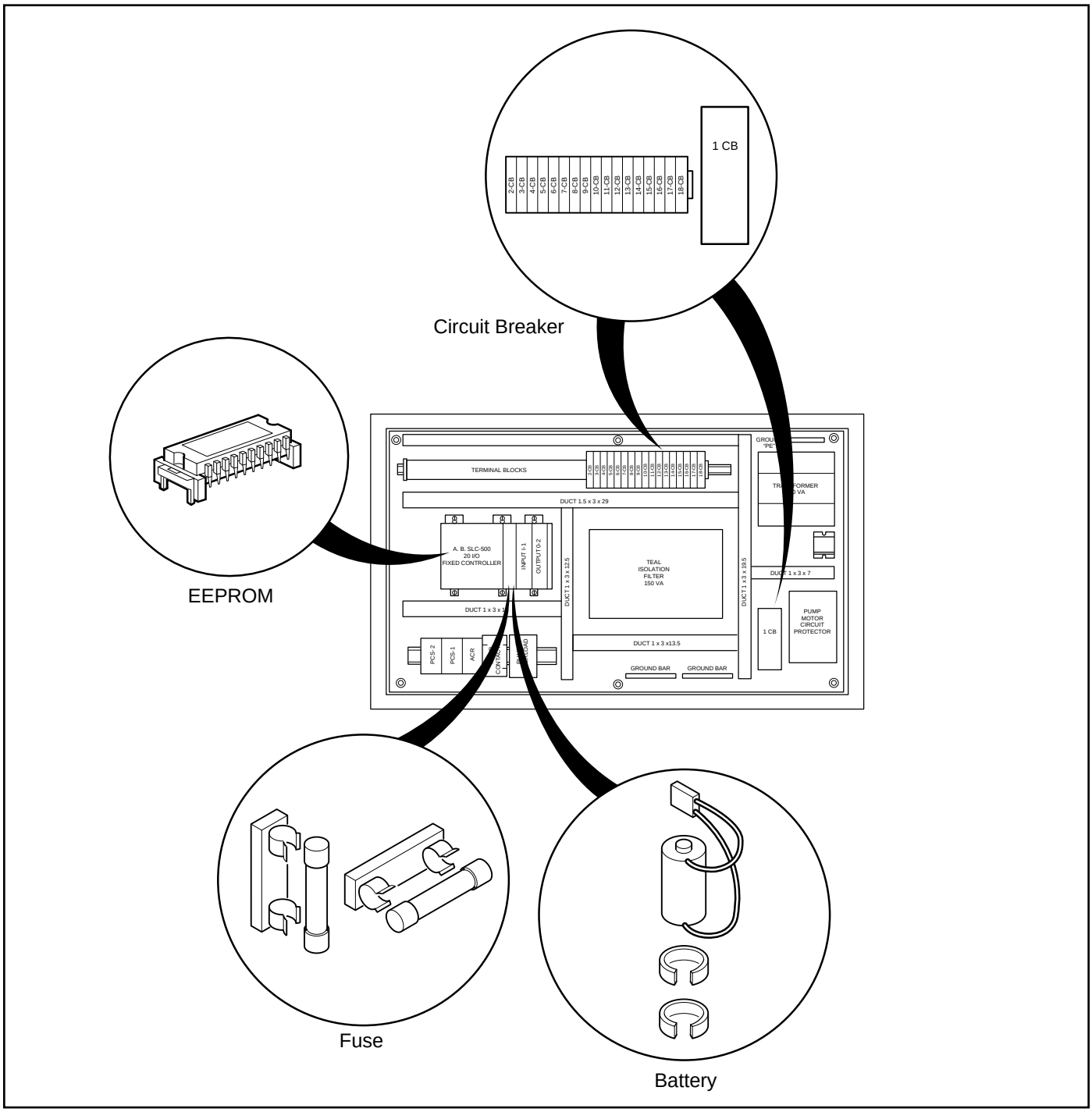

Figure 6.2 *Crawler Battery, Fuses, EEPROM and Circuit Breakers*

6.3.4 Memory Loss

When the power to the panel goes off due to a power surge, power drop or dead battery, a memory loss may result. The PLC fault light will illuminate to indicate problem. To restore the memory, turn the panel power off. Insert EEPROM into the inside of the processor. Restore the power. The SLC-500 will automatically read the EEPROM into its RAM and go into RUN mode. The PLC light will illuminate to indicate a successful transfer. Turn the power off. Remove the EEPROM from the unit.

6.3.5 Hydraulics Failure

The failure of the hydraulics system can be caused by several sources. Observe the temperature gauge to determine if this is a problem. Check the filters for clogs.

If the hydraulics lock-up, use the external hydraulic valves to move the car or crawler. Figure 6.3 shows the external hydraulics valves:

- left lift bar
- right lift bar
- wheel motors

To use an external hydraulic source, open all valves counterclockwise. The wheels or lift bar will move freely.

6.4 TECHNICAL ASSISTANCE

If these checks do not resolve the problem, please call Besser technical assistance. To best assist the Besser technical staff, be prepared with the following information:

- the sequence of events that causes shut down
- the part of the system shut down
- identification of the problem
- the LSC-100 computer screen report
- lights flashing on the car or crawler
- any input/output devices reporting trouble

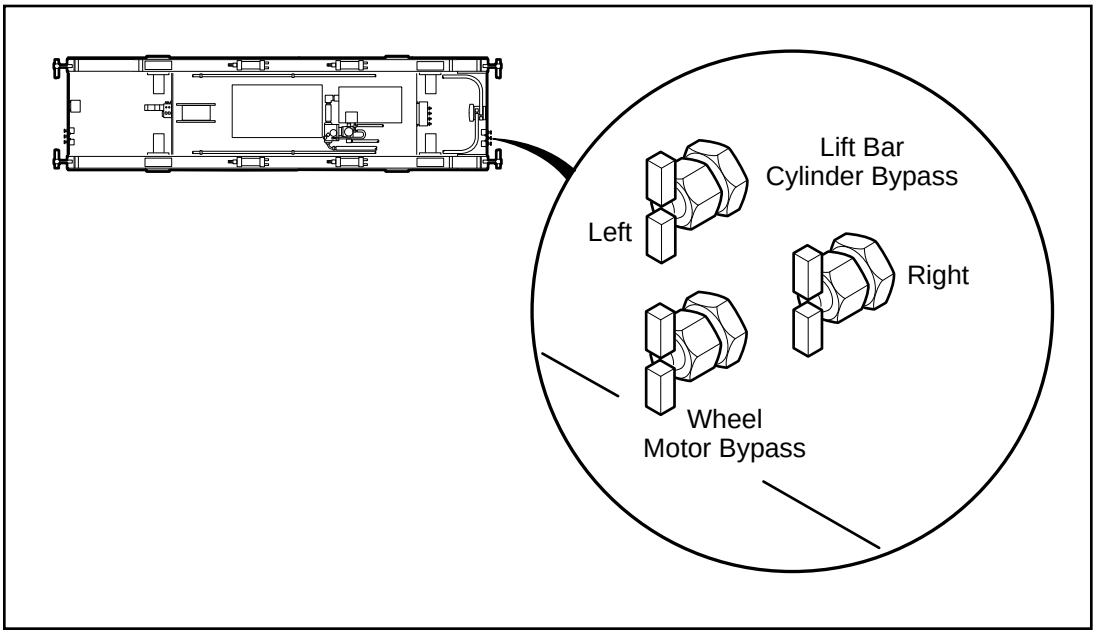

Figure 6.3 *External Hydraulic Valves*