TM4-151-39

TECHNICAL MANUAL

APOLLO/SATURN

LAUNCH COMPLEX 39

OPERATING INSTRUCTION MANUAL

175-TON BRIDGE CRANE

VOLUME I OF II

CHANGE NOTICE

LATEST CHANGED PAGES SUPERSEDE THE SAME PAGES OF PREVIOUS DATE

Insert changed pages into basic publication. Destroy superseded pages.

AUGUST 1965

CHANGED 22 NOVEMBER 1971

Page 0-1 Deleted

LIST OF EFFECTIVE PAGES

Insert latest changes; destroy superseded pages.

NOTE: The portion of the text affected by the change is indicated by a vertical line in the outer margin of the page.

TOTAL NUMBER OF PAGES IN THIS DOCUMENT IS 43, CONSISTING OF:

Page No.	Issue
0-1 Deleted	22 Nov 71
0-2	22 Nov 71
0-3 thru 0-4	Original
0-4A thru 0-7	22 Nov 71
1-1 thru 1-2	22 Nov 71
1-3 Added	22 Nov 71
2-1 thru 2-4	22 Nov 71
2-5	Original
2-6 thru 2-9	22 Nov 71
2-10 Deleted	22 Nov 71
2-11 thru 2-19	22 Nov 71
2-20 thru 2-24 Deleted	22 Nov 71
3-1	Original
3-2 thru 3-4	22 Nov 71
3-5	Original
3-6 thru 3-10	22 Nov 71
3-11	Original
3-12	22 Nov 71
3-13 Deleted	22 Nov 71
3-14 thru 3-15	22 Nov 71
3-16	Original

INTRODUCTION

GENERAL:

This Operating Instruction Manual is one of two Service Manuals required by contract for the operation, maintenance and servicing of the 175-ton bridge crane installed in the Vehicle Assembly Building (VAB) at Launch Complex 39, Merritt Island, Florida.

These Service Manuals are:

Operating Instructions
Maintenance Instructions

PURPOSE:

This Operating Instruction Manual is prepared with the main objectives of describing the 175-ton bridge crane and telling how to operate it.

SCOPE:

The Operating Manual is limited to description and operating instructions for the 175-ton bridge crane. The operating instructions are given in steps wherever possible. Separate manuals of each type are furnished for the 175-ton and 250-ton cranes respectively.

CONTENTS OF VOLUMES - OPERATING INSTRUCTION MANUAL

VOLUME I OF II - GENERAL INFORMATION AND INSTRUCTION

VOLUME II OF II - DRAWINGS

Reduced drawings of assemblies and sub-assemblies.

FOREWORD

The drawings contained in this volume reflect system modifications at the date of issue. Refer to the current drawing revisions for the latest system configuration.

See Operating Instructions, Volume II, for a cross reference of drawing numbers versus figure numbers.

TABLE OF CONTENTS - VOLUME I

TABLE OF CONTENTS (Continued)

LIST OF ILLUSTRATIONS

DRAWING LIST 175-TON CRANE
COLBY MECHANICAL ASSEMBLIES:

NOTE: These drawings are all found in Volume II of the Operating Instruction Manual.

DRAWING NO.	DRAWING TITLE
D-27264	General Arrangement & Clearances
C-26546	Aux. Hoist Drum Bearing Pedestal Assy.
D-27321	Load Block Assembly, 25 Ton
D-27322	Main Load Block General Arrangement
D-27323-1	Trolley Assembly
D-27323-2	Trolley Assembly
D-27323-3	Trolley Assembly
B-27324	Truck Wheel Drive
B-27325	Truck Wheel Idler Axle Assembly
D-27331	Bridge Truck Assembly
D-27351	Trolley Drive Assembly
B-27352	Trolley Wheel and Axle Assembly
D-27400	Operator's Cab - General Arrangement
C-27435	Bridge Truck Flexible Mounting
C-27475	Main Hoist Drum Brg. Pedestal Assy.
C-29953	Main Hoist Outboard Brg. Pedestal Assy.
C-27492	Main Hoist Drum Limit Switch Assembly
C-29946	Auxiliary Hoist Outboard Bearing Pedestal Assy
C-27826	Aux. Hoist Limit Switch Assembly
C-27877	Crown Sheave Assembly - Main Hoist
C-27893	Gear Housing Assembly - Main Hoist
C-27899	Upper Sheave Assembly - Aux. Hoist
C-28032	Equalizer Assembly - Auxiliary Hoist
D-28100	Tac. Gen. and Selsyn Assembly - Auxiliary Hoist
D-28101	Tac. Gen. and Selsyn Assembly - Main Hoist
D-28104	Tac. Gen. Assembly - Auxiliary Hoist
D-28105	Tac. Gen. Assembly - Main Hoist
C-28118	Equalizer Assembly - Main Hoist
C-28120	Trolley Bumper Weldment Assembly
C-28121	Cable Guide Assembly
D-28169	Tac. Gen. and Selsyn Assembly - Bridge Dr.
D-28195	Tac. Gen. and Selsyn Assembly - Trolley Dr.
C-28209	Bridge Bumper Assembly
B-28276	Freyssinet Bearing Pad
D-28679	Powertrak Installation
D-28769	Lubrication Chart
D-29121	Central Lube System - Bridge
D-29122	Central Lube System - Trolley

COLBY ELECTRICAL DRAWINGS:

DRAWING NO.	DRAWING TITLE
D-27315	Conductor and Collector Assy
D-28690	Conduit and Wiring Layout
D-28691	Conduit and Wiring Schedule
D-28692	Lighting Layout

INDUSTRIAL ELECTRIC REEL INC., ELECTRICAL DRAWINGS:

7124	Electrical Motor Driven Cable Reel

HANNA ENGINEERING WORKS

A-596C	Hydraulic Bumper Assembly

KSC, NASA DRAWING 67-K-L-11348, OPERATIONAL DRAWING, LAUNCH COMPLEX 39, VEHICLE ASSEMBLY BUILDING ELECTRICAL, 175-TON BRIDGE CRANE:

SHEET NO.	SHEET TITLE
1	General Information
2	Power & Lighting-Legend
3	Electronics-Legend
4	Electric Controls-Legened
5	Parts List
6	Parts List
7	Parts List
8	Parts List
9	Plan & Elevation
10	Motor Control Center and Cab Console
11	One Line Diagram & Motor Data
12	Elementary Schematic-Console, Starter & Field Control
13	Elementary Schematic - Console & Control-Main Hoist
14	Elementary Schematic-Swivel Hook & Cable Reel
15	Elementary Schematic-Motor Generator Control Circuit-Main Hoist
16	Elementary Schematic-Readout-Main Hoist
17	Elementary Schematic-Console & Control - Auxiliary Hoist
18	Elementary Schematic-Motor Generator Control Circuit-Auxiliary Hoist

KSC, NASA DRAWING 67-K-L-11348

SHEET NO.	SHEET TITLE
19	Elementary Schematic-Generator Control Auxiliary Hoist
20	Elementary Schematic-Readout-Auxiliary Hoist
21	Elementary Schematic-Starter & Brake Controls - Bridge
22	Elementary Schematic-Master Control & Blowers-Bridge
23	Elementary Schematic-Blower Motors & Readout-Bridge
24	Elementary Schematic-Motor Generator & Field Control - Bridge
25	Elementary Schematic-Console & Control-Trolley
26	Elementary Schematic-DC Power Supply & Motor Field Control-Trolley
27	Elementary Schematic-Motor Generator & Field Control - Trolley
28	Elementary Schematic - Blower Motors & Readout-Trolley
29	Elementary Schematic - Phase Failure & Lighting
30	Elementary Schematic - Power Supply & Amplifier
31	Elementary Schematic-Overspeed Protection Main & Auxiliary Hoist

SECTION II

DESCRIPTION OF CRANE

2.0 GENERAL

This is an electric bridge crane with a hook-load capacity of 175 tons. The crane was specifically designed for assembly, subassembly, and handling operations required on space vehicles in the high-bay and low-bay areas of the VAB. The crane operates on rails, the tops of which are 169 feet 2 inches above the floor. It travels between the high-bay and low-bay areas at right angles to and underneath the craneways for the 250-ton bridge cranes which are located at a higher level in the high-bay area.

In addition to the 175-ton main load hook, the crane is also equipped with a 25-ton auxiliary hoist.

The crane is operated from its cab, located under the bridge truss. The control console is shown in figure 2-6.

In general, the crane is engineered in accordance with Specification No. 61 of the Electric Overhead Crane Institute (E.O.C.I.). The class of service is designated as E.O.C.I. "C". Class C is moderate service of the type encountered in machine shops, fabrication shops and on assembly floors. Such service is generally intermittent and does not require a heavy duty cycle.

Crane features are shown in figure 2-1 and in other figures in this section.

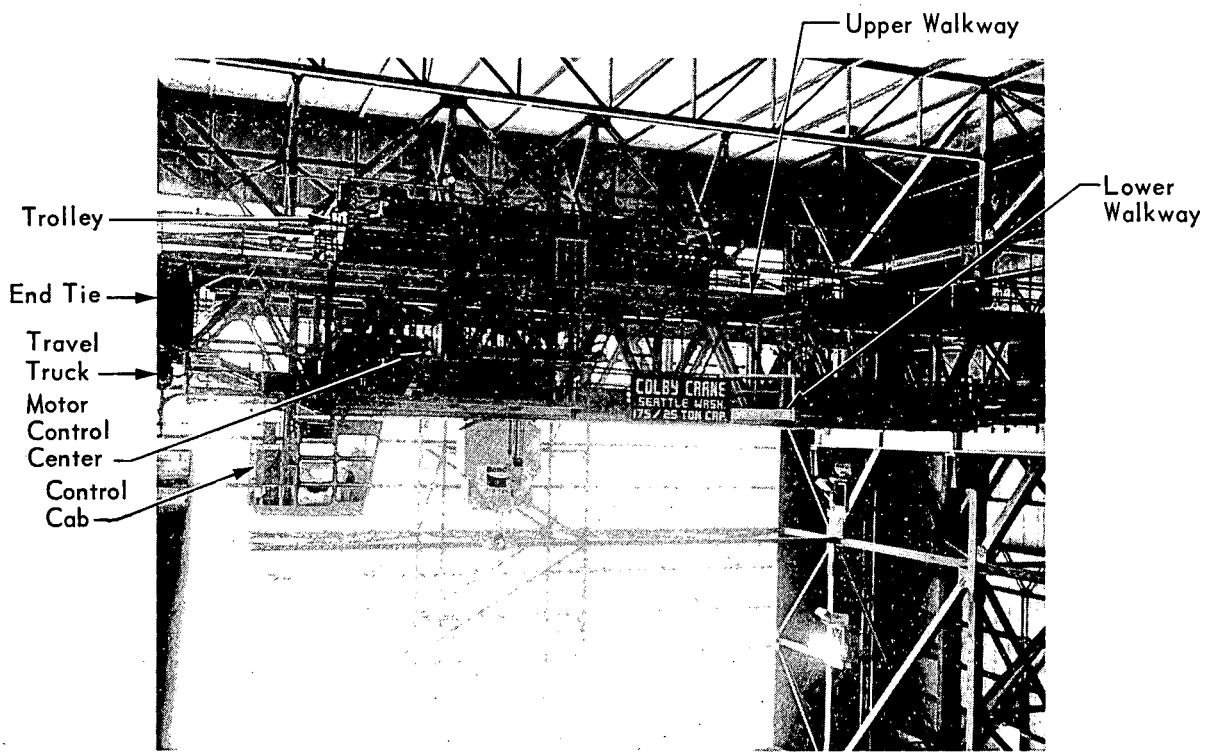


Fig. 2-1. 175-Ton Bridge Crane

2.1 CRANE STRUCTURE

The bridge structure for this crane is a typical multiple-girder design. There are two main and two auxiliary trusses; both are lattice-type welded frames made of standard rolled-steel shapes. The end ties, which are bolted with body-fit bolts to the trusses, are box-type members welded from plate and standard rolled-steel shapes. Typical structure of a main truss is shown in figure 2-2.

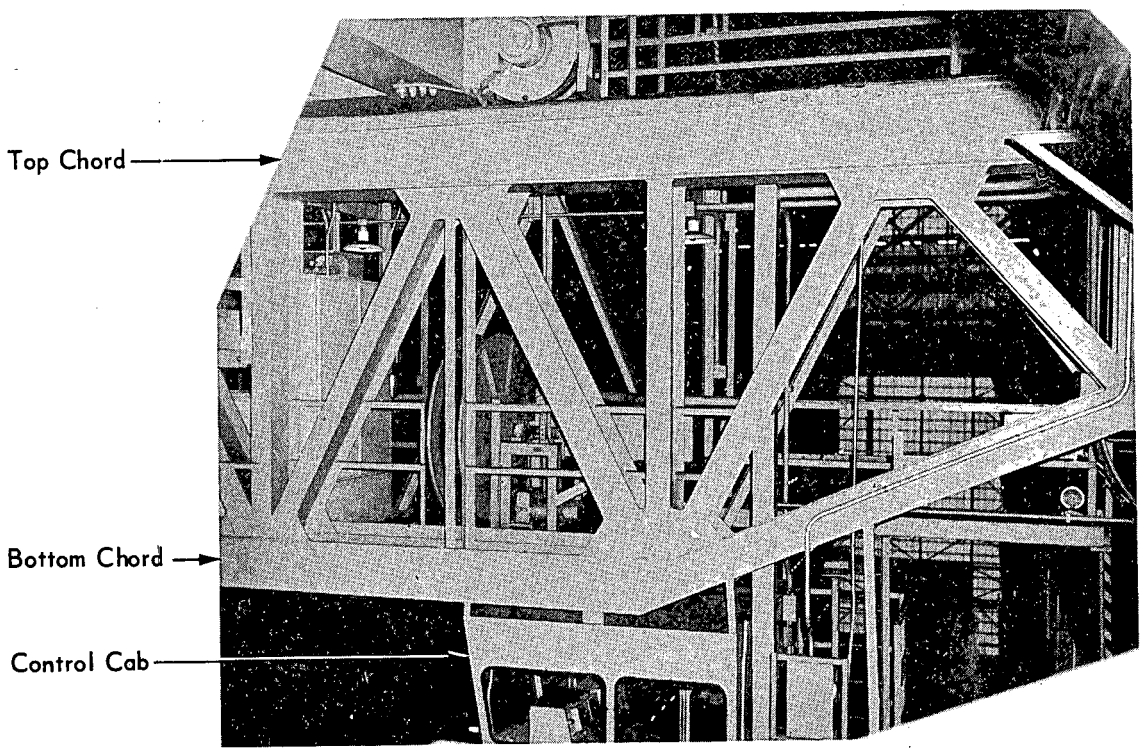


Fig. 2-2 Main Bridge Truss Construction

The load trolley rolls on transverse rails attached to the tops of the main trusses. The trolley is a welded box structure made of standard steel plate and rolled shapes.

In the VAB, high or gusty winds can cause different vibration characteristics in the crane runways as the crane is traveled from the low bay to the high bay or vice versa. To prevent damage to the crane under this condition, a special laminated neoprene-and-steel bearing pad (manufactured by the Freyssinet Corporation) is interposed between each bridge travel truck and the crane bridge structure. The compression and shear deformation characteristics of these bearing pads will allow the travel trucks to pivot and also to move sidewise with the crane runway as it vibrates, thereby absorbing the major part of such movement without transmitting it to the crane bridge. The Freyssinet bearing pads referred to here are shown on Colby drawing C-27435 and in figure 2-3.

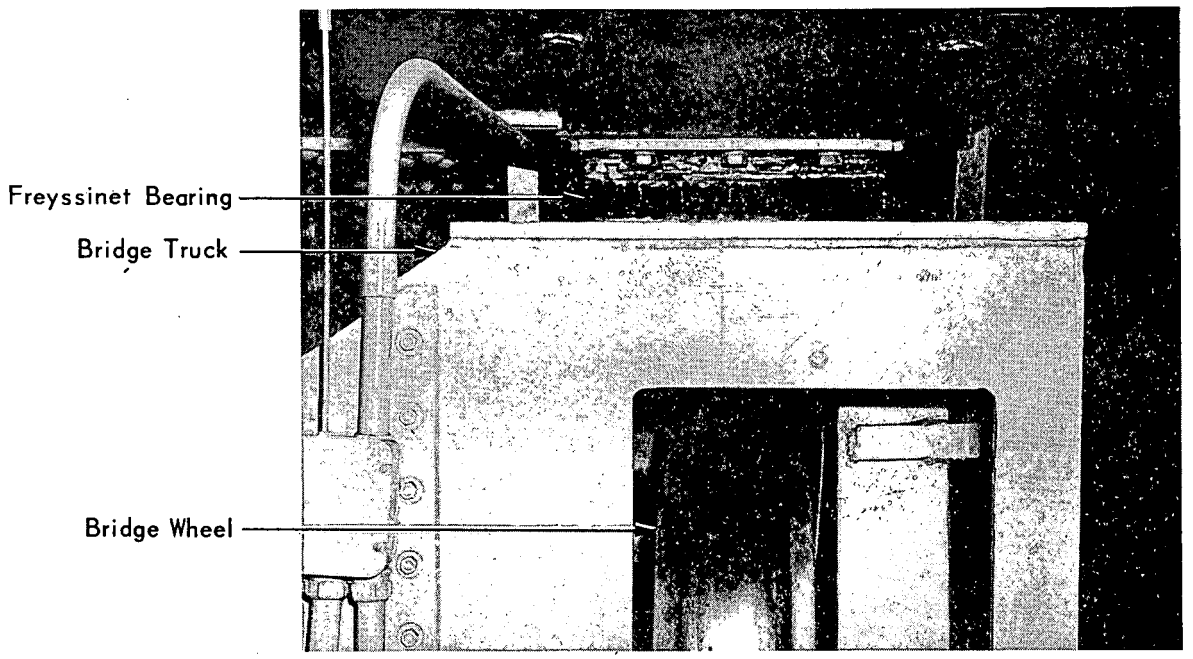


Fig. 2-3. Bridge Truck Bearing Pad

Access to the crane for maintenance is provided by walkways and ladders. Principal walkways are along the bridge beams. Upper walkways parallel to the trolley rails extend the full length of the bridge. Cross travel between the two upper walkways can be made across the trolley or across the tops of the end ties. Lower walkways are located at each corner of the bridge; they are connected to the upper walkways by ladders; see figure 2-1. The lower walkways provide access to electrical control equipment located in the bridge structure. The main electrical installations are the motor control center and the motor-generator sets.

2.2 CRANE MOTIONS

Crane motions are controlled from the console in the operator's cab, (see figure 2-6). Controls are provided for:

Hoisting and lowering the main and auxiliary load hooks.
Transverse movement of the trolley across bridge.
Traverse of the crane along the craneway.
Hook swiveling (main hook only).

2.3 POWER SUPPLY

All electrical energy for crane power, lighting, and control is taken from the building source at 480 volts ac. This power is brought in to the crane through pick-up shoes and conductors shown on KSC drawing 67-K-L-11348, Colby drawing D-27315, and in figure 2-4.

From the main-line feeder shoes, the power conductors go to the crane main circuit breaker as shown on Colby drawing D-28690.

From this point, power is distributed to the various circuits as shown on KSC drawing 67-K-L-11348.

Power for lighting at 120 volts is furnished by a 9-KVA, 3-phase transformer. The transformer is located in the lighting transfer panel of the motor-control enclosure.

Power and control are supplied to the load hook trolley through a Gleason Reel Corporation No. 222 Powertrak, shown on Colby drawing D-28679 and in figure 2-5.

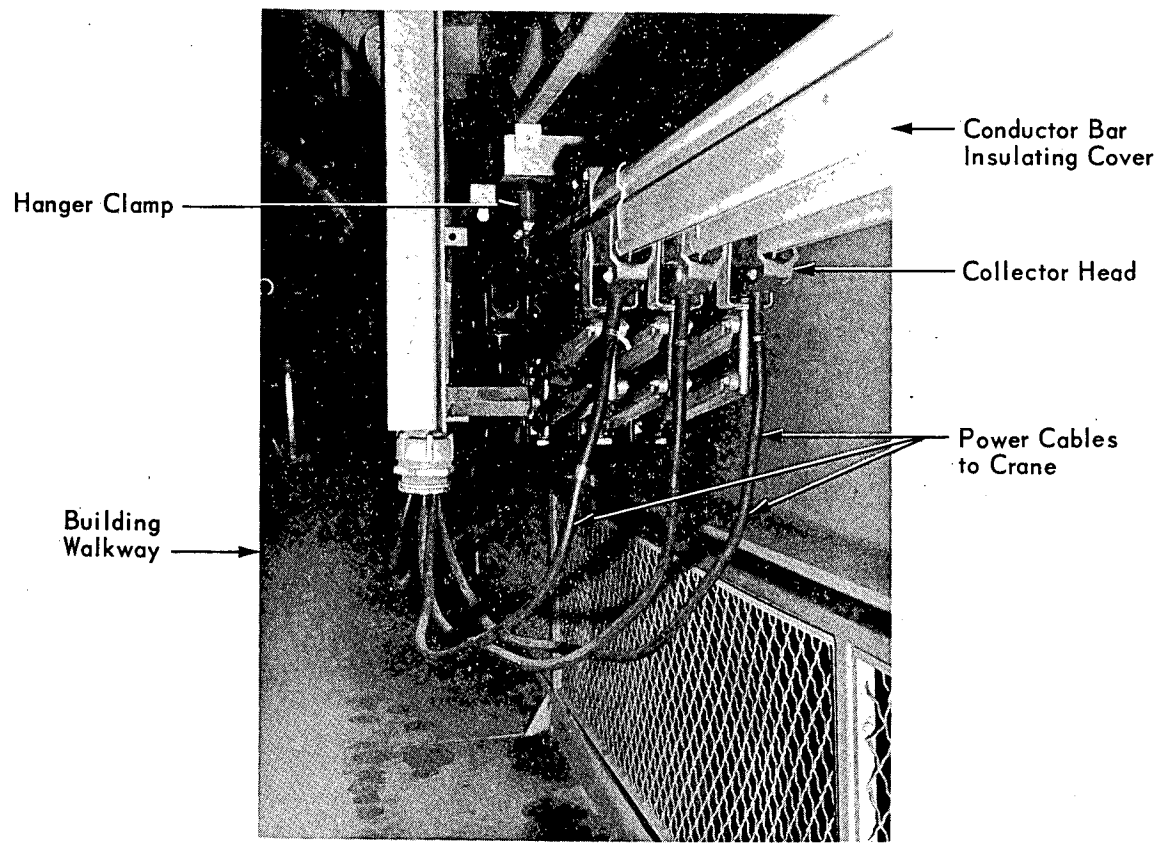


Fig. 2-4. Electrical Conductor Pickup Assembly

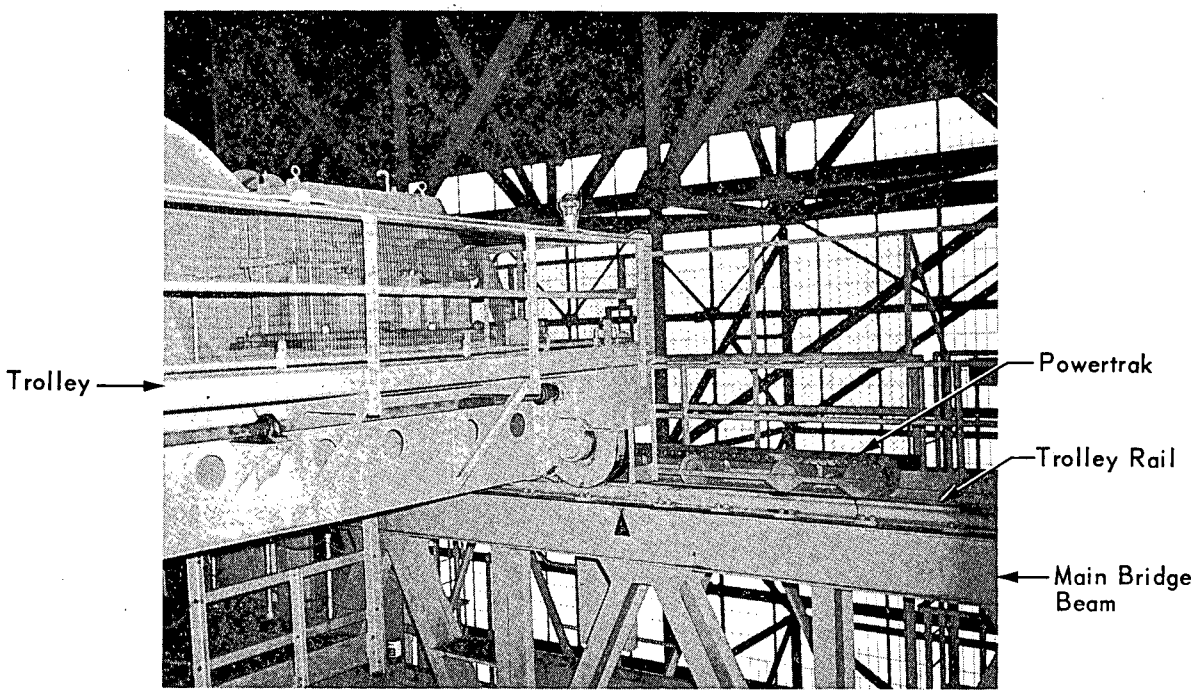


Fig. 2-5. Powertrak Installation

Although there are a number of units which require electrical energy, the largest blocks of power go to the a-c motors which drive the d-c generators furnishing power for the main movements. These are:

Trolley drive motor-generator	- 30 hp
Bridge drive motor-generator	- 125 hp
Auxiliary hoist motor-generator	- 150 hp
Main hoist motor-generator	- 300 hp

Other power requirements include the main-hook swivel motor, main-hook cable reel, remote console cable reel, motor blowers, and lights.

2.4 CRANE CONTROL SYSTEM (ELECTRICAL)

2.4.0 General

The purpose of this section is to describe the general system for powering and controlling the several crane motions. A more detailed description and location of the various control levers, pushbuttons, and switches is given in Paragraph 2.5, Operator's Cab and Controls. Step-by-step operations are included in Section III.

2.4.1 Type of System

The drive system for the crane motions (hoisting and lowering, bridge and trolley travel) is by means of variable-speed, shunt-wound, d-c motors. These motors run at a speed proportional to the applied d-c voltage independent of load. For example, at 240 volts the motor will run twice as fast as at 120 volts. Energy for these final drive motors comes from motor-generator sets, one for each crane motion. This drive method is basically the time-honored Ward Leonard ac-to-dc system with refinements. In this system, a constant speed a-c motor is directly coupled to a shunt-wound d-c generator. The output voltage of the generator is varied by the equipment and circuitry provided. This ability to vary the d-c voltage to the final drive motors enables very close control of speed and torque of the d-c drive motors. This system of control provides both accuracy and flexibility. It allows floating the load (for definition of "floating" see Paragraph 3.5.1), very slow speeds for settling or starting the load, rapid traverse of the empty hook, and regenerative braking under overhauling conditions where the load tends to drop due to gravity. A very precise and smooth control over all crane movements is given to the operator at his console.

2.5 OPERATOR'S CAB AND CONTROLS

2.5.0 General

The cab is located under the lower walkway at the northeast corner of the crane; it is enclosed with clear plastic windows; see figure 2-1. The operator, seated at his console, faces west. To reach the cab, the operator climbs to the lower walkway from the building catwalk. A trapdoor in the floor of the lower walkway opens on a short ladder leading to the cab landing.

In addition to electrical controls, the following are provided in the cab:

Air conditioning, thermostatically controlled.
Wood flooring.
Hand fire extinguisher (CO_2).
Metal tool box.
Motor overheat warning horn (automatic).
Operator's pedestal-type adjustable seat.
Telephone receptacle (located on back wall, operator's left side).
Placard, Condensed Operating Instructions (located on back wall).
Overhead light (switch on back wall).
Foot switch for warning horn.
Foot switch for main hoist.
Foot switch for auxiliary hoist.

The following drawings give information about the cab:

KSC drawing 67-K-L-11348, 175 Ton Bridge Crane.
Colby D-27264-General Arrangement and Clearances.
Colby D-27400-Operator's Cab, General Arrangement.

The operator's console is provided with switches and pushbuttons to control the crane motions, and with instruments, dials, and warning lights to guide the operator.

The hook-rotation mechanism has a cable reel on the crane to take care of electrical conductors. The location of the reel is shown on Colby drawing D-27264. The reel is shown on Industrial Electric Reels, Inc., drawing No. 7124 (Colby drawing C-28511) Electric Motor Driven Cable Reel. A safety interlock prevents activation of the main hoist hook before activation of the hoist cable reel motor.

2.5.1 Lighting

The cab has one light; its switch is on the inner back wall of the cab. All other crane lights are controlled from any of three locations by three 3-way switches. These switches are located on the outer back wall of the cab and at the cab-end of each lower bridge walkway.

2.5.2 Cab Control Console

2.5.2.0 General

The controls and their arrangement on the console are shown on KSC drawing 67-K-L-11348 and in figure 2-6.

Group A: Elements that control crane movement or electrical energy.
Group B: Elements that display information
Group C: Warning lights.

2.5.2.1 Console Arrangement

The console has an upper panel and a sloping lower panel.

2.5.2.2 Upper Panel

The upper panel contains all display instruments which give the operator information. Included are the selsyn motor indicators and the d-c drive motor ammeters. All warning lights are on this panel. Also located here are all pushbuttons for energizing the crane motions, some of the transfer and selector switches, and switches for actuating the remote control cable winder and hook rotation.

The following units are on the upper panel.

Selsyn motor shaft position indicators with readout in fractions of an inch for bridge, trolley, main, and auxiliary hoists.
Ammeters for bridge, trolley, main, and auxiliary hoist drive motors.
Start and stop pushbuttons for motor generator sets for bridge, trolley, main, and auxiliary hoists.
Digital counters reading in hundredths of a foot for travel and hoist motors.
Red warning lights for motor overheat on bridge, trolley, main, and auxiliary hoist blowers.

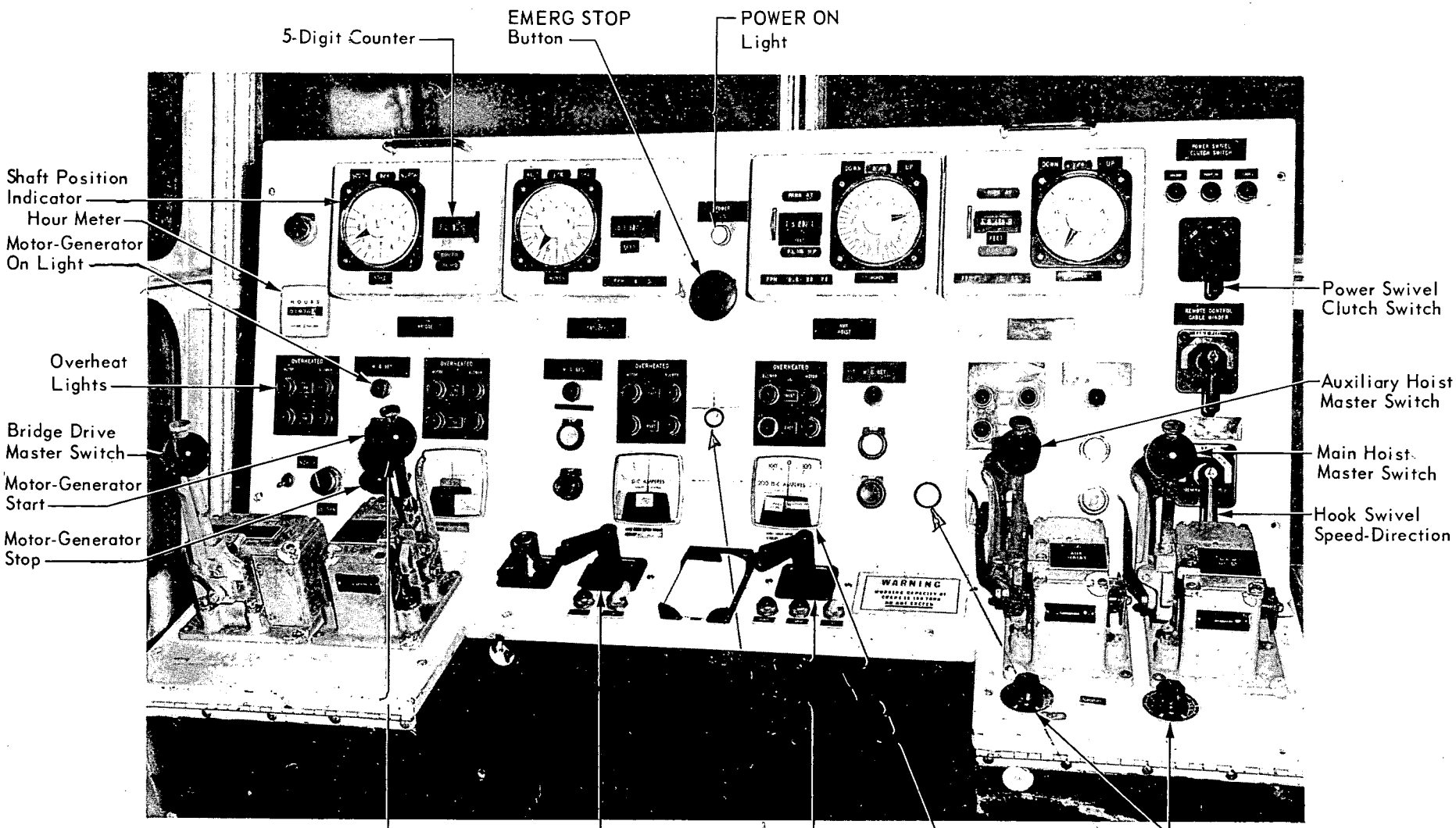


Fig. 2-6. Cab Control Console

White POWER ON light indicating that main circuit breaker on the crane bridge is closed and that electrical energy is available up to the starters for the motor-generator sets.
Switch to control main hook swiveling, two speeds CW (clockwise), CCW (counterclockwise), and OFF.
Switch to actuate hook swivel clutch pump, LOCK, UNLOCK, and OFF.
Red indicating light, hook swivel clutch PUMP ON (running).
Amber indicating light, hook swivel clutch LOCK (engaged).
Green indicating light, hook swivel clutch UNLOCK (not engaged).
EMERGENCY STOP pushbutton (red mushroom head). Shuts off power to all motor-generator sets and stops crane motion.
Hour meter that indicates elapsed crane operation time.

INSERT A

2.5.2.3 Lower Panel

The lower panel contains the crane controls. The operator uses master switches individually or in combination to obtain the crane motions he desires. Controls are also provided for various speed ranges. Two speeds, COARSE and FINE, are provided by the selector switch for the bridge and trolley. Three speeds, HIGH, COARSE, and FINE are provided by the selector switch for the main and auxiliary hoists (HIGH is for empty hook only).

The master switches are so placed on this panel that their direction of actuation corresponds to the crane movement. In the case of the hoist master switches, pushing the lever away from the operator sends the load block down; moving the lever towards the operator raises the load block.

The following units are on the lower panel:

Master switches for bridge, trolley, main and auxiliary hoists.
Load-set control knobs for load float of main and auxiliary hoists.
Speed selector switch for bridge and trolley.
Speed selector switch for main and auxiliary hoists.
Amber indicator light, bridge and trolley coarse speed engaged.
Green indicator light, bridge and trolley fine speed engaged.
Red indicator lights, main and auxiliary hoist high speed engaged.
Amber indicator light, main and auxiliary hoist coarse speed engaged.
Green indicator light, main and auxiliary hoist fine speed engaged.

Fig. 2-7. Deleted

2.5.3 through 2.5.3.2 (Deleted)

2.5.4 Master Switches

The cab is equipped with four lever-operated master switches, General Electric Type 1C-3012-K613C. These control the movements of the main and auxiliary hoist load blocks, and the trolley and bridge travel.

Each lever has a ball end with a thumb latch on top. The thumb latch is a detent or lock for the neutral position of the lever only. Pressing down on the thumb latch releases the master switch lever from the OFF position.

Each master switch lever is provided with a squeeze-type lever at the side. The function of the lever is to enable the release of the brake when required by the master switch lever or float control.

The master switches are stepless with spring return to the OFF position when released (dead-man control).

The speed of the motor controlled by the master switch is proportional to the displacement or movement of the switch lever from the neutral position. Full displacement will produce maximum motor speed. There are no detents or steps.

The speed with which the operator pushes or moves the master switch does not affect acceleration. This is accomplished automatically by the acceleration circuitry provided.

The master switches are arranged on the cab console so that the crane will move in the direction in which the lever is pushed.

The position or setting of the master switch lever establishes a voltage requirement for the motor which it controls. The Metadyne compares a feedback signal with the command signal and generates an error signal to control the d-c generator. This provides for extremely smooth control of speed, acceleration, and deceleration.

NOTE: The appropriate master switch float lever load-set knob and selsyn motor shaft position indicator are used together by the operator to float the load on the main and auxiliary hooks. The load is said to float when its vertical position is maintained and the hook neither rises nor falls. The method for doing this is given in the Operating Instructions, Section III of this manual.

2.5.5 Tachometer Generators

These are small two-pole generators driven by belts from the drive motors in the case of the trolley and bridge. Tachometer generators are provided for the control of both hoists for overspeed. The tachometer generators produce a voltage which is proportional to the speed of the corresponding motor. This voltage is coupled to a voltage sensing relay and shuts the hoist system (main or auxiliary as applicable) down on overspeed.

2.5.6 Synchros (selsyns)

This system consists of a transmitter driven by a belt from the motor, a signalling five-wire conductor system, and a receiver located in the cab console. The receivers are directly connected to the selsyn motor position-indicator dials and geared to the digital counters. The sole function of the synchro is to monitor, electrically, the position of a shaft in one location, and display it at another location. In this case, the various shaft rotations are displayed on dials on the console. When the crane movements are fast, the dial pointers and digital counters are moving fast, and are of no value. When the crane movements are slow, the dials and counters can be easily read. Very small movements of the bridge, trolley, and hoists can be detected and controlled (see Paragraph 2.16).

2.6 BRAKING

All braking of crane movements is accomplished by dynamic braking and by spring-set brakes attached to drive motors. Dynamic braking is provided by the energy of a drive motor when it is being rotated to function as a generator. The main hoist motor, for example, exhibits dynamic braking in resisting the efforts of the hook load acting under the influence of gravity.

When electrical power is interrupted to any drive motor, the spring-set brakes automatically engage. This type of brake is used on the bridge and trolley travel as well as on both the main and auxiliary hoists. When the master switch that controls these motions is in the neutral position, the brakes are set just as in the case of a power interruption. Spring-set brakes are intended primarily for holding.

2.7 SKEW CONTROL AND ADJUSTMENT

Due to unequal forces which may be applied to a bridge crane structure by unequal loading at the trucks, it is possible for a bridge crane structure to be forced out of square. Such a condition, though not likely to occur on this crane because of the electrical design of the bridge motor control, can be readily adjusted. The procedure for making this adjustment is given in Paragraph 3.7.

2.8 LIMIT SWITCHES AND PROTECTIVE DEVICES

The crane motions and motors are protected with limit switches as follows:

2.8.1 Crane Motions, End Travel

Main and auxiliary hoist, upper and lower limits.
Bridge, both ends of travel.
Trolley, both ends of travel.

2.8.2 Crane Motions, Decelerating

Bridge, 10 feet from end of travel, decelerate to 7.5 feet per minute at both ends of travel and at joint between high and low bay of the building.

2.8.3 Motor Protection

Motor field loss, relay control.
Instantaneous overload, relay control.
Undervoltage, relay control.
Single-phase, relay control.
Reverse phase, relay control.
Overtemperature, thermistor control.
Overspeed, tachometer/relay control.

2.9 BRIDGE AND TROLLEY TRUCKS

2.9.0 General

The bridge and trolley are driven by separate d-c motors, reduction gearing, shafting, and wheels. The travel motion motors are controlled from the consoles as explained in Paragraph 2.5. The general arrangement of the trucks is shown on Colby drawing D-27264. Figure 2-8 shows an end view of a bridge truck. In order to equalize speed and torque, drive wheels must always be kept in matched sets. The wheel tread diameters must be the same in matched sets.

2.9.1 Bridge Drive Trucks (See Colby Drawing D-27331).

The bridge is supported by four drive trucks - two on each end. Each truck contains two 30-inch matched wheels, one driver and one idler. There is no mechanical connection between the four trucks. The four trucks are alike except that two are right-hand and two are left-hand as determined by the motor and reduction gear arrangement. One truck on each end includes a selsyn motor and tachometer generator for bridge travel control.

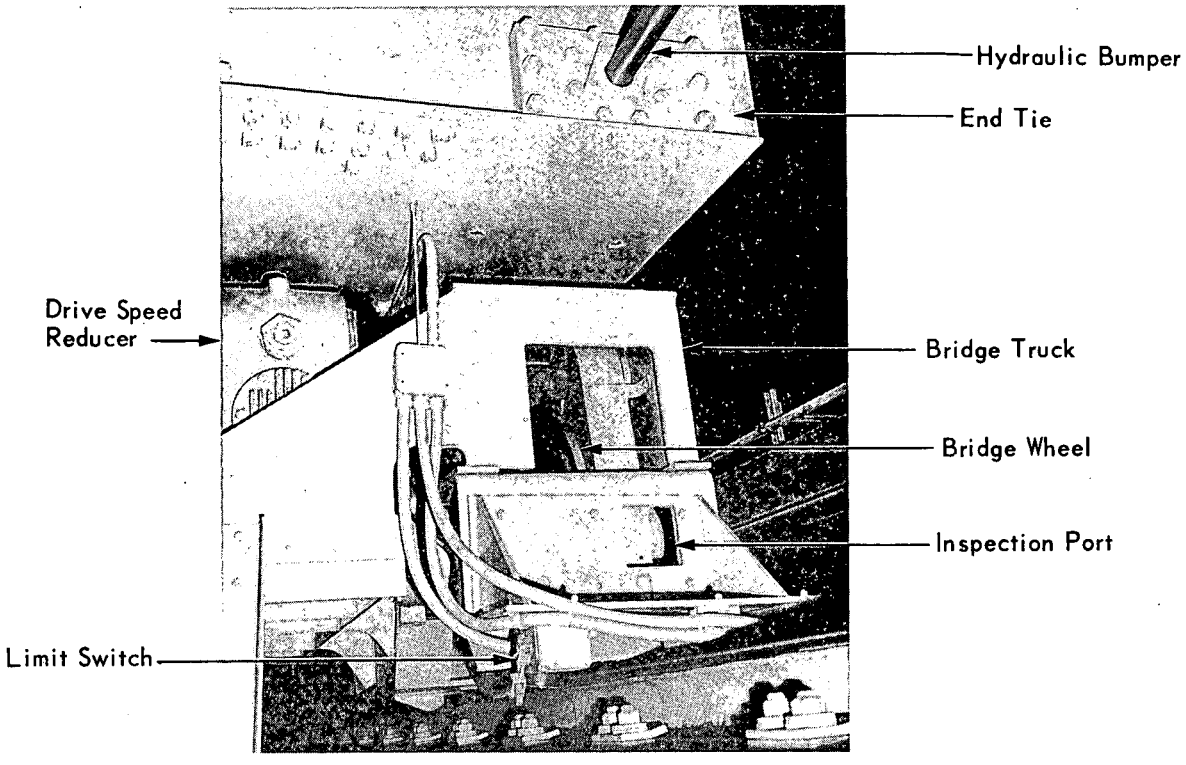


Fig. 2-8. Bridge Truck

2.9.2 Trolley Drive Trucks (See Colby Drawing D-27351).

The trolley is supported by four 27-inch matched wheels. All four are drive wheels. Drive mechanism is located on the north side of the trolley. There are two sets of drive motors and reduction gears, one right-hand and one left-hand. Each set drives an adjacent trolley wheel and, through a drive shaft, an opposite wheel on the other side of the trolley.

2.10 BUMPERS (See Colby Drawing C-28209)

The bridge is equipped with hydraulic bumpers on both sides. These are for emergency protection only in case of failure of end travel limit switches; they are not for use by the operator in stopping the crane at the end of travel. The trolley is equipped with double-ended bumpers; trolley stops are located along the trolley rail.

2.11 HOIST DRUMS (See Colby Drawing D-27323-I-(Plan View)

The main and auxiliary hoist drums, located on the trolley, have machined grooves for the wire rope and are grooved right and left hand from the center of the drum. All wire rope can be wound on the drums in a single layer. In each case, the drum drives are dual with a gear on each end of the drum. The drive pinions for these gears are driven by separate motors and enclosed gear sets. Provisions have been made for quickly disconnecting each drive by sliding the drive pinion from its splined shaft. Viewing ports have been cut into each end of the main and auxiliary hoist drum covers to allow inspection of the cable attach points to the drum.

2.12 REEVING

2.12.0 General

The reeving of the wire rope on the main and auxiliary load-blocks and drums is shown on Colby drawing D-27264. Reeving procedures are given in TM4-151-39, Maintenance Manual, Volume I.

2.12.1 Main Hoist Reeving

The main hoist block is double reeved. There are two separate wire ropes, each starting at opposite ends of the equalizer bar and dead-ending on the main hoist drum. In the event of failure of one of the main hoist wire ropes, the other will take up the full load with only a slight shift in the hook position.

In addition to the equalizer bar, there are six sheaves in a fixed position on the trolley and eight sheaves located on and moving with the load block. This gives the appearance of a 16-part block, although from the standpoint of block and rope movement, it is an 8-part block, as follows:

Mechanical advantage	8:1
Speed	1:8
Rope tension	1:16

For example (neglecting friction), a pull of 100 pounds on one hoist rope will produce a lift of 800 pounds on the hook.

2.12.2 Auxiliary Hoist Reeving

This also a double-reeved block:

Mechanical advantage	4:1
Speed	1:4
Rope tension	1:8

2.13 LOAD BLOCKS

2.13.1 Main Load Block (See Colby Drawing No. D-27322)

In addition to the reeving and rope tension features referred to in Paragraph 2.12, the main hook can be rotated by means of a motor and drive mechanism located in the load block. The drive mechanism includes a hydraulically operated sliding jaw clutch; see Paragraph 3.5.4 for description of clutch operation. Rotation of the hook is controlled from the console in the crane cab. See Paragraph 2.17 for performance speeds.

2.13.2 Auxiliary Load Block (See Colby Drawing No. D-27321)

This is a conventional, enclosed, antifriction-bearing, load block with no unusual features.

2.14 TRACK OILERS

Two bridge trucks, one for each end of the crane, are equipped with roller-type oilers for lubricating the sides of the crane rails. See figure 2-9 for an illustration of the applicator rollers. The rollers deposit a minute film of lubricant on the rails as the crane travels back and forth. The film of oil is of significant benefit in preventing wear on crane wheels and on the rails.

Operation of the track oilers is automatic. A pump for supplying oil to the felt rollers is mounted on the truck adjacent to the speed reducer. The pump is driven by an eccentric attached to the speed reducer output shaft. Supply lines connect the pump to the rollers.

2.15 CENTRAL LUBRICATION SYSTEM

The crane is equipped with a central lubrication system that provides measured lubrication to trolley components and to the bridge travel trucks. Three separate systems are used, one for the trolley and one for each end of the bridge. Each system consists of a hand pump, supply lines, and adjustment valves. See Colby drawings D-29121 and D-29122 and figure 2-10.

Operation of the handpump forces lubricant through the supply lines. Control over the quantity of lubricant is provided by the adjustable valves. The valves can be adjusted to supply a precise quantity of lubricant. The valves also indicate that the lubricant is being fed to the particular lubrication point.

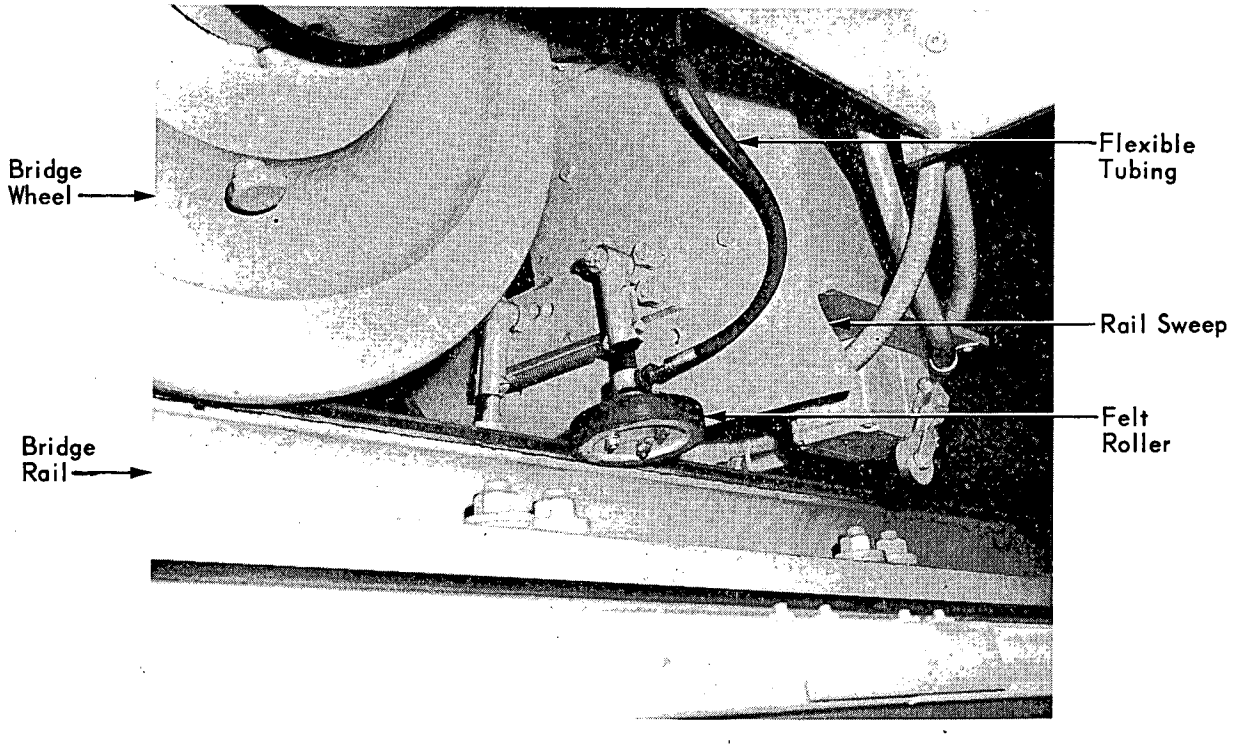


Fig. 2-9 Crane Rail Lubricator

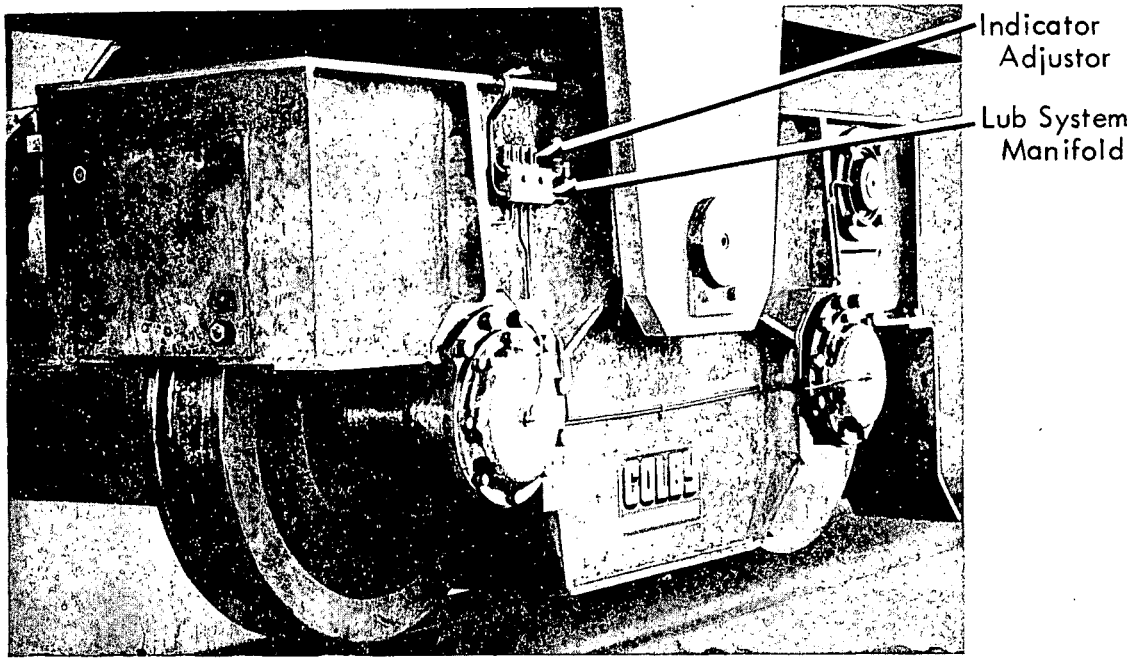


Fig. 2-10 Bridge Truck Lubrication System

2.16 SELSYN MOTOR SHAFT POSITION INDICATORS

Because of the tasks required of this crane in assembling and handling space vehicles, very close control is required for the positioning of the load hooks. To assist the crane operator, suitable displays and controls have been provided on the crane consoles.

The control console in the cab has four display dials showing movement of the bridge, trolley, main, and auxiliary hoist respectively. There is also a 5-digit counter for each movement. These digital counters can be reset to zero at any time by the crane operator. By watching the dials and using his controls, the crane operator can control all crane movements very closely.

As described in Paragraph 2.5.6, the position-indicator dials and digital counters are driven by synchros. When the crane and load block movements are slow, the dials and counters can be read to very small movements. The dials are shown on KSC drawing 67-K-L-11348 and the method of use is described in Paragraph 3.5 of this manual.

2.17 PERFORMANCE RATINGS

2.17.1 Load Capacities

Main hook . . . . . 175 standard short tons
Auxiliary hook . . . . . 25 standard short tons

2.17.2 Vertical Lift (from VAB ground floor)

Main hook . . . . . 160 feet 3 inches
Auxiliary hook . . . . . 169 feet

2.17.3 Main Hook Rotation

Two speeds, as selected:

1/2 rpm max., in either direction
1/4 rpm min., in either direction

2.17.4 Maximum Speeds (See Paragraphs 3.5.2 and 3.5.3 for speed range)

Bridge @ rated capacity	75 fpm
Trolley @ rated capacity	50 fpm
Main Hoist @ rated capacity	10 fpm
Auxiliary Hoist @ rated capacity	25 fpm
Main Hoist, empty hook	30 fpm
Auxiliary Hoist, empty hook	75 fpm

2.17.5 Class of Service

Electric Overhead Crane Institute Class "C", Moderate.

2.17.6 Electrical Ratings (100% Load)

Main Hoist	
MG Set Motor (ac)	323 amperes
Hoist Motor (dc)	340 amperes
Auxiliary Hoist	
MG Set Motor (ac)	150 amperes
Hoist Motor (dc)	144 amperes
Bridge Drive	
MG Set Motor (ac)	131 amperes
Drive Motor (dc)	52 amperes
Trolley Drive	
MG Set Motor (ac)	31.9 amperes
Drive Motor (dc)	35 amperes

2.18 ESTIMATED WEIGHTS

	Pounds
Bridge girders and walkways	138,000
End ties	37,400
Bridge travel trucks	32,000
Trolley sheave girders	9,000
Trolley end girders	9,600
Auxiliary hoist connecting girder	1,900
Main hoist drum and gear	52,600
Main hoist machinery	48,000
Auxiliary hoist machinery	40,000
Main hoist block	23,500
Auxiliary hoist block	1,000
Main and Auxiliary hoist wire rope	8,500
Operator's cab	4,000
Miscellaneous Electrics	42,000
Miscellaneous	10,050
Estimated Net Weight, Total	457,550 pounds

2.19 through 2.19.13 (Deleted)

SECTION III

OPERATING INSTRUCTIONS

3.0 GENERAL

It is recommended that crane operators first read the information given in Section II of this volume.

They should next study the drawings in Volume II to become familiar with the general construction and arrangement of the crane and its components.

It is the intention to limit the information given in this section, as far as practicable, to only that which is needed to operate the crane.

Information on lubrication, maintenance, and repair of mechanical equipment and components is contained in Volume I of the Maintenance Manual. Similar information for electrical equipment is contained in Volume II of the Maintenance Manual. The equipment and components usually included with the electrical system are: motors, generators, electric brakes, motor starting equipment, controls, control panels, distribution panels, and related electrical components such as relays, switches, circuit breakers, master switches, and resistance grids.

3.1 INITIAL CHECKS (For new or reactivated equipment)

NOTE: Equipment which is new or reactivated requires certain checks that are not necessary once the crane has been put into regular operation.

3.1.1 Check with maintenance personnel to see that all points of lubrication have been properly taken care of. Colby instructions are given in drawings furnished with the manuals. Vendor instructions are given in their literature which is furnished with the Maintenance Manual.

3.1.2 Check with electrical personnel to see that all electrical connections and settings have been checked out, that limit switches and breakers are properly set, that motor rotations are correct, and that electrical power is available to the crane.

3.1.3 Check the operating area and craneway to see that there are no temporary obstructions or installations which will interfere with required crane operation.

3.1.4 Check with the mechanical maintenance personnel to see that all mechanical equipment and components are in correct working order.

3.2 SAFE CRANE OPERATING PRACTICES

a. Do not load the crane beyond rated capacity. The capacity of the main hook is 175 tons; the auxiliary hook 25 tons.

b. Attach loads to hooks only with slings or other approved devices.

c. Make sure hoist cables are always straight and that they are never caught against obstructions.

d. Center the load block over the load if possible; avoid side pull.

e. Use approved communication between floor and operator.

f. Avoid sudden starts and stops. The crane has adequate speed control and can accelerate and decelerate smoothly.

g. Do not hoist while anyone is riding the load. Do not use crane for lifting personnel.

h. Do not carry loads over people unless necessary. Sound warning horn before load is moved. Foot operated horn switch is in operator's cab.

i. Do not use limit switches for normal operation. Limit switches are for emergency use. Control the crane with the master switches.

j. Do not leave the controls unattended with a load on either hook.

3.3 NORMAL OPERATION

3.3.0 General

All controls for this crane are located in the operator's cab which is mounted under the bridge structure. The cab console is described in Section II. Before the crane can be operated, electrical energy must be made available through the pickup shoes and conductors to the 1000-ampere main circuit breaker located on the crane bridge.

The operator should read the description of the controls in Section II of this manual before proceeding with actual operation of the crane.

After the steps are taken which are required in Preparation for Start-Up, the operator will be able to control the following crane movements:

Hoisting or lowering with the main load hook.
Hoisting or lowering with the auxiliary load hook.
Trolley travel (east and west).
Bridge travel (north and south).
Floating the load hooks.

3.3.1 Preparation for Start-Up

On the crane bridge, before entering the cab:

STEP 1

Close the main 1000-ampere circuit breaker. This is an enclosure on the bridge structure, adjacent to the motor control center.

STEP 2 (See KSC drawing No. 67-K-L-11348)

Close all circuit breakers on the motor control center as follows:

Bridge blower motors. ✓
Main and auxiliary hoist and trolley blower motors. ✓
Phase reversal. ✓
Cable reel panel. ✓
Swivel hook panel. ✓
Lighting transformer. ✓
Lighting distribution. ✓
Trolley drive. ✓
Bridge drive. ✓
Auxiliary hoist drive. ✓
Main hoist drive. ✓
Cable winder. ✓

NOTE: During normal day-to-day operation, it is permissable to leave these circuit breakers closed. When work is to be done on the circuits, these breakers must be opened. Likewise, if the crane is to be shut down and operations discontinued for several days or more, these circuit breakers should be opened.

WARNING: The circuit breakers should be locked open and placarded when electrical or other work is to be done on the crane.

STEP 3

Check to see that the floor and craneways are clear to carry out the necessary crane movements for the task at hand. Go to upper walkway and make a visual inspection of the trolley and rails.

STEP 4

Go to the lighting panel adjacent to the cab.

STEP 5

Turn on light circuits as required.
Next: Go to the cab console.

STEP 6

Check white POWER ON indicator light on upper panel. This should be lit. If not, notify electrical maintenance personnel and await investigation and correction.

INSERT B

STEP 7 Starting motor-generator sets

There are four motor-generator sets to put in operation, one each for the bridge, trolley, auxiliary hoist, and main hoist. START pushbuttons are provided for each of these from left to right on the upper panel of the console. Start each of these sets in turn. The auxiliary and main hoists are electrically interlocked, therefore only one of them will start at a time.

NOTE: With the completion of these seven steps, the crane is ready to operate. The status of the equipment is as follows:

Three motor-generator sets should be running with d-c power available to the motors for main or auxiliary hoisting, trolley, and bridge.

Green indicator lights should be lit for the three motor-generator sets in use.

Bridge, trolley, and one of the hoist motor load ammeters should show only no-load current values. The unused hoist motor load ammeter should show zero current.

All master switches should be in the neutral position.

All electric motor brakes are normally set in the ON position. If any motions are observed, press EMERG stop button on console and investigate.

The white POWER ON light should be lit on the upper panel.

3.4 CAB DISPLAYS

3.4.0 General

This section deals with the instruments that display information for the guidance of the crane operator.

3.4.1 Selsyn Motor Shaft Position Indicators

The cab console is equipped with 5-digit counters which show movement of the bridge, trolley, main, and auxiliary hoists. It also has dials which show crane movements. How these dials and counters work is described in Section II of this volume.

By observing selsyn motor shaft position indicators and 5 digit-counters, the operator can see the crane movements displayed for either direction.

On the dials:

Bridge	± 1/16 inch
Trolley	± 1/32 inch
Auxiliary Hoist (Vertical)	± 1/32 inch
Main Hoist (Vertical)	± 1/64 inch

On the counters (5 digits):

Feet and hundredths of a foot, xxx.xx

NOTE: To obtain close control over small movements, use the FINE speed on the SPEED SELECTOR SWITCHES.

3.4.2 Motor Ammeters

The cab console only is provided with ammeters, one for each crane motion of the bridge, trolley, main hoist, and auxiliary hoist. These ammeters show the motor current for a given crane movement. For example, there are four motors driving the bridge and the current displayed on the bridge ammeter is the sum of all four motors. This motor current is used by the crane operator as a guide to the motor load so that he can avoid overloading the drive motors and motor-generator sets. Approximate proper values of current for full load conditions are shown on the Operating Placard in the cab. These values are also used in obtaining hoist float settings.

3.4.3 Warning Indicators

Each bridge, trolley, auxiliary, and main hoist motor is equipped with a block of warning indicator lights. The corresponding blower motors are similarly equipped. The indicators will light up to indicate a motor overheat condition:

Amber . . . . . Blower motor
Red . . . . . Crane motion motor

In addition to the red warning light, a warning horn will sound in event of a motor overheating.

CAUTION: If an overheat condition is signaled by these warning indicators, the operator should shut down the crane as soon as feasible and call maintenance personnel. If operation is continued and temperatures continue to rise, the motor-generator set will be stopped automatically by a higher-set thermistor in the motor control circuit.

3.5 CONTROL OF CRANE MOVEMENTS FROM CAB

3.5.0 General

The control console is described in Paragraph 2.5, and illustrated in figure 2-6. In Paragraph 2.5.2.0, the operator's attention is called to the fact that the cab console has three types of devices on it. The operator will find his task simplified if he identifies these three types of devices as follows:

Group A

Devices that control crane movement or electrical energy, such as master switches, speed selector switches, start and stop pushbuttons, load sets, hook swivel, speed and direction control, remote control cable winder, control switch, power swivel clutch switch, and remote console selector switch.

Group B

Devices that display information for the operator's guidance in running the crane, such as shaft position indicators, 5-digit counters, motor ammeters, lock, unlock, motor-generator set running, travel speed selection, hoist speed selection.

Group C

Warning lights such as POWER ON, PUMP ON, MOTOR OVERHEAT, and BLOWER OVERHEAT.

NOTE: The crane can be operated by following the various steps given below, after completing the Preparation for Start-Up (7 steps) given in Paragraph 3.3.1.

3.5.1 Float Control of Main and Auxiliary Hoists

This operation refers to holding the load motionless on the hook (either main or auxiliary) with no vertical movement and with the brake released. Motor torque and friction balance the pull of gravity on the load. When this operation is carried out, the three remaining master switches are in neutral and the electric brakes for those motions are set.

To adjust and maintain the main hook in the float condition, the operator uses the following:

Master switch.
Thumb latch (button on top of master switch). Leave engaged.
Brake release enable lever (squeeze-type, on side of master switch).
Load-set knob (load-float rheostat).
Position indicator dial and 5-digit counter.
Float switch (foot operated).

The operator uses the above controls and instruments as follows:

Master Switch — Keep in the OFF position. The thumb latch button will hold it there.

CAUTION: — Do not move the master switch from the OFF position during the float operation; to do so will stop the float condition.

Thumb Latch — This button operated detent will hold the master switch in the OFF position without any further control from the operator.

Brake Release Enable Lever — This is a squeeze-type lever located on the side of the master switch. The operator closes a (dead-man control) switch which allows the brake to be released upon master switch engagement.

Load Set Knob — This controls the load float rheostat and adjusts the motor current. It is turned by the operator with his right hand and adjusted as described below.

Float Switch — Transfers hoisting command signal origin from master switch to float rheostat.

Selsyn Shaft Position Indicator and Digital Counter

These units are on the upper panel of the console as shown on figure 2-6. They are described in Paragraph 2.16 of this manual.

Any movement of the load block up or down is displayed on the dial and counters. The main hoist movement, when very slow, can be read to 1/64 inch on the selsyn shaft position indicator, and estimated even closer.

Upward movement of block shows clockwise. Downward movement of block shows counterclockwise on the selsyn shaft position indicator.

Ammeter — This instrument shows the total direct current for drive motors. This is the total combined current of the two hoist motors. The range of the main hoist ammeter is ±600 amperes; the auxiliary hoist ±200 amperes.

NOTE: (1) The purpose of this equipment is twofold:

(a) To enable the operator to set the proper motor current to float the load which he has picked up.

(b) To be observed and interpreted by the operator to determine when the load is too great for the crane rating.

STEPS FOR SETTING HOIST FLOAT CURRENT

STEP 1

Using the master switch, pick up the load so that it is suspended from the hook and clear of the floor by 6 to 10 feet.

STEP 2

Stop hoisting by bringing the master switch to the off position where it is automatically held by the thumb latch detent.

STEP 3

When the hoisting speed is approximately zero, and with float knob approximately in the center position, depress the foot operated float switch and locate the desired setting of the load set knob per Step 4.

STEP 4 (While performing Step 3)

With the right hand, rotate the LOAD SET rheostat knob clockwise until the position indicator dial pointer starts to move clockwise also. (This action increased the hoist motor current and raised the load).

Read the current value on the ammeter.

NOTE (2): For illustration only, some current values will be assumed here. Actual values for full rated load will be given on the Condensed Operating Instructions Placard in the cab.

NOTE (3): This crane is equipped with d-c shunt motors where torque is proportional to current; i.e., if current is reduced one-half, the torque is also reduced one-half.

STEP 5 (While performing Step 3)

Rotate the LOAD SET rheostat counterclockwise until the POSITION INDICATOR dial pointer starts to move counterclockwise.

Read the current value on the ammeter.

NOTE (4): In Step 4, the operator took an ammeter reading which showed the motor amperes which were necessary to just start moving the load up.

Assume, for example, that this was 300 amperes.

In Step 5, the operator took an ammeter reading which showed the motor amperes which were necessary to just let the load start moving down.

Assume, for example, that this was 150 amperes.

Between these two readings is the correct amperage which will keep the load floating. The best practice is to set a value of motor current which is nearer the low reading.

In this example, the high reading (Step 4) was 300 amperes. The low reading (Step 5) was 150 amperes. The recommended setting would be approximately 175 amperes.

STEP 6 (While performing Step 3)

With the LOAD SET knob, set the motor amperes to the desired value. (In this example, at 175 amperes.)

NOTE (5): The operator has now accomplished the two-fold purpose of the equipment as stated in Note (1):

(a) He has established a current value for floating the load that was on the hook. If this was for full-rated load of 175 tons, he knows that at half load he will need about half the amperes. In this example, that will be approximately 90 amperes, and similarly for other load values.

(b) In the example used, the rated load of 175 tons, gave a maximum reading of 300 amperes on the meter. Assume that after picking up an unknown load, the maximum reading as obtained in Step 4 was 360 amperes. This is 20 percent above normal for the load. This is an indication that either the load is greater than the rated capacity or that there is something wrong with the equipment. Such an event should be reported at once.

STEP 7

While in the float control condition, the operator may raise or lower the load by rotating the LOAD SET rheostat knob slowly until motion is indicated on the selsyn shaft position indicator.

Clockwise	UP
Counterclockwise	DOWN

CAUTION: Prolonged operation on the float control condition is not recommended. Continuous operation at float or low speeds cuts down brush and commutator life.

3.5.2 Hoisting and Lowering, Main and Auxiliary

STEP 1

Pull the HOIST SPEED SELECTOR switch lever out far enough to unlock it for free rotation. This is located on the lower desk panel. The switch has three speed ranges from which to select as required. The HIGH speed is used only with an empty hook.

Engage the desired speed by rotating the HOIST SPEED selector switch:

Switch Marking	Max. Ft./Min. Main	Max. Ft./Min. Aux.	Min. Ft./Min. Main	Min. Ft./Min. Aux.	Indicator Light
FINE	1	2.5	0.1	0.25	Green
COARSE	10	25	1	2.5	Amber
HIGH	30	30	1	2.5	Red

STEP 2

Operate the hoist up or down using the master switch (main or auxiliary).

DOWN Push master switch lever away from operator.
UP Pull master switch lever towards the operator.

CAUTION: Prolonged operation at minimum speeds is not recommended Continuous operation at slow speeds cuts down brush and commutator life.

3.5.3 Travel Motions, Trolley and Bridge

STEP 1

Pull the TRAVEL SPEED SELECTOR switch lever out far enough to unlock it for free rotation. The switch is located on the lower desk panel. The switch has two speed ranges FINE and COARSE from which to select as required.

Engage the desired speed by rotating the TRAVEL SPEED selector switch:

Switch Marking	Max. Ft./Min. Bridge	Max. Ft./Min. Trolley	Min. Ft./Min. Bridge	Min. Ft./Min. Trolley	Indicator Light
FINE	7.5	5	0.75	0.5	Green
COARSE	75	50	7.5	5	Amber

STEP 2

Operate the trolley or bridge in either direction using the master switches provided:

Trolley travel WEST	-	Push master switch lever away from operator.
Trolley travel EAST	-	Pull master switch lever towards the operator.
Bridge travel NORTH	-	Pull master switch lever towards the operator's right.
Bridge travel SOUTH	-	Push master switch lever

NOTE: The operator is provided with position indicator dials, 5-digit counters, and ammeters for his guidance on the travel and bridge movements. These are described in Paragraph 3.4. With these instruments and the master switches, the operator can spot the bridge and trolley to a very close location.

The squeeze lever on the side of the master switch releases the electric (spring set) brake. Any time the master switch is returned to neutral and the squeeze lever released, the brakes will set.

3.5.4 Hook Swiveling

The main hook can be rotated thru 360 degrees or more from the cab permitting angular orientation of the load as desired (See Paragraph 2.13.1). Two rotative speeds are provided in both directions. The hook swiveling motor receives its power from the trolley through reeled conductor cable. The cable reel motor has torque in only the up direction. When the main hook is lowered, it pulls the cable from the reel down against the torque of the reel motor. No attention is required from the operator for this.

NOTE (1): The reel motor is always energized when the main hoist brake relay is energized.

NOTE (2): The POWER SWIVEL CLUTCH switch and the HOOK SWIVEL SPEED & DIRECTION CONTROL SWITCH are both spring return to the OFF position. This means that they must be held in position by the operator at any switch location other than OFF.

STEP 1

Start the hydraulic pump motor in the load block by turning the POWER SWIVEL CLUTCH switch to LOCK, and hold it there.

NOTE: The pump will activate a hydraulic cylinder in the load block which will try to engage a sliding-jaw clutch. This in turn engages the hook swiveling mechanism consisting of the swivel motor, shafting, sliding jaw clutch, and bevel gearing. If the clutch engagement is successful, it will be so indicated by lighting of the amber indicator lamp in this group. (Lighting of the red lamp indicates only that the hydraulic pump is running).

If the clutch engagement is not successful, the amber light will not come on. (The red light should remain lit, showing that the hydraulic pump is running).

STEP 2

With the POWER SWIVEL CLUTCH switch still on LOCK, jog the HOOK SWIVEL SWITCH in either direction until the amber light goes on; this indicates that the clutch is now properly engaged and the load hook can be swiveled.

CAUTION: When the POWER SWIVEL CLUTCH switch is held in either LOCK or UNLOCK, the hydraulic pump should be running and the red indicator light should be lit. If this light is not lit, the operator should report this to maintenance personnel.

STEP 3

Start the hook swivel motor (attached to the load block) in its low speed (No. 1) in the desired direction (clockwise or counterclockwise) using the HOOK SWIVEL SPEED & DIRECTION CONTROL switch. This switch is located in the lower right-hand corner of the upper control panel.

The switch positions are as follows:

OFF
CCW-1 - Counterclockwise low speed
CCW-2 - Counterclockwise high speed
CW-1 - Clockwise low speed
CW-2 - Clockwise high speed

(Low speed; 1/4 RPM; high speed 1/2 RPM).

The operator may advance to the high or maximum hook rotation speed as desired.

NOTE: There is no display showing the rotation position of the load hook. Proper positioning can be secured only by sight or communication between the operator and authorized floor personnel.

STEP 4

To discontinue and disengage the hook swivel mechanism, proceed as follows:

Allow the HOOK SWIVEL SPEED & DIRECTION CONTROL SWITCH to return to the OFF position by spring action.

Turn the POWER SWIVEL CLUTCH SWITCH TO UNLOCK and hold it there.

When the green, UNLOCK indicating light goes on, allow the POWER SWIVEL CLUTCH switch to return to OFF.

The indicating lights in this group show the following:

Green — is on when unlocked.
is off when locked.

Amber — is on when locked.
is off when unlocked.

Red — is on when pump is running.
is off when pump is not running.

3.6 through 3.6.4 (Deleted)

3.7 BRIDGE SKEW CORRECTION

Paragraph 2.7 describes the necessity for an occasional check on possible skewing of the bridge structure. As explained, the bridge is driven by four separate motors, and the electrical connections are such that normally no skew condition will exist.

The existence of skew can be checked by carefully bringing the crane bumpers up against the stanchions at the end of travel. If there is skew, there will be an opening between one of the bumpers and its stanchion. To close this gap and take out the skew, the drive motors on one side can be de-energized by opening knife switch 3KS in the motor-generator set control panel for bridge drive. The motor-generator is located just above the operator's cab on the lower walkway. The gap can then be equalized slowly with the drive motors controlled from the operator's console.

NOTE (1): The maximum skew or out-of-square condition permissible with this crane is a gap of 10 inches between crane bumper and end stanchion at one side. This is based on the stanchions being 89 feet apart with their faces square with the crane rail within 1 inch in 89 feet, and with one crane bumper in contact with one stanchion. The gap, if any, should be measured at the other stanchion.

NOTE (2): Be sure to close switch 3KS after aligning bridge.

3.8 RECOVERY FROM TRIPPING OF OVERTRAVEL LIMIT SWITCHES

All crane movements are protected by overtravel limit switches which set the spring-applied brakes. These limit switches can be reset by backing off with the master or other switches provided in the opposite direction from that which caused the trip. Once the limit switch has been reset in this fashion, the operator can again proceed in the original direction. This should be done with caution as the limit switches are put there to protect personnel and equipment.

If it appears that a limit switch requires adjustment, refer it to electrical maintenance personnel.

3.9 EMERGENCY STOP

3.9.1 To shut down all crane operations immediately from the cab:

Push the EMERGENCY STOP (red mushroom button).

NOTE: This opens each of the four circuit breakers in the motor control center which feed the main hoist, auxiliary hoist, trolley, and bridge motor-generator sets and controls. This sets all brakes and shuts down all four motor-generator sets, but leaves all other power on, including the lighting circuits.

CAUTION:

The EMERGENCY STOP button is not a regular operating control and should be used only in those special situations where it is necessary.

3.9.2 To shut down all crane operations immediately from any of the remote EMERGENCY STOP stations:

Push the EMERGENCY STOP (pendant button).

NOTE: This opens the substation breaker, which is the crane power source, sets all brakes and shuts down all crane functions.

3.9.2.1 Six remote EMERGENCY STOP stations are located on both sides of the transfer aisle.

3.10 SHUTTING DOWN THE CRANE

3.10.1 Short-term shutdown

When shutting down the crane for periods up to one or two hours, take the following steps:

STEP 1

Deposit any hook loads on the operating floor or as directed by an individual with proper authority.

CAUTION: Never leave the crane unattended while a load is suspended from either hook.

STEP 2

Pull up both main and auxiliary hooks close enough to the bridge to prevent fouling of obstructions and swaying of the cables during crane travel.

STEP 3

Push the STOP buttons for each of the four motor-generator sets.

NOTE: The crane equipment is now in the following condition:

The motor-generator sets are shut down.
The crane motion motors (travel and hoisting) are de-energized.
The motor blowers are de-energized.
All crane motion brakes are spring-set.

The following circuits are still energized:

Lights.
Main hook swivel.
Main hook cable reel motor.
Remote cable reel motor.
White POWER ON console light.
Phase-reversal relay and motor-generator start circuits.

STEP 4

Close the cab door.

3.10.2 Indeterminate Shutdown

When the period of shut-down is more than 2 hours, the following procedure should be followed:

Carry out the first four steps as in Paragraph 3.10.1 and follow with:

STEP 5

Open the main circuit breaker in the motor control center on the bridge.

3.10.3 Crane Exercise

This crane is not equipped with heating elements to drive off accumulated moisture from panels, motors, generators, and other items of electrical equipment. Suitable exercising will keep the equipment dry. This is very important in humid climates where moisture accumulates due to condensation. Make sure the crane is operated at least once a week. Special exercise is not required if the crane is in service. If the crane is idle, however, start up motor-generator sets and exercise all crane motions for about one hour each. Operation at high speed is recommended. During the period of exercise, all limit switches should be actuated at least once to ensure their proper operation.

3.10.4 Long-term Shutdown and Storage

Where the crane is to be shut down for a number of months or more, it should be suitably prepared for long-time storage. Recommendations for storage are contained in the Maintenance Manual.

3.11 EMERGENCY OPERATION

The d-c drive motors are conservatively sized and equipped with blowers which allow the drive motors to operate at a high overload capacity.

The hoists and trolley are equipped with two motors each and the bridge with four motors. In case of a failure of one motor, the crane can be operated with the remaining motors. However, this requires changing electrical connections by maintenance personnel.

Single-motor operation, where the crane motion normally requires two motors, will require double the current that would be drawn with two motors running.

The Maintenance Manual tells how to change connections for single-motor operation.

ECN 75479

W.O. 7038-1085-72

DATE June 16, 1972

O&M CRITERIA SHEET

TM4-151-39
Volume I of II
Operating Instruction Manual

The following criteria are recommended:

1. Paragraph 2.5.2.2, second paragraph, page 2-7. Add the following as the first unit on the upper panel:

   Coarse Speed Enable Switch for increasing speed of bridge while operating inside slowdown limits.

2. Fig. 2-6, page 2-8. Add callout to identify COARSE SPEED ENABLE Switch.

3. Paragraph 3.5.3, page 3-10. Add the following information at the end of 3.5.3.

   Coarse Speed Enable Switch

   The Coarse Speed Enable switch is installed to provide increased speed of bridge while operating inside slowdown limits. The operator must manually reset the circuit for fast speed operation.

ECN 75511

W. O. 7038-1244-73

DATE October 30, 1972

O&M CRITERIA SHEET

TM4-151-39
TM4-152-39

NOTE

EO's to 79K02342 and 79K02343 provide for the installation of strip heaters on the DC motor-generator sets in the 175-ton and the 250-ton bridge cranes in the VAB of LC-39. The heaters are installed to reduce moisture condensation during periods of crane inactivity, and range in ratings from 125 to 200 watts. Power for the heaters is obtained from the revised light fixture wiring in the motor-generator set control cabinets. The heaters are fed from circuit breakers 9 and 11 in each control cabinet, are energized at time of installation, and remain energized during crane operation and storage.

The following criteria are recommended:

TM4-151-39 (Operating, Volume II of II)

1. Page 57, Figure 52. Add lamp circuit between circuit breaker and grounded side of transformer secondary as shown in Figure 1 below.

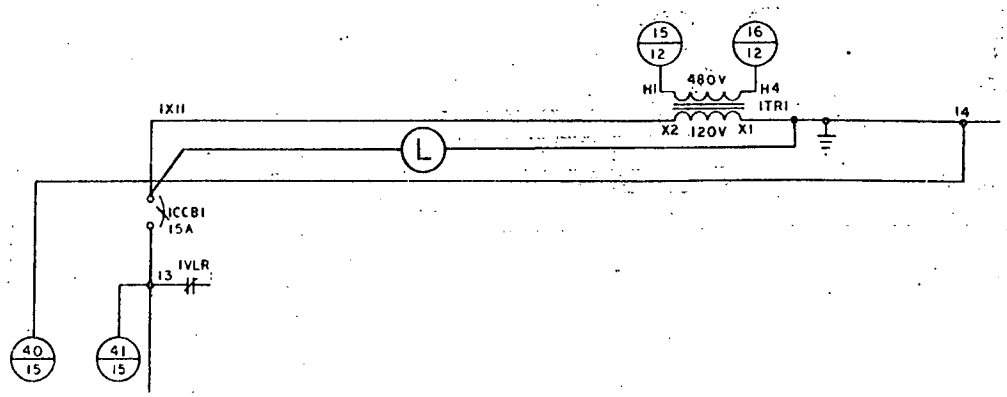


Figure 1. Revised Electrical Schematic, Console 7 Control - Main Hoist

2. Page 61, Figure 56. Add lamp circuit between circuit breaker and grounded side of transformer secondary as shown in Figure 2 below.

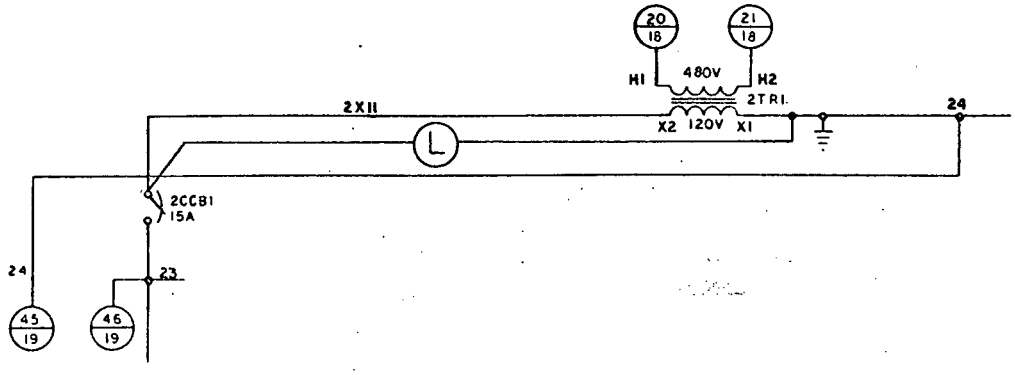


Figure 2. Revised Electrical Schematic, Console & Control - Auxiliary Hoist

3. Page 65, Figure 60. Add lamp circuit between circuit breaker and grounded side of transformer secondary as shown in Figure 3 below.

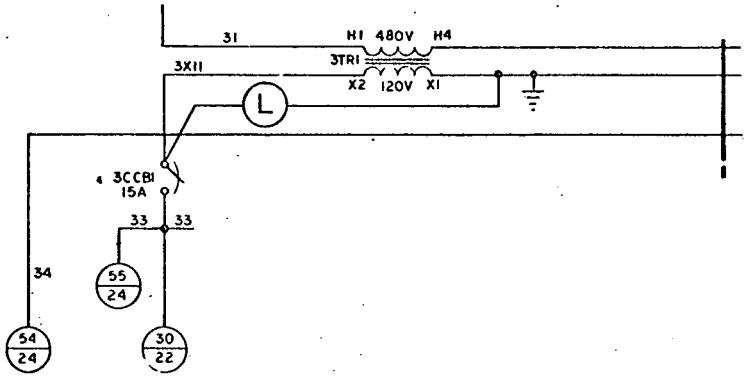


Figure 3. Revised Electrical Schematic, Starter & Brake Controls - Bridge

4. Page 69, Figure 64. Add lamp circuit between circuit breaker and grounded side of transformer secondary as shown in Figure 4 below.

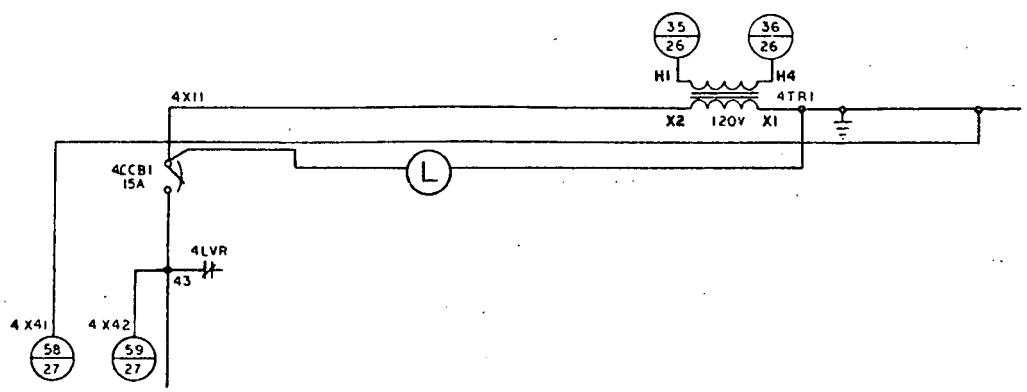


Figure 4. Revised Electrical Schematic, Console & Control - Trolley

5. Page 73, Figure 68. Revise legend at circuit breaker 9 from "MG Set Lights" to "MG Set Heaters", and revise legend at circuit breaker 11 from "Spare" to "MG Set Heaters", as shown in Figure 5 below.

FROM TO

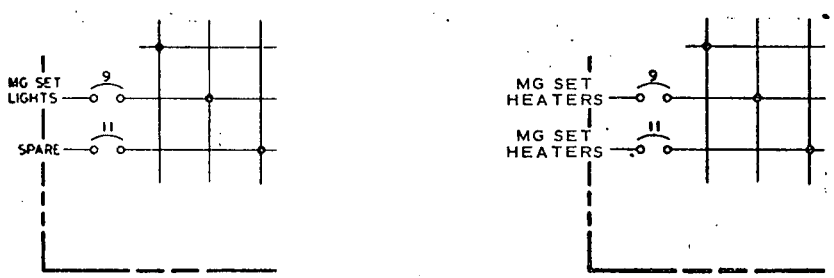


Figure 5. Revised Electrical Schematic, Phase Failure & Lighting

TM4-152-39 (Operating, Volume II of II)

1. Page 53, Figure 48. Add lamp circuit between circuit breaker and grounded side of transformer secondary as shown in Figure 1 below.

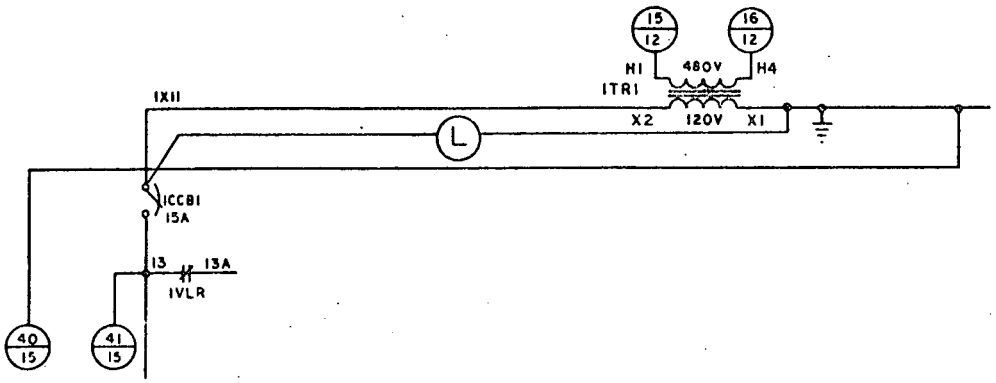


Figure 1. Revised Electrical Schematic, Console & Control - Main Hoist

2. Page 57, Figure 52. Add lamp circuit between circuit breaker and grounded side of transformer secondary as shown in Figure 2 below.

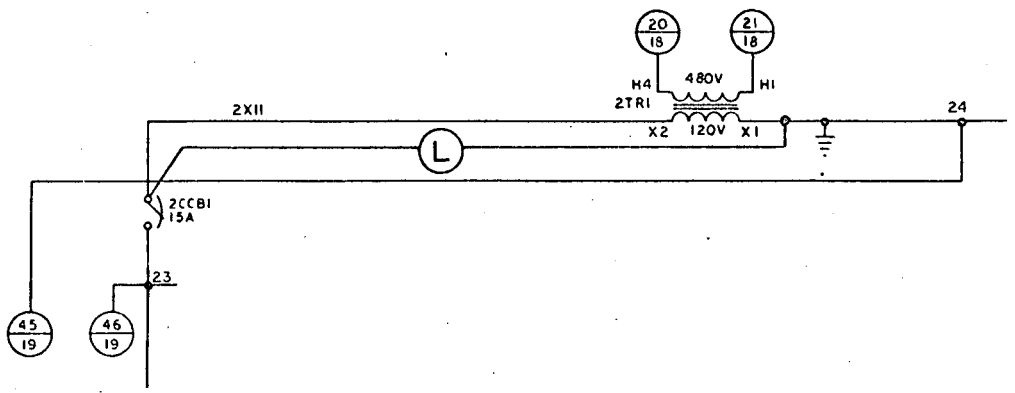


Figure 2. Revised Electrical Schematic, Console & Control - Auxiliary Hoist

3. Page 61, Figure 56. Add lamp circuit between circuit breaker and grounded side of transformer secondary as shown in Figure 3 below.

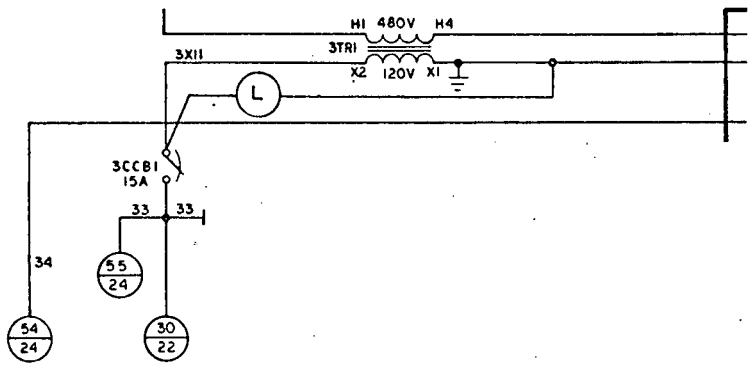


Figure 3. Revised Electrical Schematic, Start & Brake Controls - Bridge

4. Page 65, Figure 60. Add lamp circuit between circuit breaker and grounded side of transformer secondary as shown in Figure 4 below.

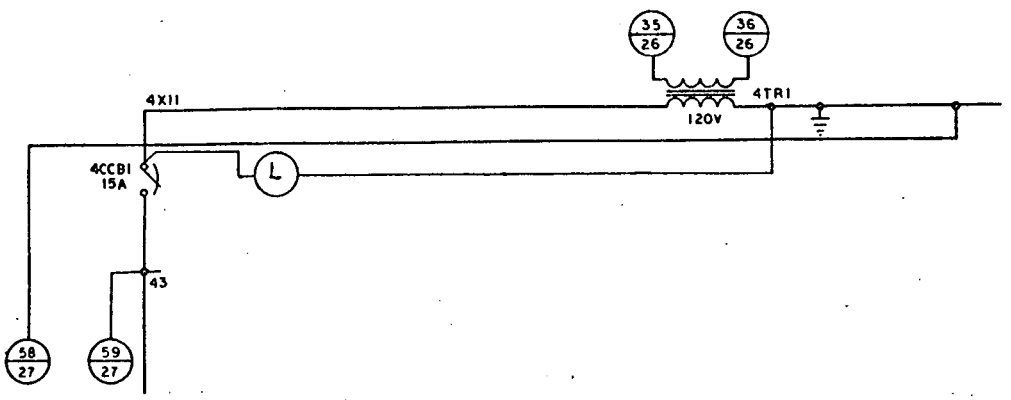
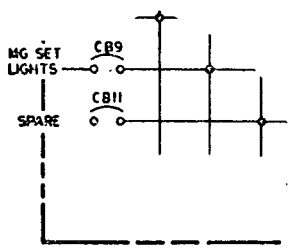


Figure 4. Revised Electrical Schematic, Console Control - Trolley

5. Page 69, Figure 64. Revise legend at circuit breaker 9 from "MG Set Lights" to "MG Set Heaters", and revise legend at circuit breaker 11 from "Spare" to "MG Set Heaters", as shown in Figure 5 below.

FROM



TO

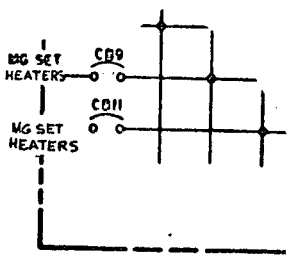


Figure 5. Revised Electrical Schematic, Phase Failure & Lighting

ECN 76201

W.O. 7038-1567-74

DATE August 3, 1973

O&M CRITERIA SHEET
TM4-152-39
Volume II of II
Operating Instruction Manual

The following criteria are recommended:

1. Page 52, Figure 17. Install field loss relays in series with motor fields as shown in Figure 1. Remove existing field loss relay and field bypass resistor and connect FWR to wire 1R15 as shown in Figure 2.

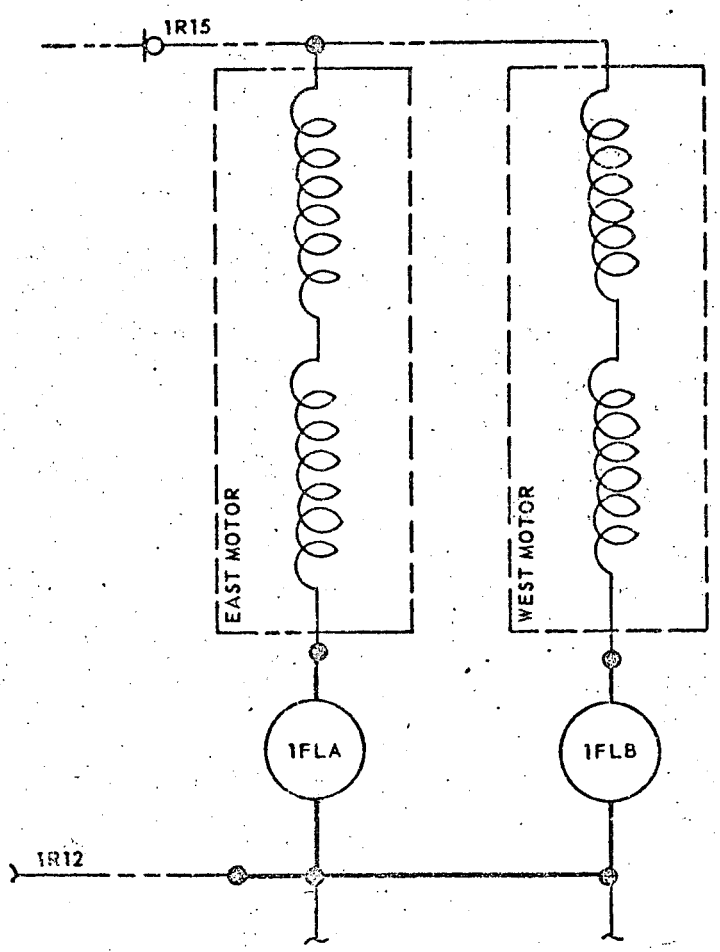


Figure 1. Revised Electrical Schematic Console and Control-Main Hoist

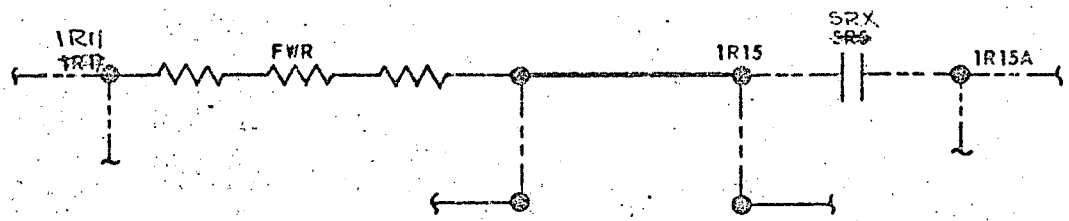


Figure 2. Revised Electrical Schematic, Console and Control-Main Hoist

2. Page 53, Figure 48. Install normally open contacts from field loss relays in series between voltage loss relay and overspeed interlock as shown in Figure 3.

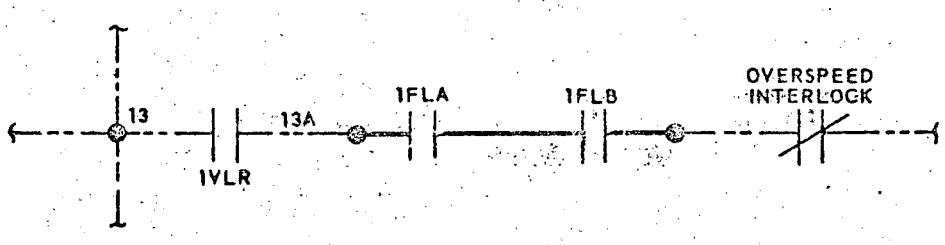


Figure 3. Revised Electrical Schematic, Console and Control-Main Hoist.

3. Page 57, Figure 53. Install normally open contacts from field loss relays in series between voltage loss relay and 20LA relay as shown in Figure 4.

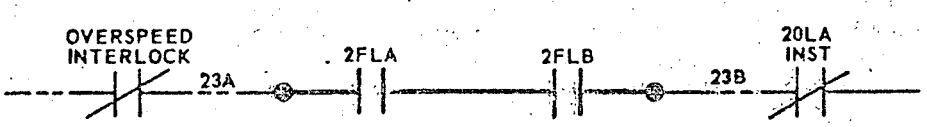


Figure 4. Revised Electrical Schematic, Console and Control-Auxiliary Hoist.

4. Page 58, Figure 53. Install field loss relays in series with motor fields as shown in Figure 5. Remove existing field loss relay and field loss bypass resistor and connect wire 2 FWR to RES A and SRX contact as shown in Figure 6.

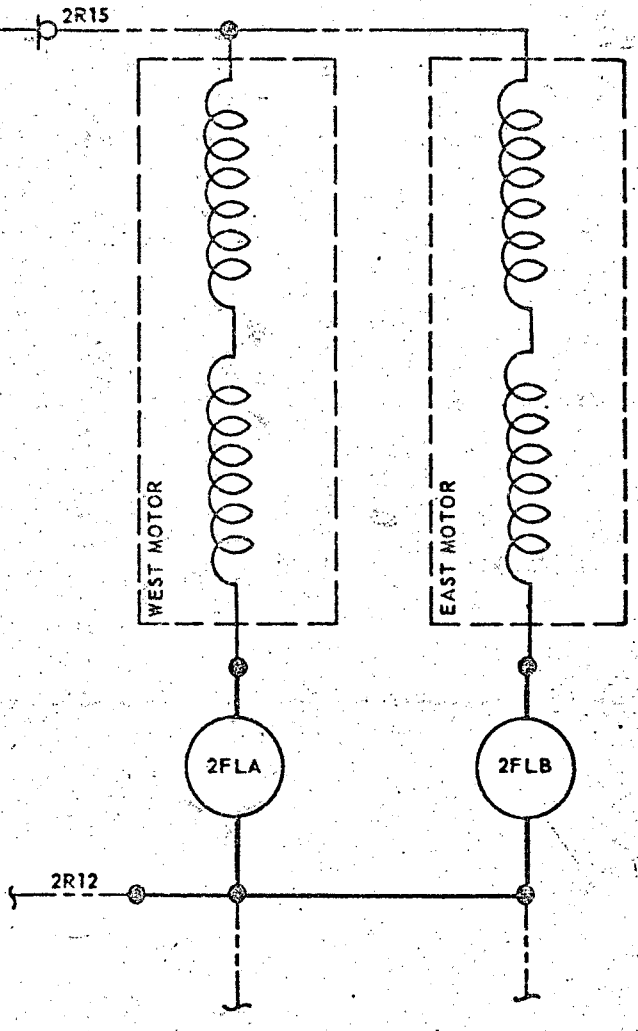


Figure 5. Revised Electrical Schematic, Motor Generator Control Circuit - Auxiliary Hoist.

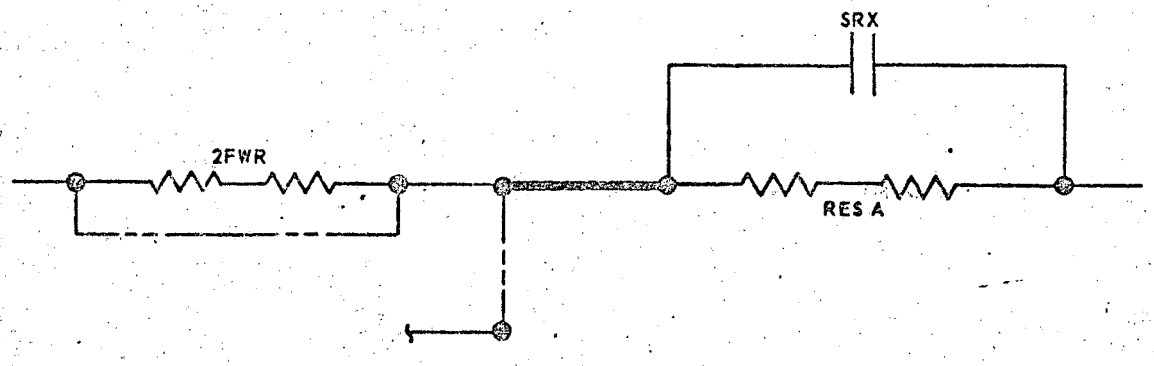


Figure 6. Revised Electrical Schematic, Motor Generator Control Circuit - Auxiliary Hoist

5. Page 61, Figure 56. Remove existing field loss relay and field loss bypass resistor and connect wire 3R11 to wire 3R13 as shown in Figure 7. Install normally open contacts from field loss relays in series between voltage loss and 33BB as shown in Figure 8. Install field loss relays in series with motor fields as shown in Figure 9.

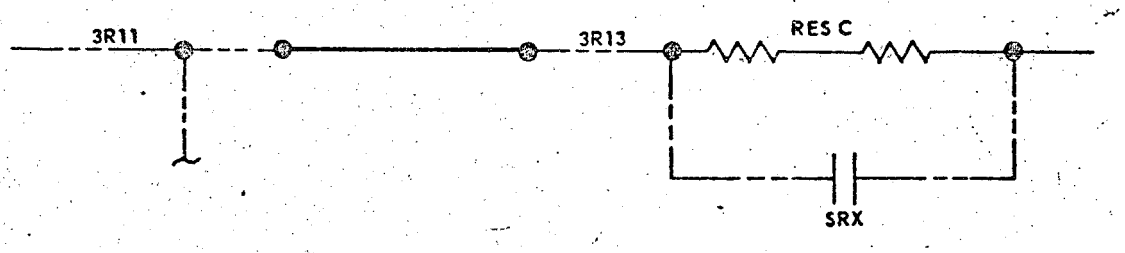


Figure 7. Revised Electrical Schematic, Starter and Brake Controls - Bridge

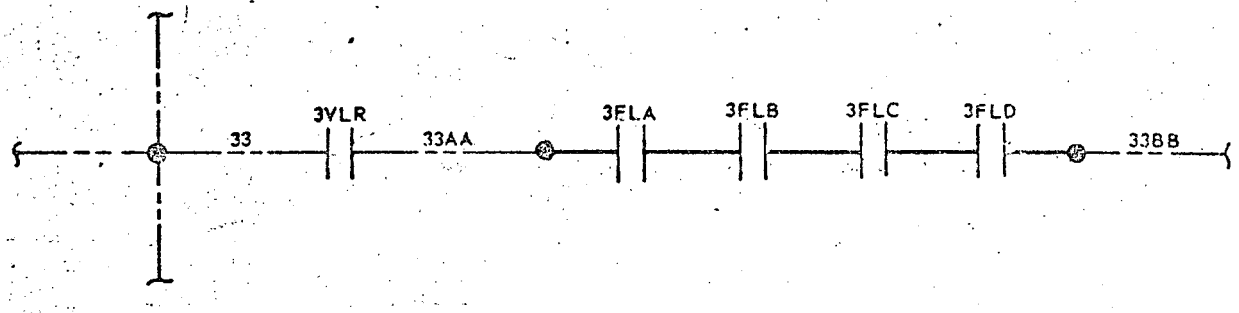


Figure 8. Revised Electrical Schematic, Starter and Brake Controls - Bridge.

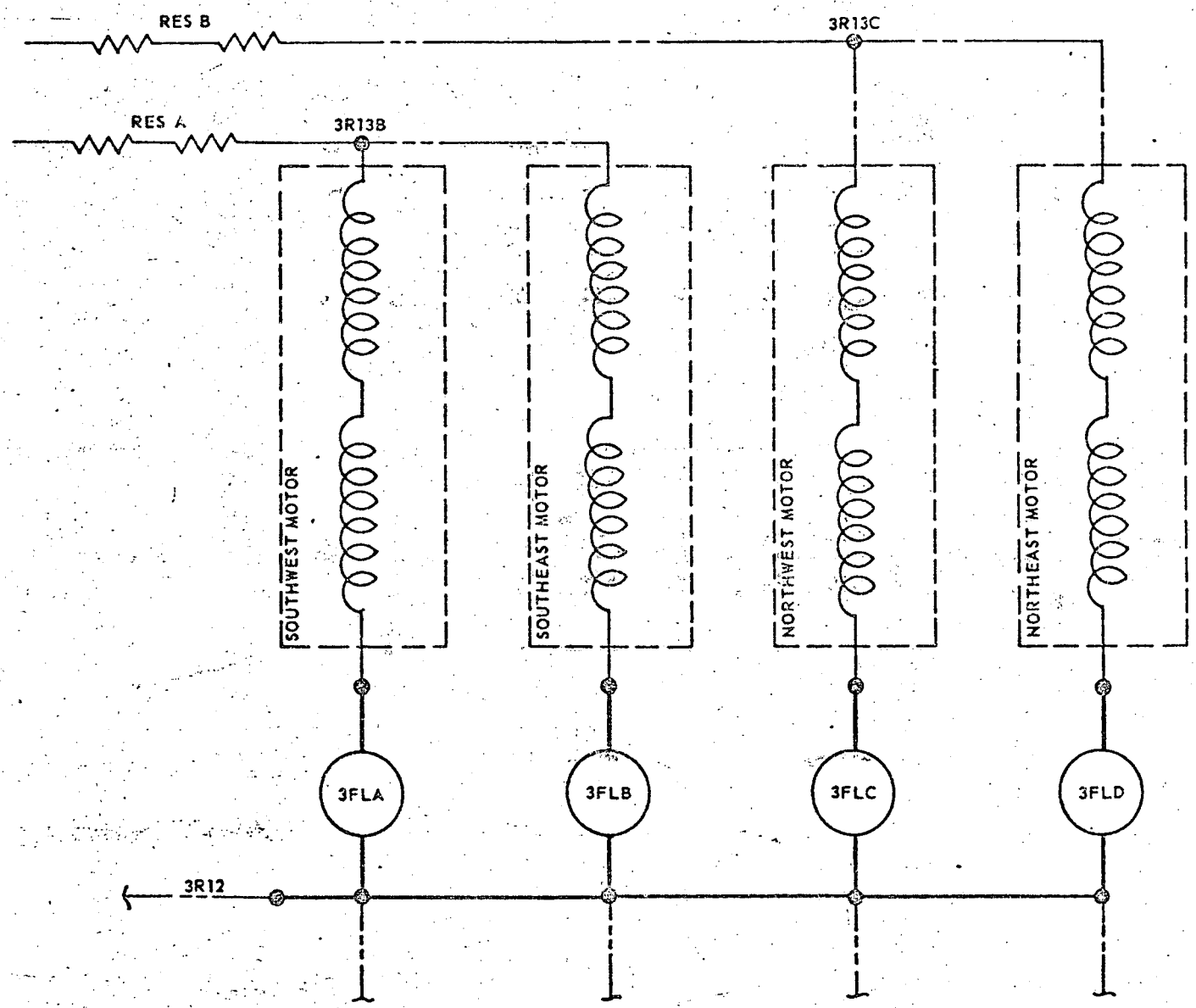


Figure 9. Revised Electrical Schematic, Starter and Brake Controls - Bridge

6. Page 65, Figure 60. Remove normally open contact of 4 FL from between 4 VLR and 40 LA and connect wire 43AA to wire 43B as shown in Figure 10. Install normally open contacts from field loss relays 4 FLA and 4 FLB in series between wire 43M and Trolley start 4 SR as shown in Figure 11.

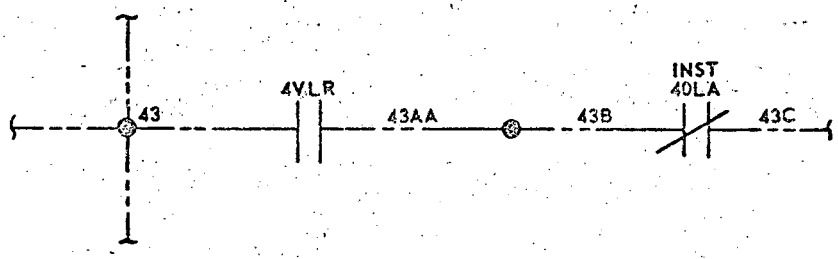


Figure 10. Revised Electrical Schematic, Control and Console - Trolley

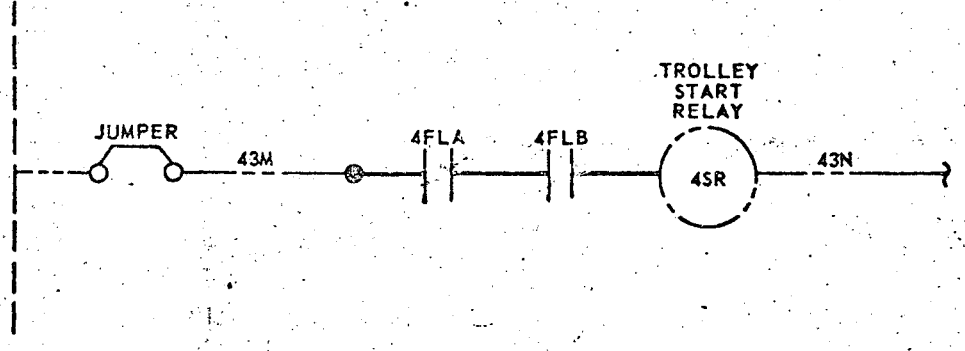


Figure 11. Revised Electrical Schematic, Control and Console - Trolley

7. Page 66, Figure 61. Remove existing field loss relay and field loss bypass resistor and connect wire 4R11 and wire 4R13 as shown in Figure 12. Install field loss relays in series with motor fields as shown in Figure 13.

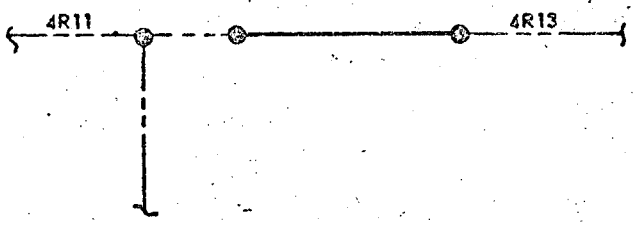


Figure 12. Revised Electrical Schematic, DC Power Supply and Motor Field Control - Trolley

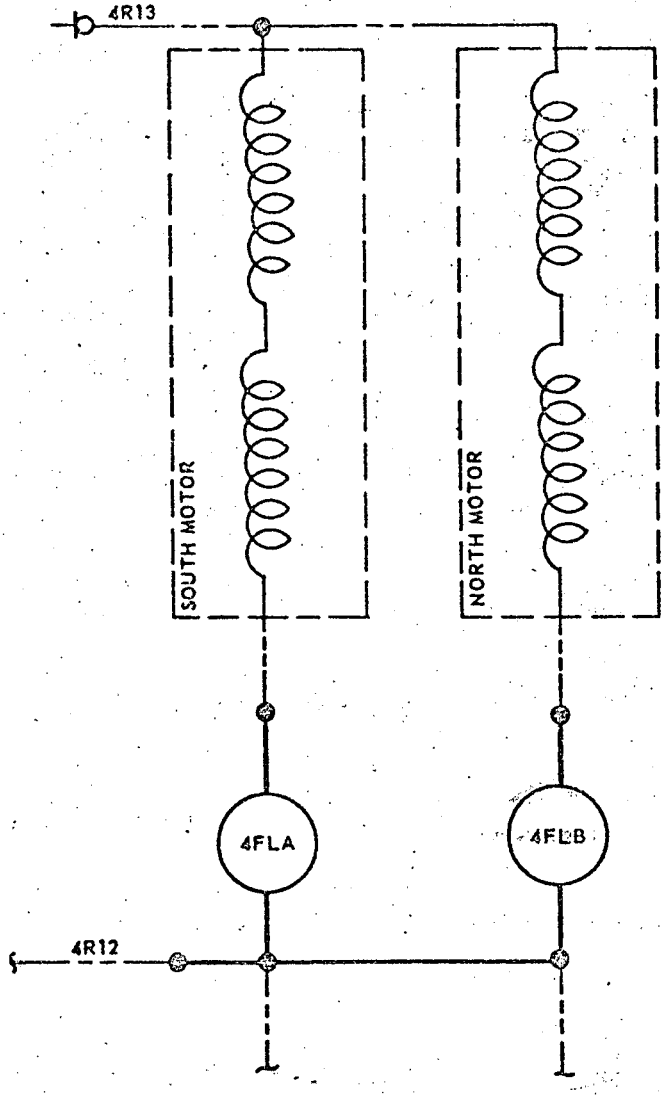


Figure 13. Revised Electrical Schematic, DC Power Supply and Motor Field Control - Trolley

TM4-151-39

JOHN F. KENNEDY
SPACE CENTER

TECHNICAL MANUAL

APOLLO/SATURN

LAUNCH COMPLEX 39

OPERATING INSTRUCTION MANUAL

175-TON BRIDGE CRANE

VOLUME I OF II

ECN 75479

W.O. 7038-1085-72

DATE June 16, 1972

O&M CRITERIA SHEET

TM4-151-39
Volume II of II
Operating Instruction Manual

The following criteria are recommended:

1. Page 54. Change sheet 10 of 67-K-L-11348 to indicate changes shown on Figure 1 of this criteria sheet.

2. Page 66. Change sheet 22 of 67-K-L-11348 to indicate changes shown on Figure 2 of this criteria sheet.

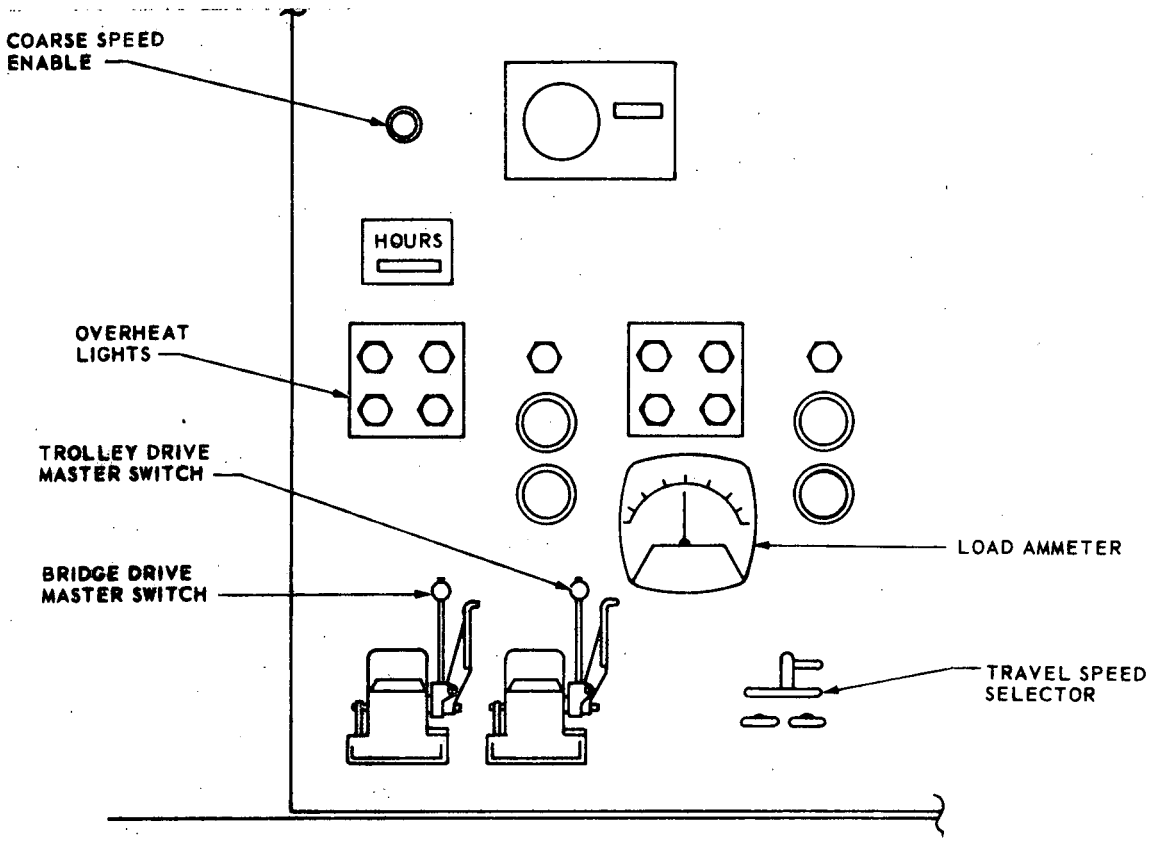


Figure 1

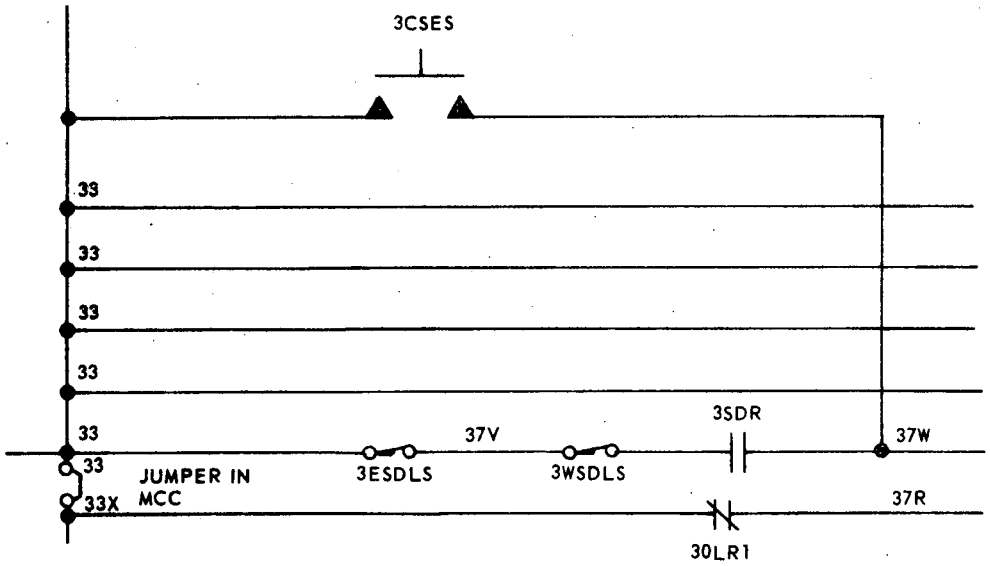


Figure 2

ECN 76201

W.O. 7038-1567-74

DATE August 3, 1973

O&M CRITERIA SHEET
TM4-151-39
Volume II of II
Operating Instruction Manual

The following criteria are recommended:

1. Page 56, Figure 51. Install field loss relays in series with motor fields as shown in Figure 1. Remove existing field loss relay and field bypass resistor and connect FWR to wire 1R15 as shown in Figure 2.

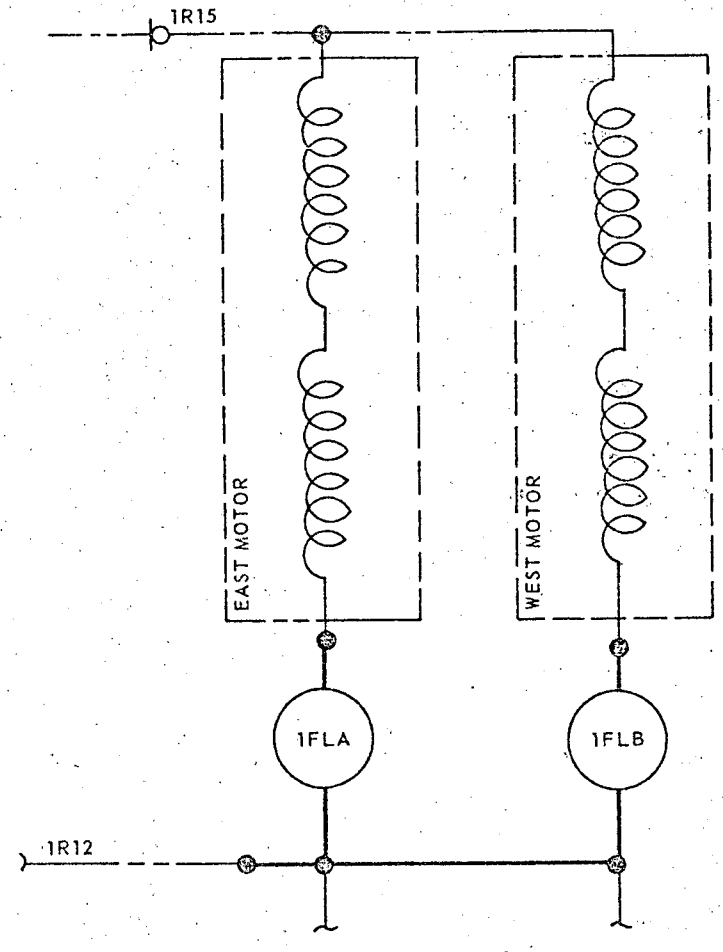


Figure 1. Revised Electrical Schematic Console and Control-Main Hoist

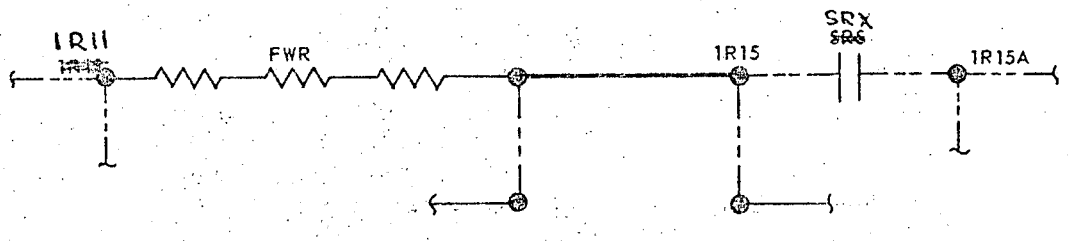


Figure 2. Revised Electrical Schematic, Console and Control-Main Hoist

2. Page 57, Figure 52. Install normally open contacts from field loss relays in series between voltage loss relay and over speed interlock as shown in Figure 3.

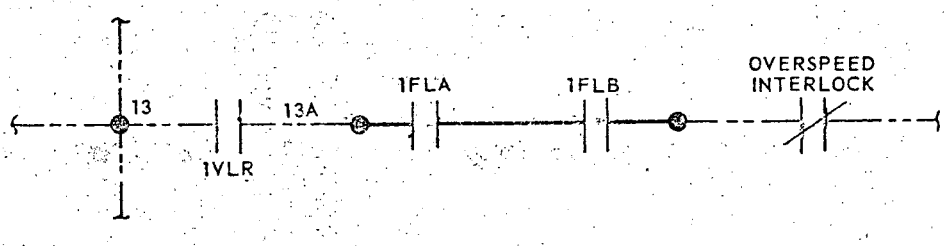


Figure 3. Revised Electrical Schematic, Console and Control-Main Hoist

3. Page 61, Figure 56. Install normally open contacts from field loss relays in series between voltage loss relay and 20LA relay as shown in Figure 4.

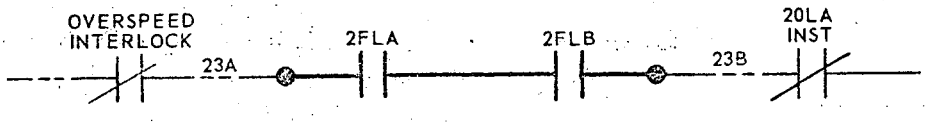


Figure 4. Revised Electrical Schematic, Console and Control-Auxiliary Hoist.

4. Page 62, Figure 56. Install field loss relays in series with motor fields as shown in Figure 5. Remove existing field loss relay and field loss bypass resistor and connect wire 2 FWR to RES A and SRX contact as shown in Figure 6.

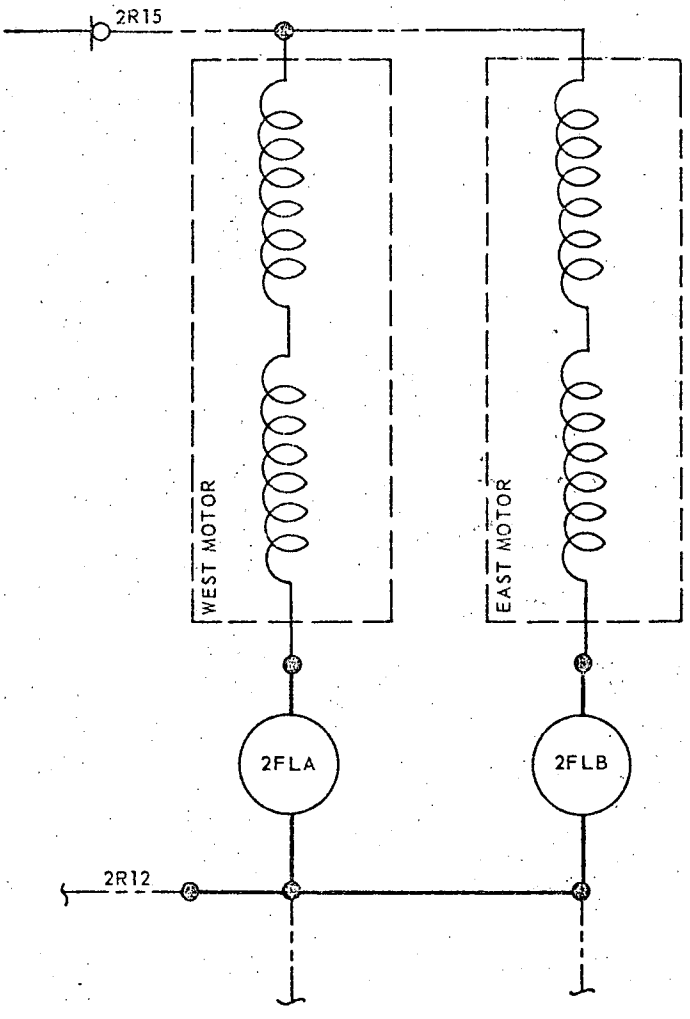


Figure 5. Revised Electrical Schematic, Motor Generator Control Circuit - Auxiliary Hoist.

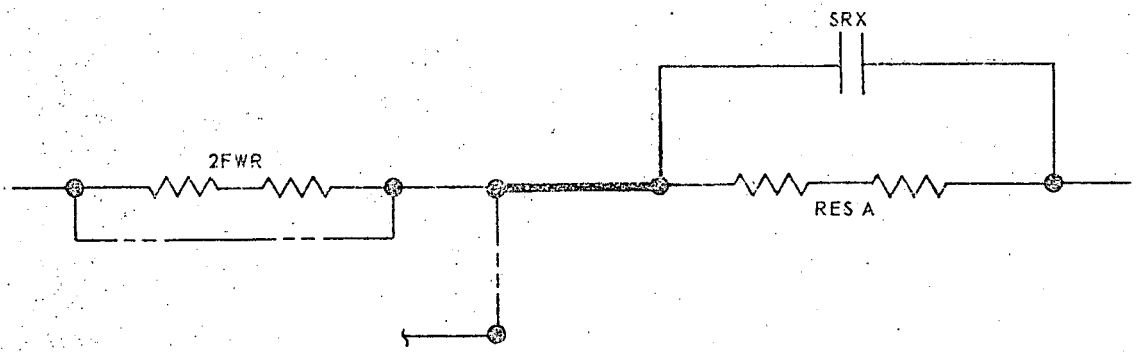


Figure 6. Revised Electrical Schematic, Motor Generator Control Circuit - Auxiliary Hoist

7. Page 65, Figure 60. Remove existing field loss relay and field loss bypass resistor and connect wire 3R11 to wire 3R13 as shown in Figure 7. Install normally open contacts from field loss relays in series between voltage loss and 33BB as shown in Figure 8. Install field loss relays in series with motor fields as shown in Figure 9.

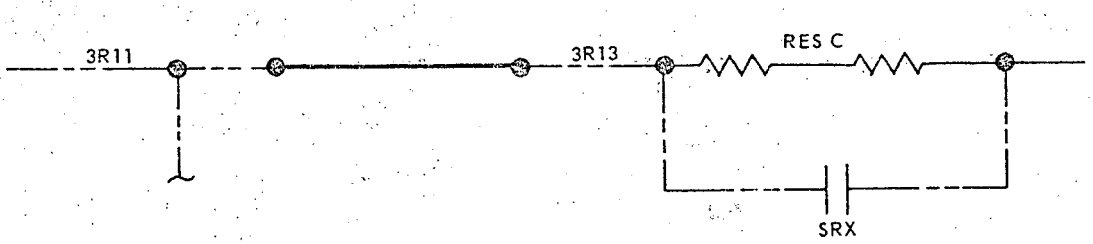


Figure 7. Revised Electrical Schematic, Starter and Brake Controls - Bridge

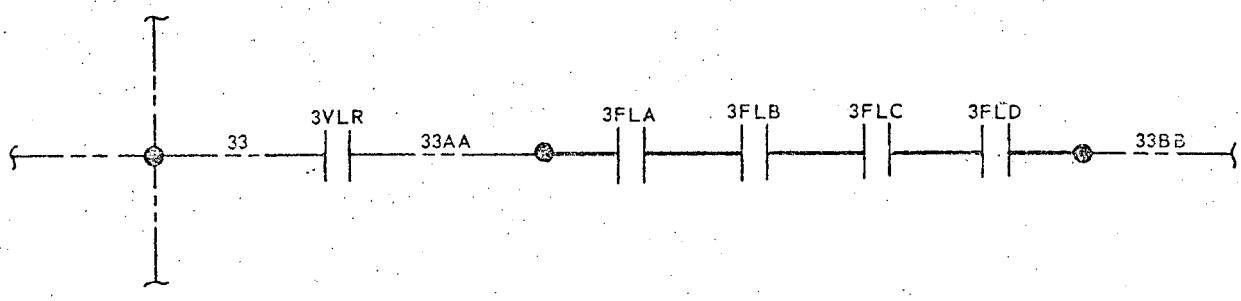


Figure 8. Revised Electrical Schematic, Starter and Brake Controls - Bridge.

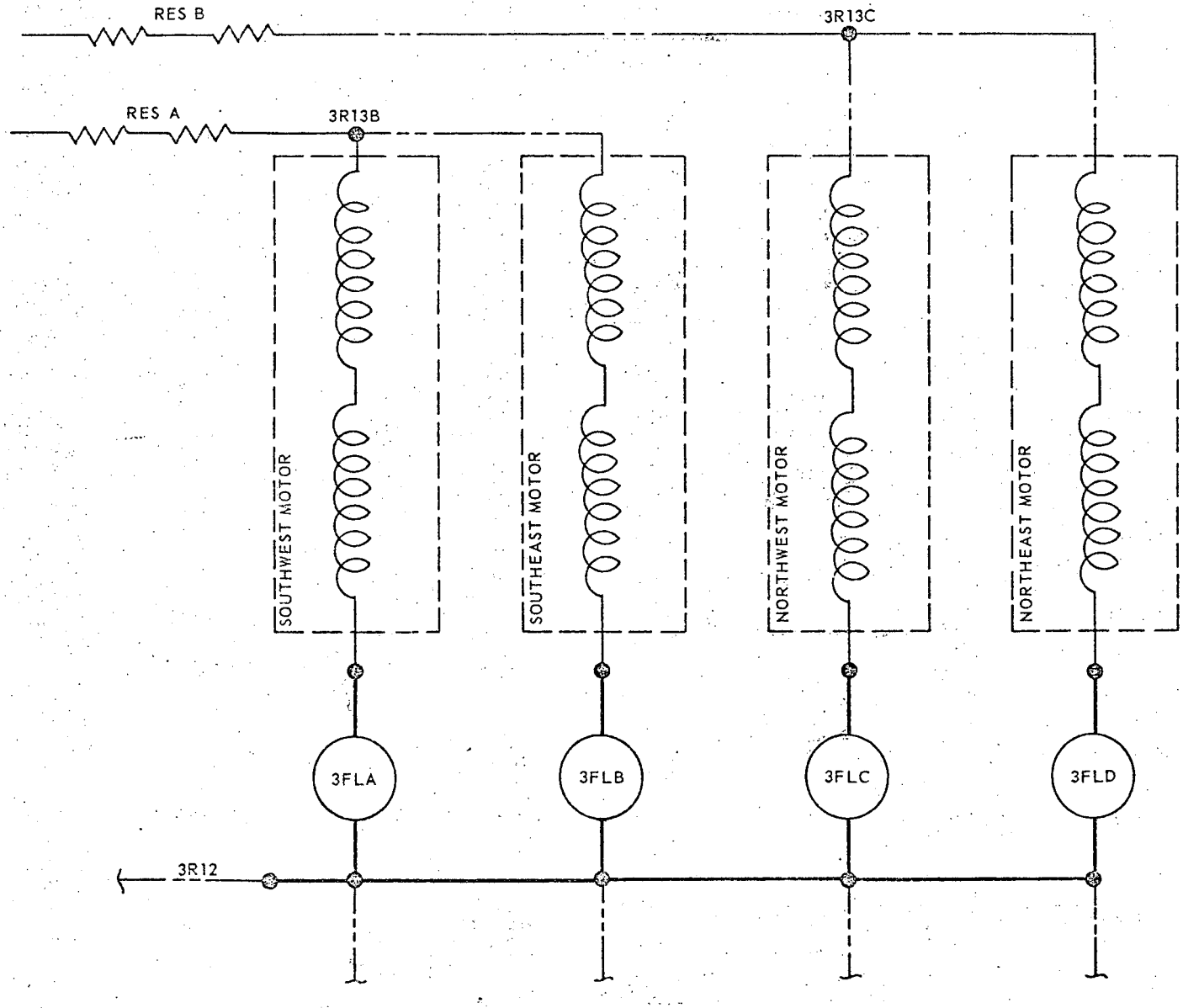


Figure 9. Revised Electrical Schematic, Starter and Brake Controls - Bridge.

6. Page 69, Figure 64. Remove normally open contact of 4 FL from between 4VLR and 40 LA and connect wire 43AA to wire 43B as shown in Figure 10. Install normally open contacts from field loss relays 4 FLA and 4 FLB in series between wire 43 M and Trolley start 4 SR as shown in Figure 11.

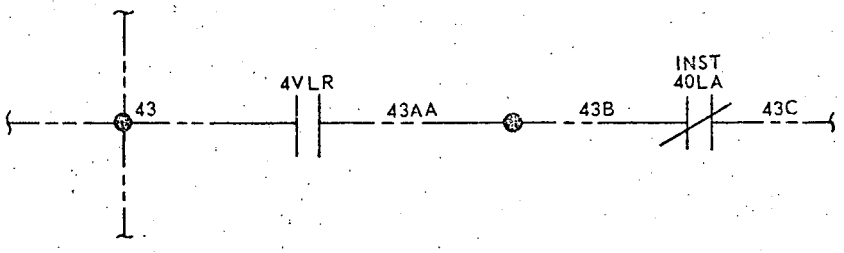


Figure 10. Revised Electrical Schematic, Control and Console - Trolley

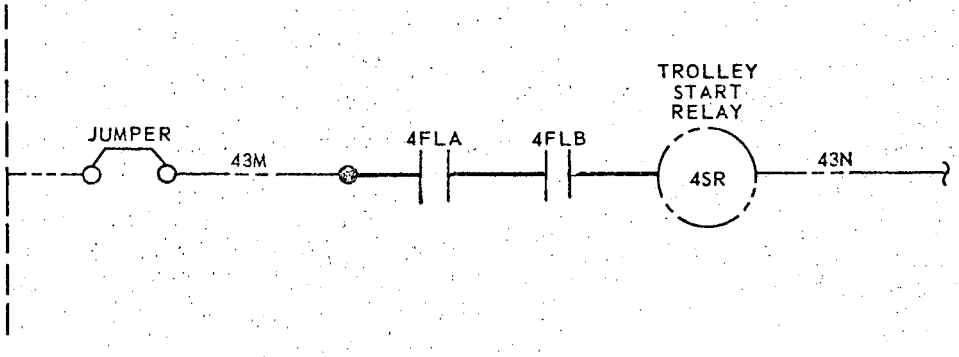


Figure 11. Revised Electrical Schematic, Control and Console - Trolley

7. Page 70, Figure 65. Remove existing field loss relay and field loss bypass resistor and connect wire 4R11 and wire 4R13 as shown in Figure 12. Install field loss relays in series with motor fields as shown in Figure 13.

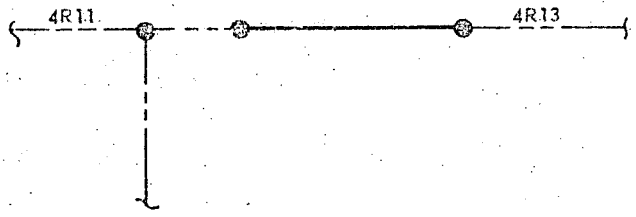


Figure 12. Revised Electrical Schematic, DC Power Supply and Motor Field Control - Trolley

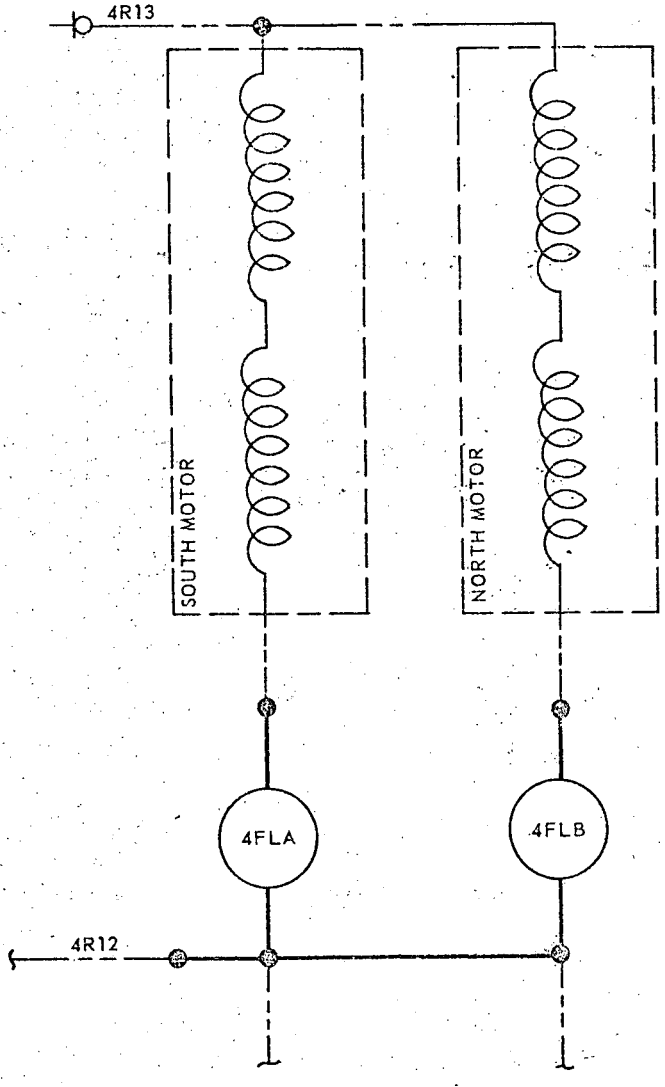


Figure 13. Revised Electrical Schematic, DC Power Supply and Motor Field Control - Trolley

ECN 75511

W. O. 7038-1244-73

DATE October 30, 1972

O&M CRITERIA SHEET

TM4-151-39
TM4-152-39

NOTE

EO's to 79K02342 and 79K02343 provide for the installation of strip heaters on the DC motor-generator sets in the 175-ton and the 250-ton bridge cranes in the VAB of LC-39. The heaters are installed to reduce moisture condensation during periods of crane inactivity, and range in ratings from 125 to 200 watts. Power for the heaters is obtained from the revised light fixture wiring in the motor-generator set control cabinets. The heaters are fed from circuit breakers 9 and 11 in each control cabinet, are energized at time of installation, and remain energized during crane operation and storage.

The following criteria are recommended:

TM4-151-39 (Operating, Volume II of II)

1. Page 57, Figure 52. Add lamp circuit between circuit breaker and grounded side of transformer secondary as shown in Figure 1 below.

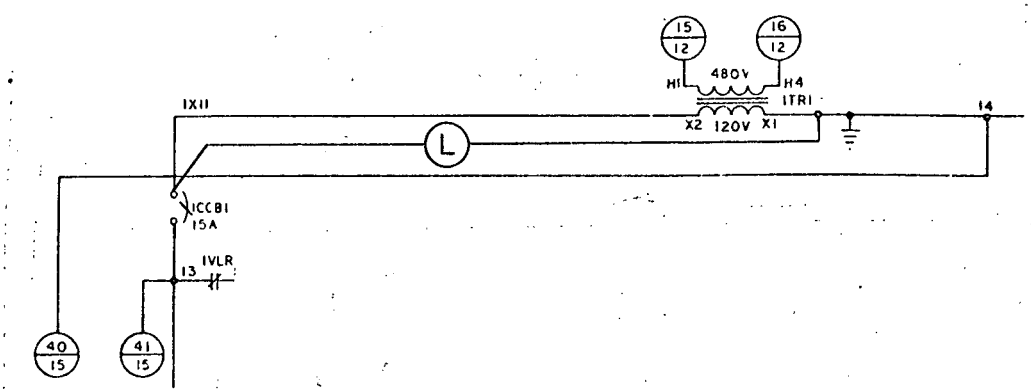


Figure 1. Revised Electrical Schematic, Console 7 Control - Main Hoist

2. Page 61, Figure 56. Add lamp circuit between circuit breaker and grounded side of transformer secondary as shown in Figure 2 below.

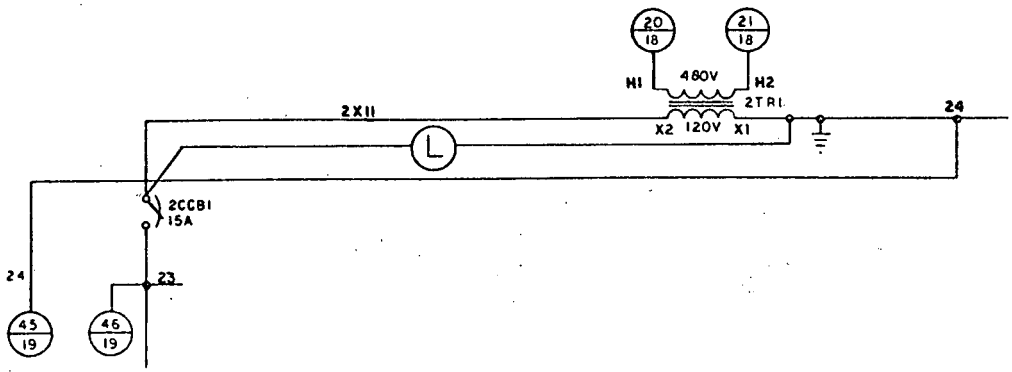


Figure 2. Revised Electrical Schematic, Console & Control - Auxiliary Hoist

3. Page 65, Figure 60. Add lamp circuit between circuit breaker and grounded side of transformer secondary as shown in Figure 3 below.

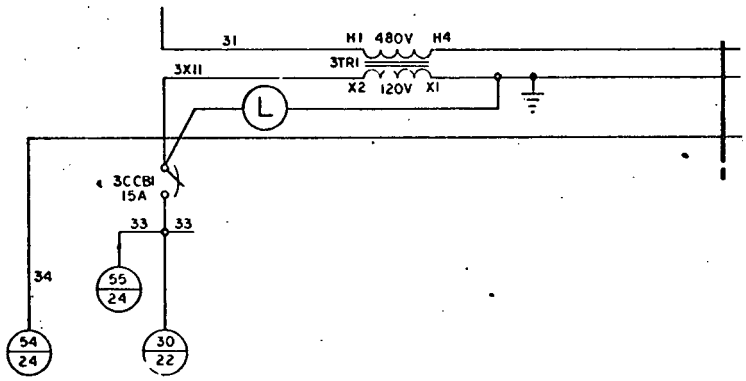


Figure 3. Revised Electrical Schematic, Starter & Brake Controls - Bridge

4. Page 69, Figure 64. Add lamp circuit between circuit breaker and grounded side of transformer secondary as shown in Figure 4 below.

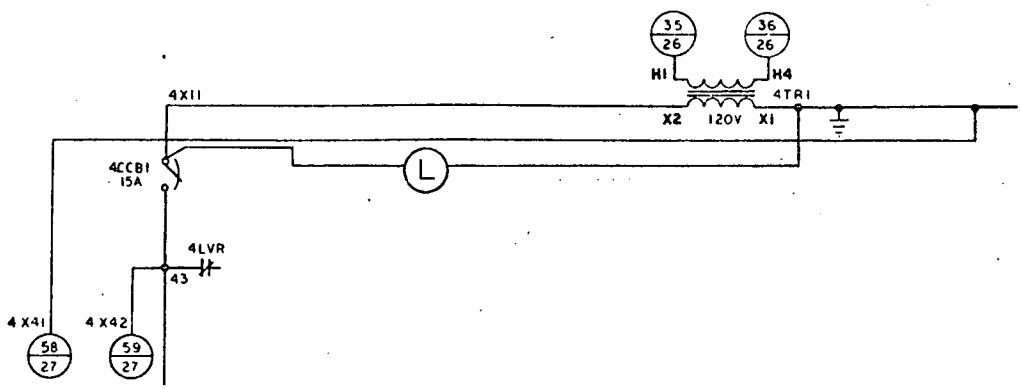


Figure 4. Revised Electrical Schematic, Console & Control - Trolley

5. Page 73, Figure 68. Revise legend at circuit breaker 9 from "MG Set Lights" to "MG Set Heaters", and revise legend at circuit breaker 11 from "Spare" to "MG Set Heaters", as shown in Figure 5 below.

FROM TO

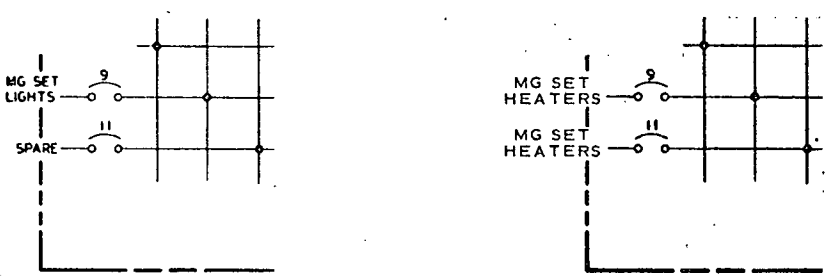


Figure 5. Revised Electrical Schematic, Phase Failure & Lighting

ECN 75511

DATE October 30, 1972

TM4-152-39 (Operating, Volume II of II)

1. Page 53, Figure 48. Add lamp circuit between circuit breaker and grounded side of transformer secondary as shown in Figure 1 below.

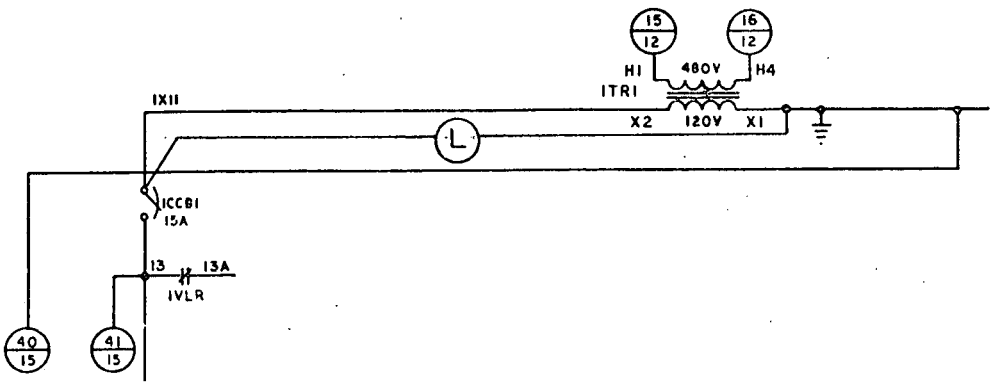


Figure 1. Revised Electrical Schematic, Console & Control - Main Hoist

2. Page 57, Figure 52. Add lamp circuit between circuit breaker and grounded side of transformer secondary as shown in Figure 2 below.

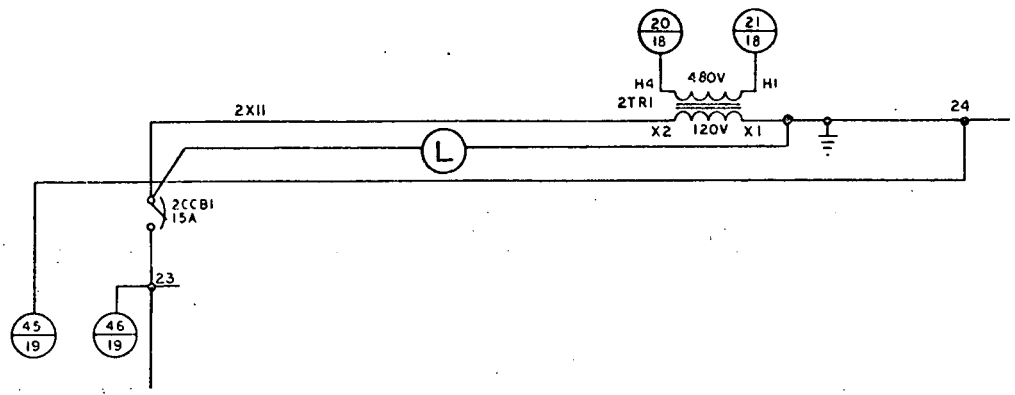


Figure 2. Revised Electrical Schematic, Console & Control - Auxiliary Hoist

3. Page 61, Figure 56. Add lamp circuit between circuit breaker and grounded side of transformer secondary as shown in Figure 3 below.

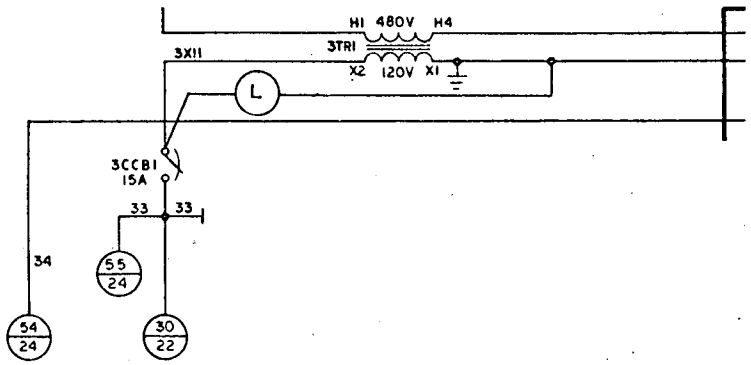


Figure 3. Revised Electrical Schematic, Start & Brake Controls - Bridge

4. Page 65, Figure 60. Add lamp circuit between circuit breaker and grounded side of transformer secondary as shown in Figure 4 below.

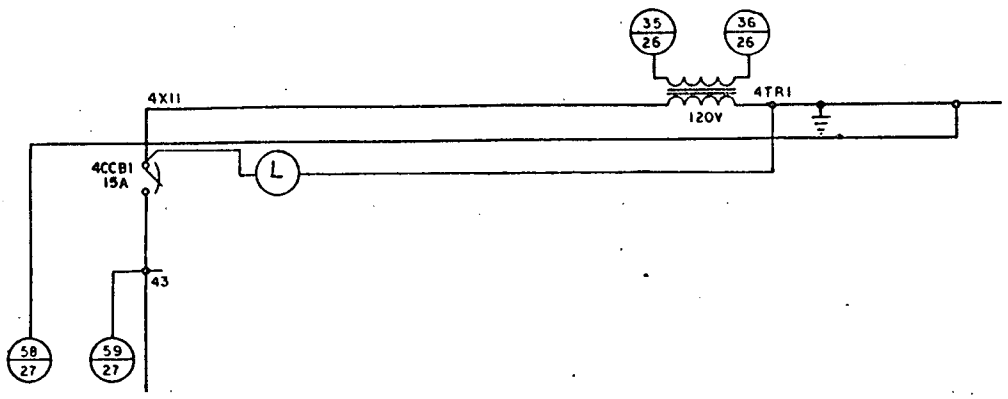
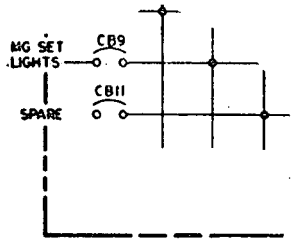


Figure 4. Revised Electrical Schematic, Console Control - Trolley

5. Page 69, Figure 64. Revise legend at circuit breaker 9 from "MG Set Lights" to "MG Set Heaters", and revise legend at circuit breaker 11 from "Spare" to "MG Set Heaters", as shown in Figure 5 below.

FROM



TO

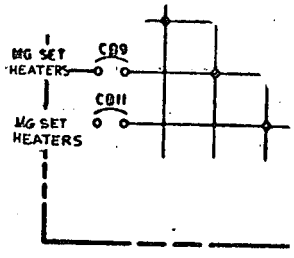


Figure 5. Revised Electrical Schematic, Phase Failure & Lighting

ECN 75479

W.O. 7038-1085-72

DATE June 16, 1972

O&M CRITERIA SHEET

TM4-151-39
Volume II of II
Operating Instruction Manual

The following criteria are recommended:

1. Page 54. Change sheet 10 of 67-K-L-11348 to indicate changes shown on Figure 1 of this criteria sheet.

2. Page 66. Change sheet 22 of 67-K-L-11348 to indicate changes shown on Figure 2 of this criteria sheet.

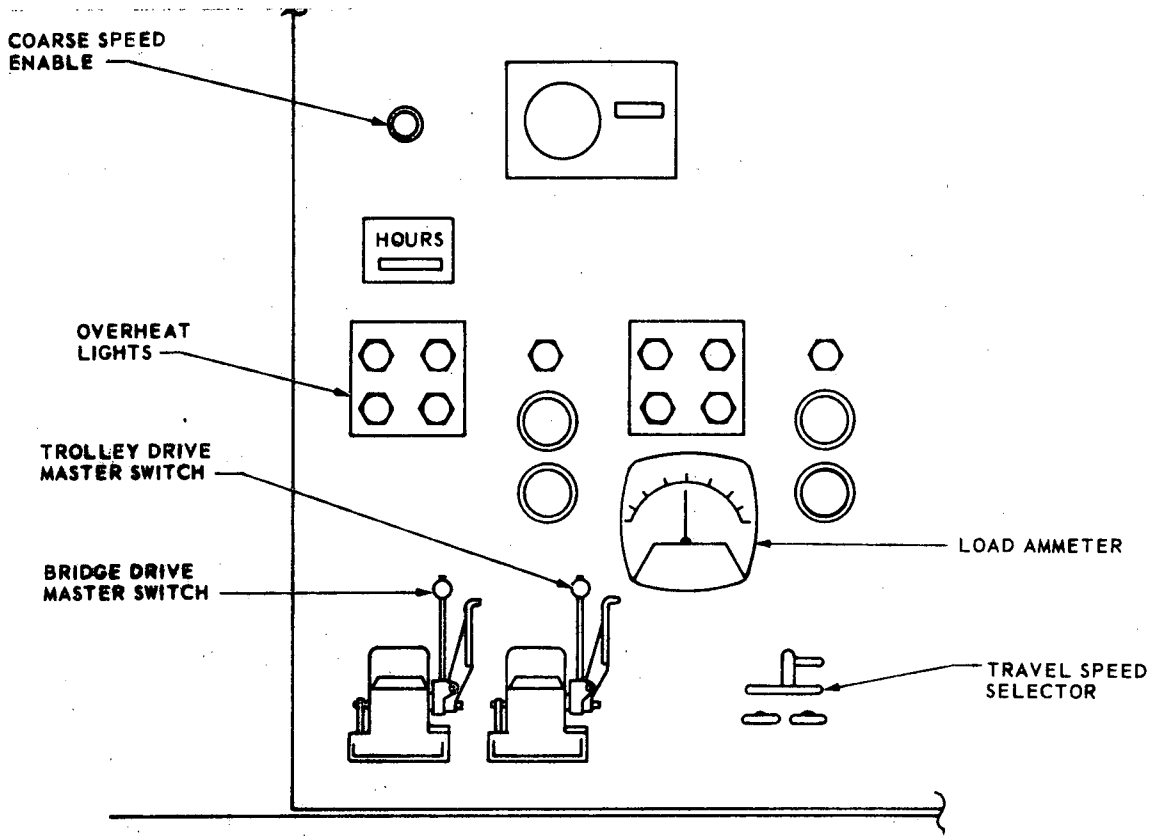


Figure 1

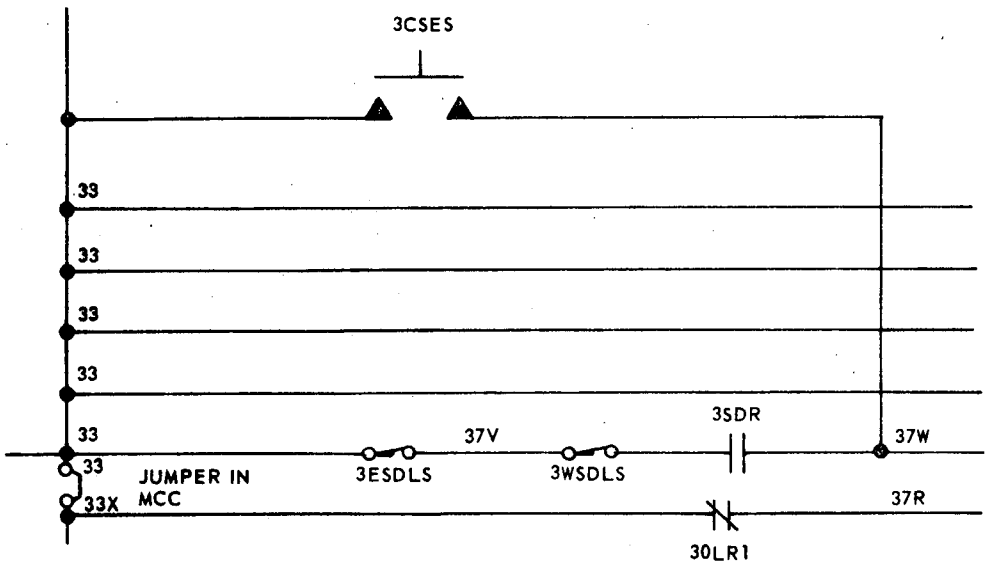


Figure 2