Section 10
Electrical Items

Training Objective

At the completion of this section, students should have a working knowledge of:

- major electrical components of cranes and hoists that require inspection and
- the criteria for adjustment or replacement.

Electrical Topics to be Covered

- Crane and Hoist power system
- Contacts and Overloads
- Motors & Resistors
- Brakes
- Limit switches

Crane And Hoist Power System

Reference:

- **OSHA 1910.179(g)(6)**
- OSHA 1910.179(j)(3)(x)
- OSHA 1910.179(k)
- ASME B30.2-2.1.3(b)(7)
- ASME B30.16-2.1.3(c)(7)
- ASME B30.17-2.1.5(e)(7)
- ASME B30.17-2.1.5(e)(12)
- NEC 610

INSPECT:

- Conductor bar (New installations)
- Collector shoes
- Guards OSHA1910.179(g)(2) (i), (ii), (iii)
- Disconnects
- Festoon system

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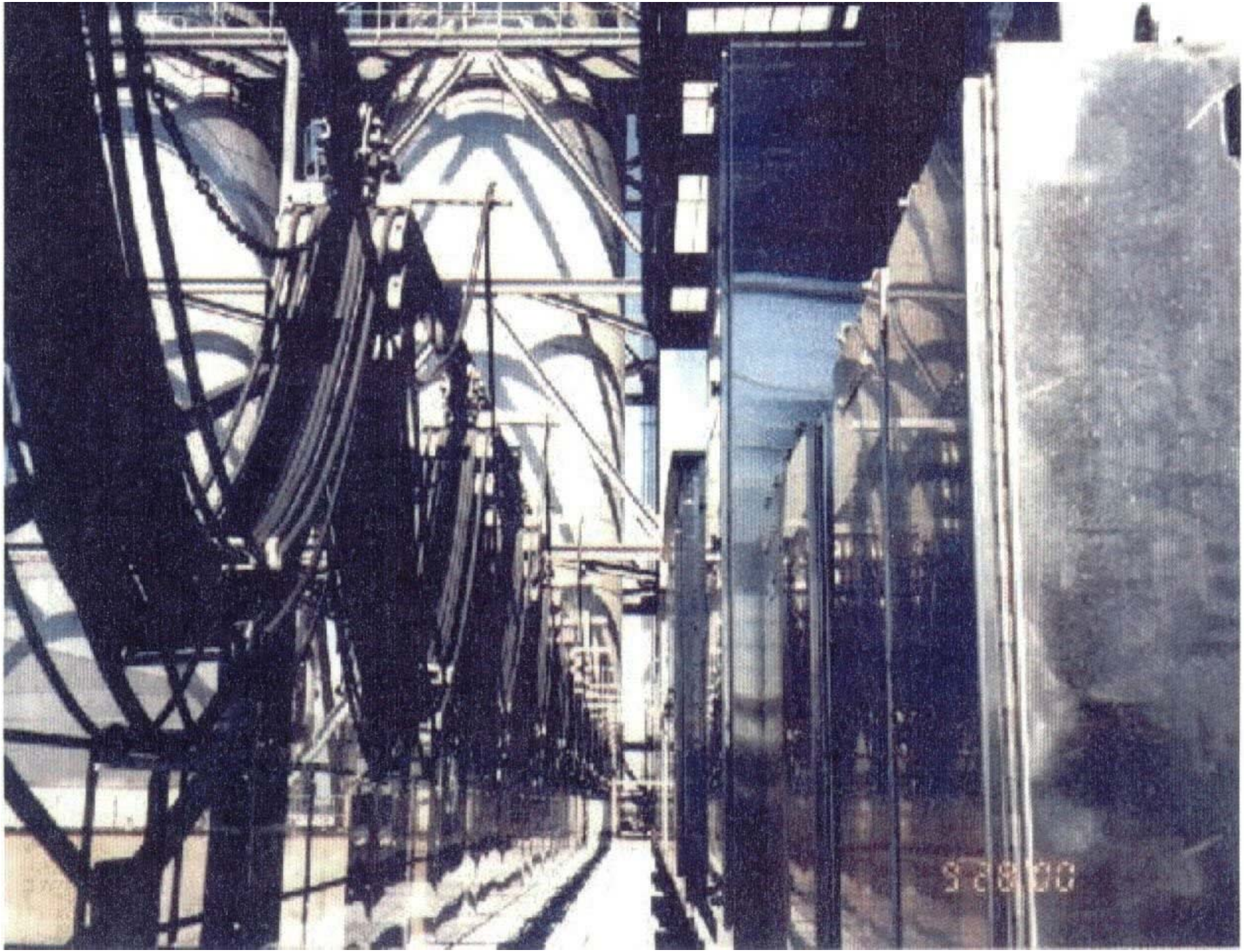

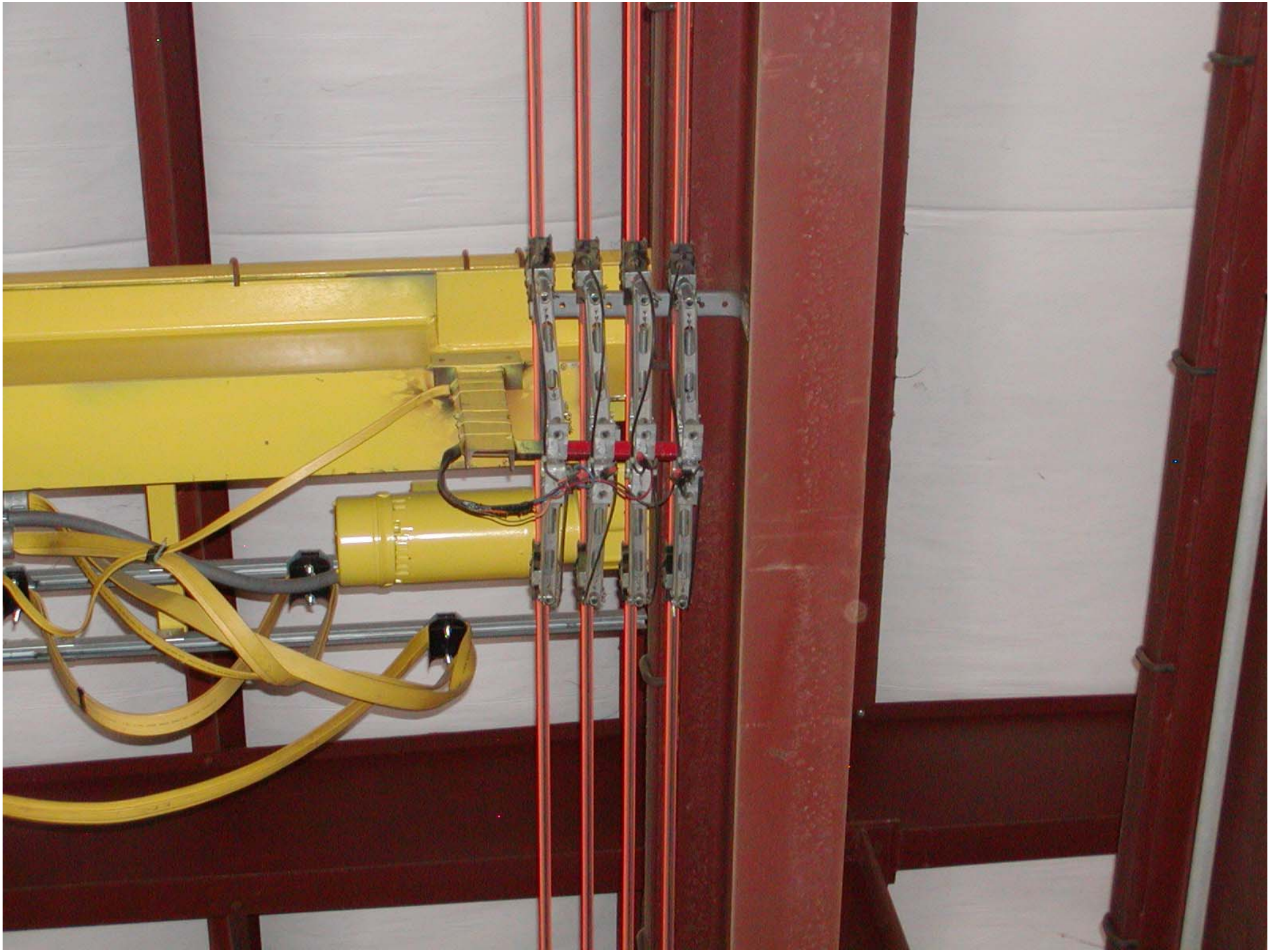

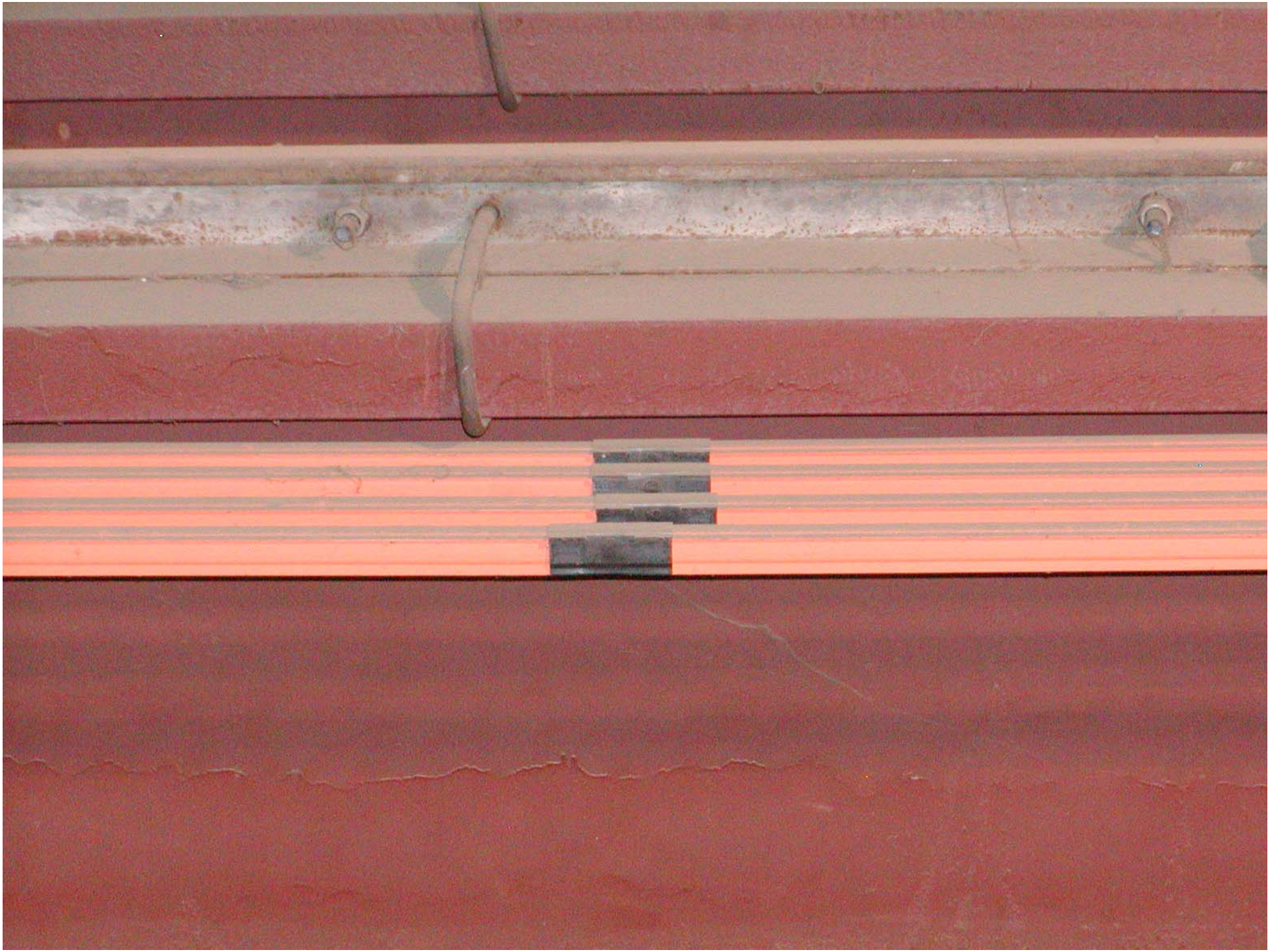


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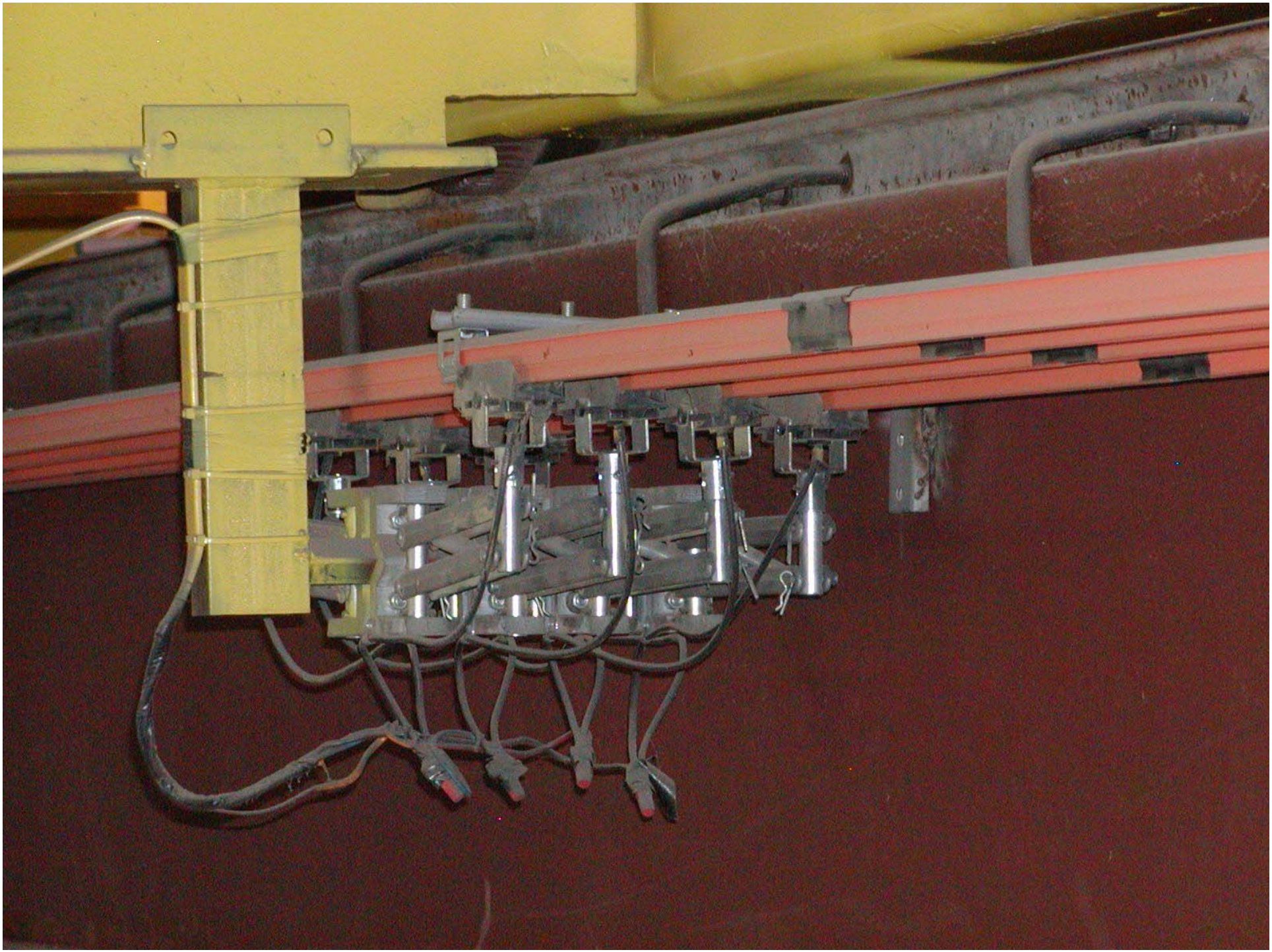

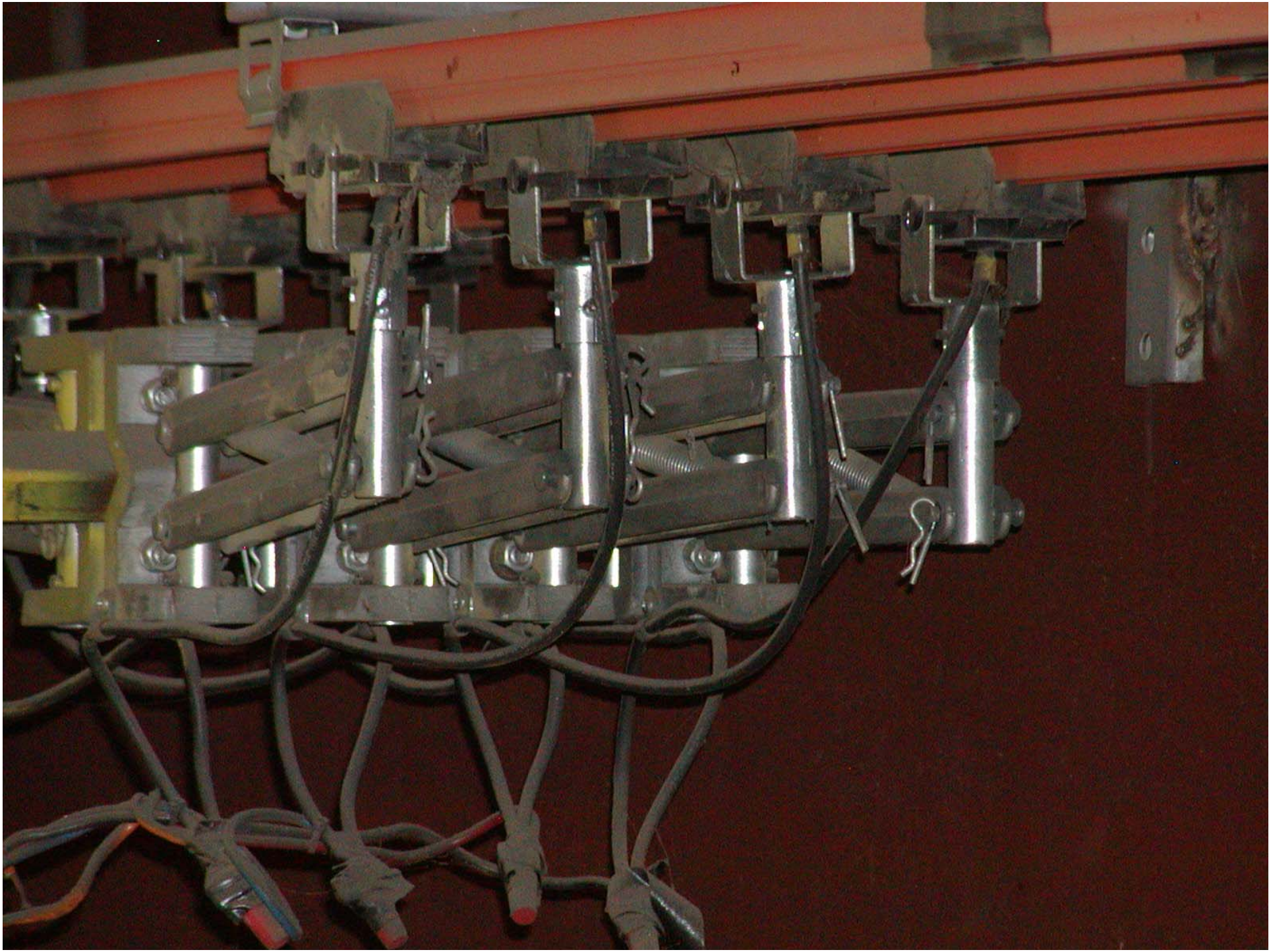

NEC 610 CHANGES

NEC 610.61 GROUNDING

- All exposed non-current-carrying metal parts of cranes, monorail hoists and accessories, including pendant controls, shall be metallically joined together into a continuous electrical conductor so that the entire crane or hoist will be grounded in accordance with Article 250.
- Moving parts, other than removable accessories or attachments that have metal to metal bearing surfaces, shall be considered to be electrically connected to each other through the bearing surfaces for grounding purposes.
- The trolley frame and bridge frame shall **NOT** be considered as electrically grounded through the bridge or trolley wheels and its respective tracks.
- A separate bonding conductor **SHALL** be provided.
- Some manufacturer's such as Duct-O-Wire provide a conductor bar with and optional GREEN cover to function as a grounding conductor.

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CSA B167-16

5.7.1

Cranes shall comply with the following electrical codes, standards, and requirements for the design of cranes:
Canadian Electrical Code, Part I, Section 40 and Table 58;
CSA C22.2 No. 14;
CSA C22.2 No. 27;
CSA C22.2 No. 33;
CAN/CSA-C22.2 No. 94; and
CSA Z460.

5.7.5

Cranes and hoists shall be properly grounded to prevent shock and damage to equipment. Runway conductors shall provide for a separate grounding conductor.

5.7.6

Cranes and hoists using AFD's (adjustable frequency drives) or using under-hook electric magnet devices shall have double collector shoes on each phase.

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Overloads

Reference:

- OSHA 1910.179(g)
- OSHA 1910.179(k)
- OSHA 1910.179(j)(3)(x)
- ASME B30.2-2.1.3(b)(7)
- ASME B30.16-2.1.5(c)(8)
- ASME B30.17-2.1.5(e)(7)
- ASME B30.17-2.1.3

INSPECT:

- Heater coil
- Oil level in dashpot
- Wire terminations

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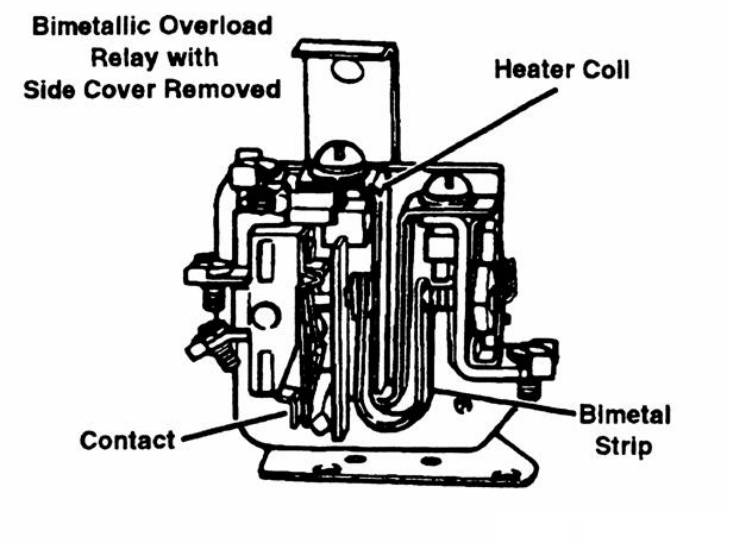
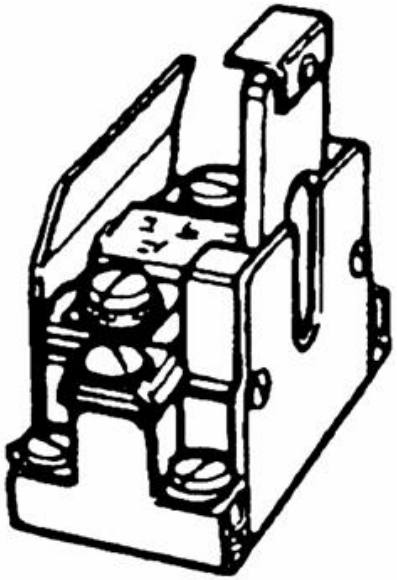
Overloads



Single Pole
Melting Alloy
Thermal Overload
Relay



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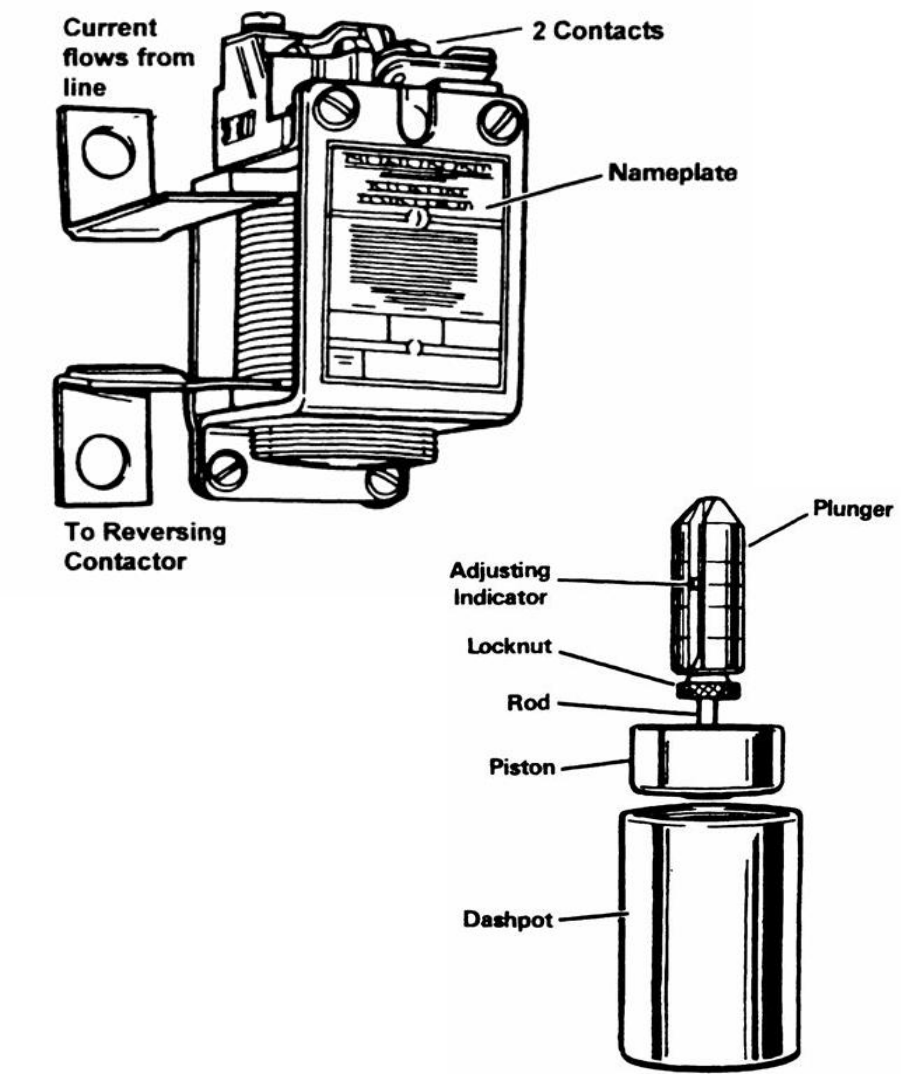
Dash Pots



INSPECT:

- Oil level
- Contacts
- Wire termination
- Leakage
- Piston cup
- Over tighten

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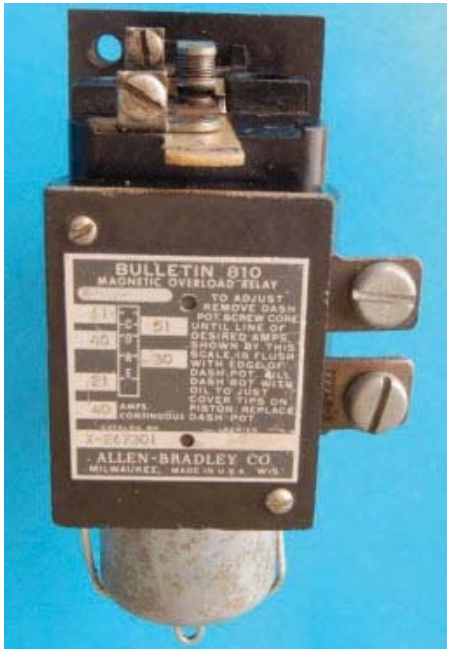
Dashpot Overload Relays



Dashpot overload relays receive their name from the device used to accomplish the time delay that permits the motor to start. A dashpot timer is basically a container, a piston, and a shaft. The piston is placed inside the container, and the container is filled with a special type of oil called *dashpot oil*. Dashpot oil maintains a constant viscosity over a wide range of temperatures. The type and viscosity of oil used is one of the factors that determine the amount of time delay for the timer. The other factor is the setting of the opening of the orifice holes in the piston. Orifice holes permit the oil to flow through the piston as it rises through the oil. The opening of the orifice holes can be set by adjusting a sliding valve on the piston.

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Dashpot Overload Relays

The dashpot overload relay contains a coil that is connected in series with the motor. As current flows through the coil, a magnetic field is developed around the coil. The strength of the magnetic field is proportional to the motor current. This magnetic field draws the shaft of the dashpot timer into the coil. The shaft's movement is retarded by the fact that the piston must displace the oil in the container. If the motor is operating normally, the motor current will drop to a safe level before the shaft is drawn far enough into the coil to open the normally closed contact. If the motor is overloaded, however, the magnetic field will be strong enough to continue drawing the shaft into the coil until it opens the overload contact. When power is disconnected from the motor, the magnetic field collapses and the piston returns to the bottom of the container. Check valves permit the piston to return to the bottom of the container almost immediately when motor current ceases.

Dashpot overloads generally provide some method that permits the relay to be adjusted for different full load current values. To make this adjustment, the shaft is connected to a threaded rod. This permits the shaft to be lengthened or shortened inside the coil. The greater the length of the shaft, the less current is required to draw the shaft into the coil far enough to open the contacts. A nameplate on the coil lists the different current settings for a particular overload relay. The adjustment is made by moving the shaft until the line on the shaft representing the desired current is flush with the top of the dashpot container.

Contacts

Contactor

Overload Contactor

An **overload** relay is made up of a heater paired with normally-closed **contacts** that open once the heater gets too hot. The **overload contacts** are connected in series and located between the **contactor** and the motor itself to prevent the motor from restarting once the **overload** trips

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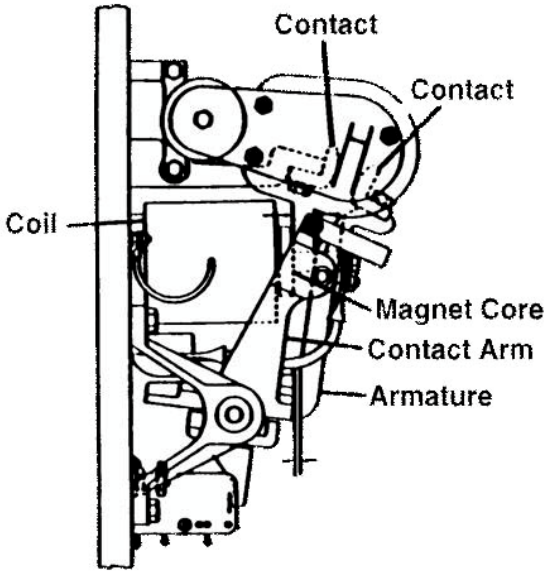
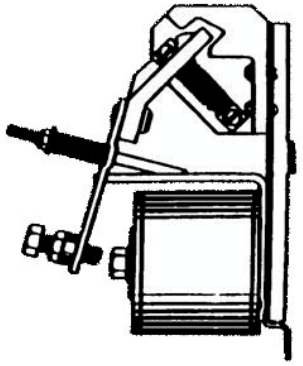
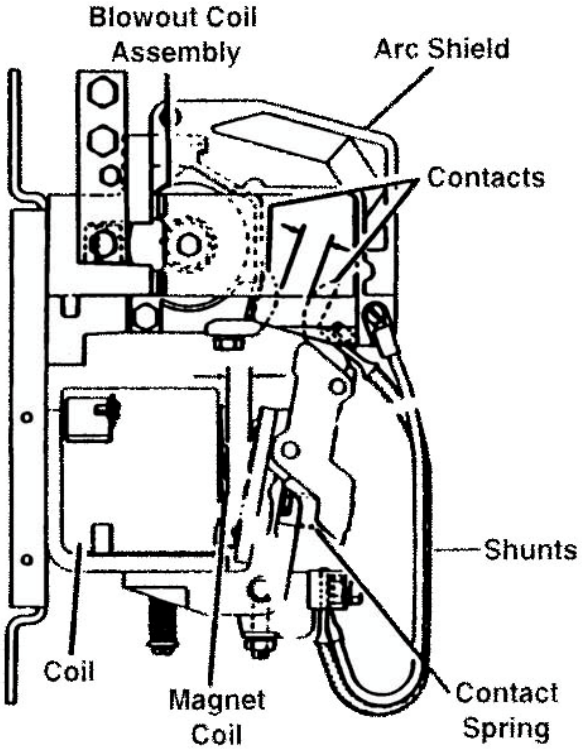
Contacts





Relay



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Contacts

Reference:

- OSHA 1910.179(g)
- OSHA 1910.179(k)
- OSHA 1910.179(j)(3)(x)
- ASME B30.2-2.1.3(b)(7)
- ASME B30.16-2.1.5(c)(8)
- ASME B30.17-2.1.5(e)(7)
- ASME B30.17-2.1.3

INSPECT:

- Contact tips
- Wire terminations
- Timing
- Arc Shield
- Shunts
- Interlocks
- Carbon build-up
- Smell test

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WESTINGHOUSE
CONTACTOR
TYPE NR
STYLE
SIZE
POLES
AC VOLTS MAX
600
AMPERE RATING ENCLOSED
90
AMPERE RATING OPEN
100
R5
WESTINGHOUSE
CONTACTOR

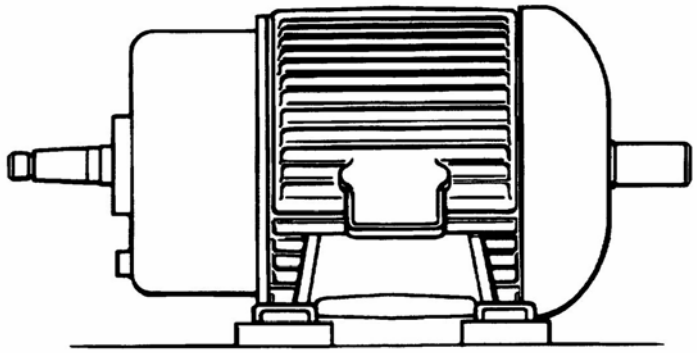
Motors

Reference:

- OSHA 1910.179(g)
- OSHA 1910.179(k)
- OSHA 1910.179(j)(3)(x)
- ASME B30.2-2.1.3(b)(7)
- ASME B30.16-2.1.5(c)(8)
- ASME B30.17-2.1.5(e)(7)
- ASME B30.17-2.1.3

INSPECT:

- Motor mounts
- Brake side shaft (tapered side)
- Condition inside motor
- Brushes
- Brush holders
- Slip Rings
- Commutator
- Mego-meter reading



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Motor Brushes

BRUSHES SHOULD BE REPLACED AT 50% WEAR

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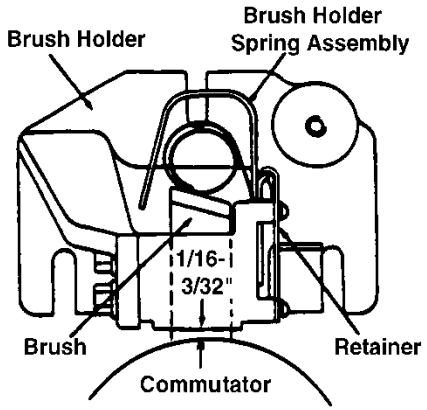
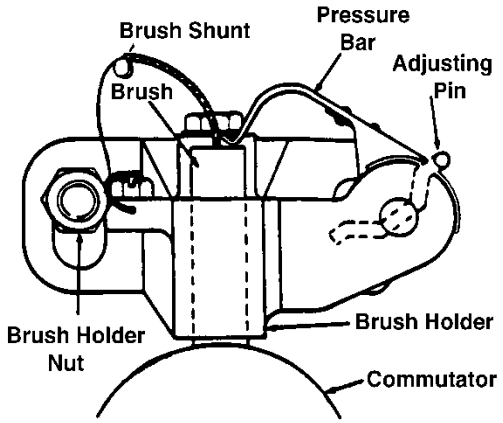
Motor Brush Springs & Holders

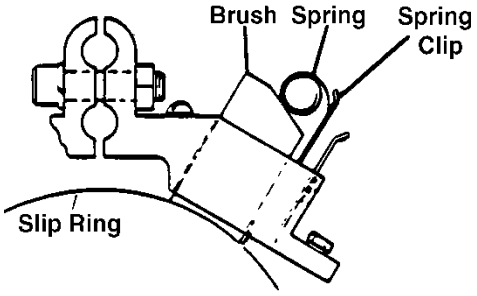


Constant-Pressure Brush Holder

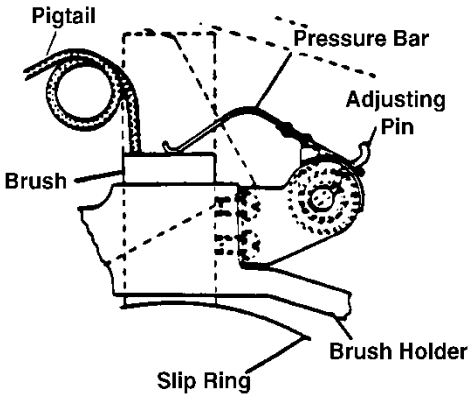


Adjustable Brush Holder

DC Motors



Constant-Pressure Brush Assembly



Adjustable Brush Holder Assembly

AC Motors

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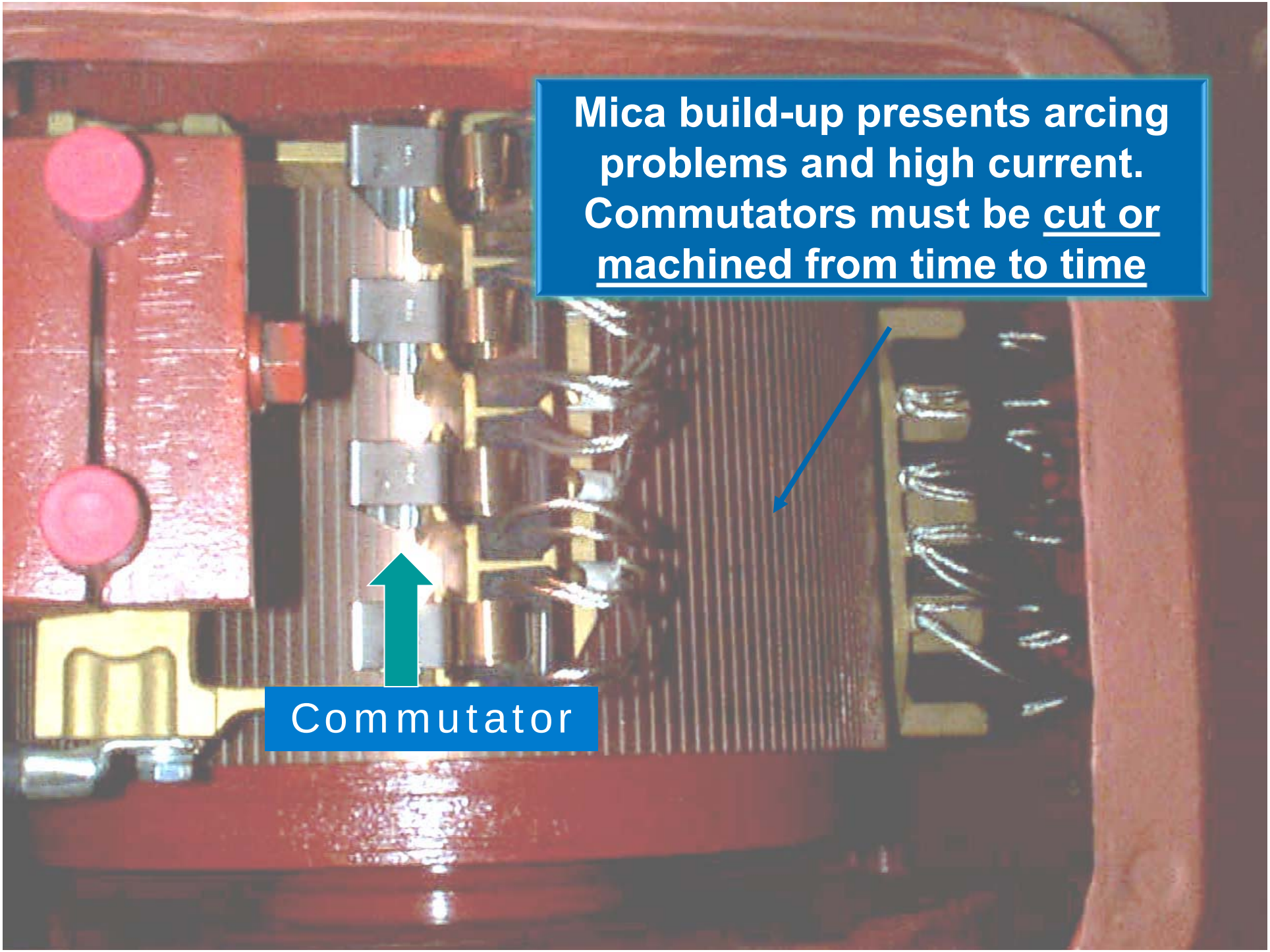
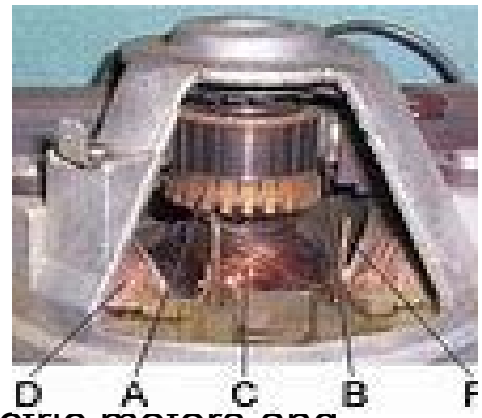

Mica build-up presents arcing problems and high current. Commutators must be cut or machined from time to time
Commutator

Commutator

1.an attachment, connected to the armature of a motor or generator, through which electrical connection is made and which ensures that the current flows as direct current.

2.a device for reversing the direction of flow of electric current.



A commutator is a rotary electrical switch in certain types of electric motors and electrical generators that periodically reverses the current direction between the rotor and the external circuit. It consists of a cylinder composed of multiple metal contact segments on the rotating armature of the machine. Two or more electrical contacts called "brushes" made of a soft conductive material like carbon press against the commutator, making sliding contact with successive segments of the commutator as it rotates. The windings (coils of wire) on the armature are connected to the commutator segments.

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Resistors

Reference:

- OSHA 1910.179(j)(3)(x)
- ASME B30.2-2.1.5(c)(8)
- ASME B30.16-2.1.5
- ASME B30.17-2.1.5(e)(7)
- ASME B30.17-2.1.5(e)(12)
- OSHA 1910.179(g)
- OSHA 1910.179(g)((2)(iii)
- OSHA 1910.179(g)(4)
- OSHA 1910.179(g)((4)(i)
- OSHA 1910.179(g)((4)(ii)
- OSHA 1910.179(g)((4)(iii)

INSPECT:

- Enclosures (OSHA 1910.179(g)((4)(i)
- Mounts (OSHA 1910.179(g)((4)(i)
- Drip pan (OSHA 1910.179(g)((4)(iii)
- Wire terminations (Lugs)
- Grid separation
- Arc scars
- Compression rods

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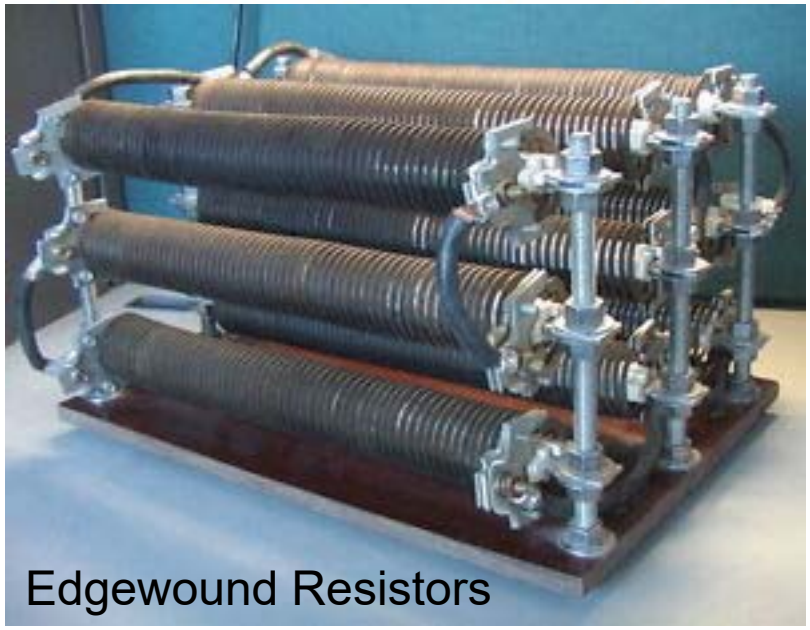
Resistors



Edgewound Resistors

Stamped Steel Plate Resistors

Wirewound Resistors

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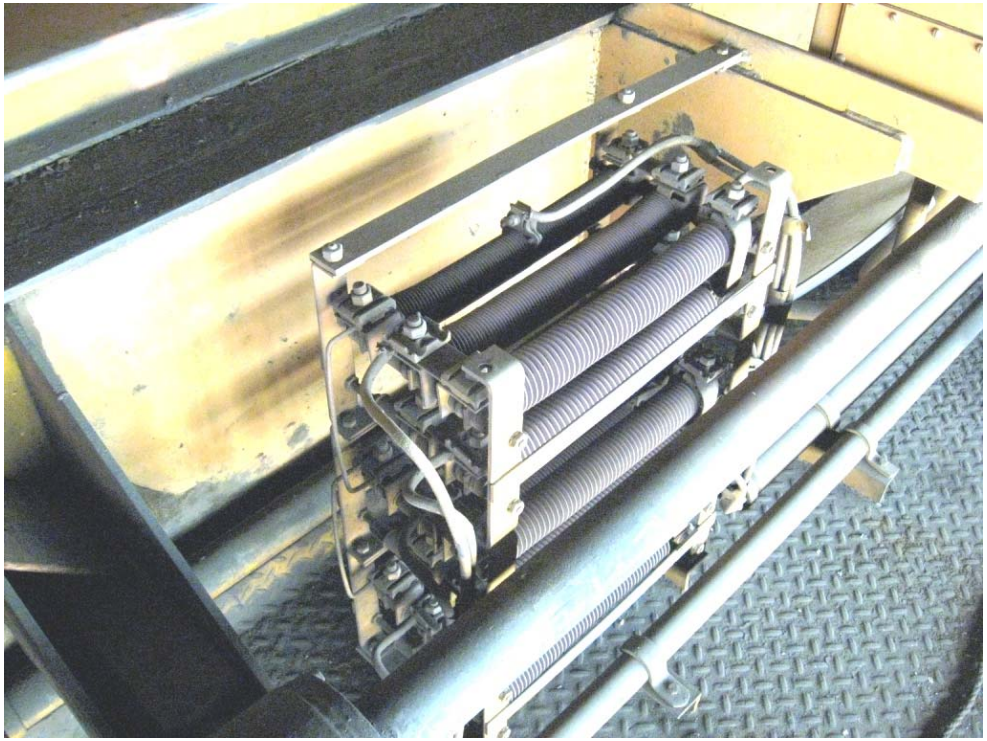
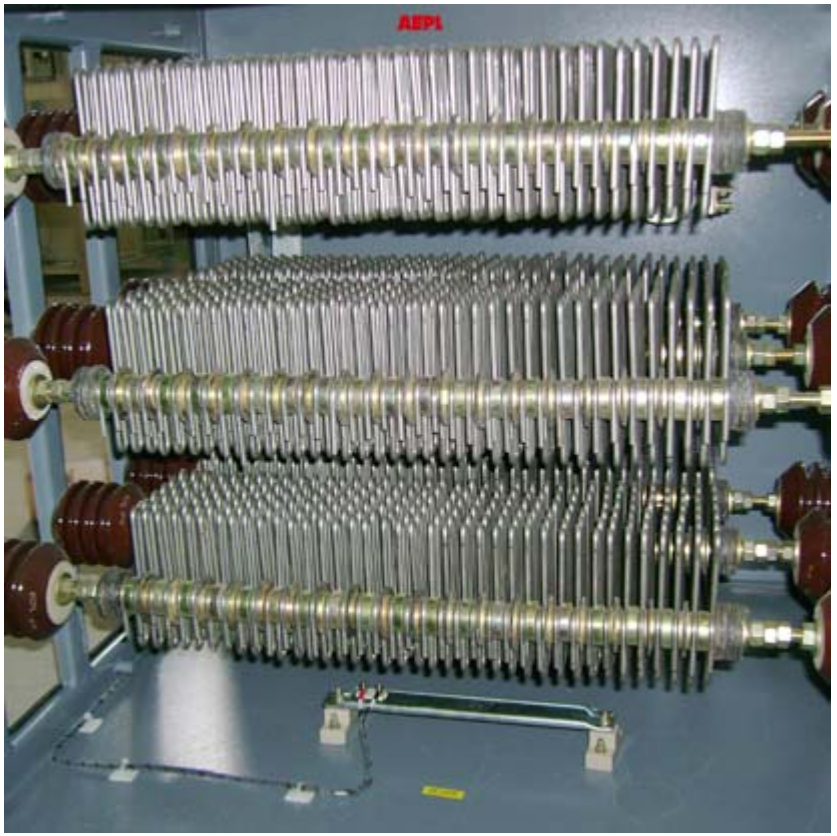


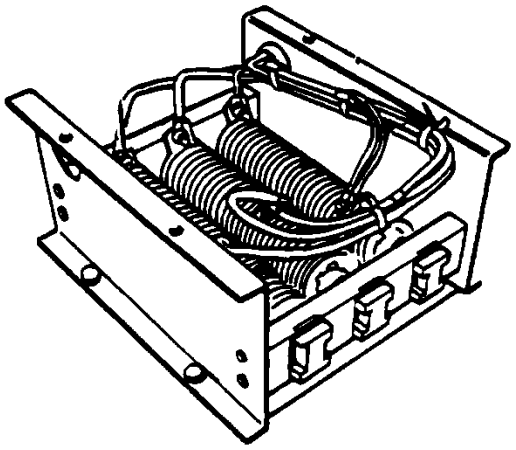

AEPI

Resistors

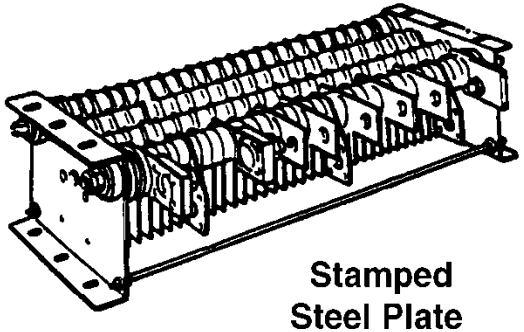
Enclosures for resistors shall have openings to provide adequate ventilation, and shall be installed to prevent accumulation of combustible matter too near to hot parts

Resistor units shall be supported so as to be as free as possible from vibration

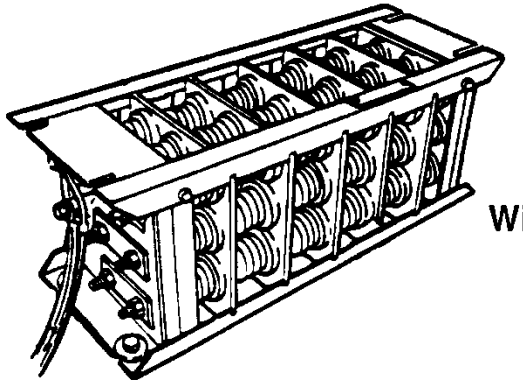
Provision shall be made to prevent broken parts or molten metal from falling from the crane.



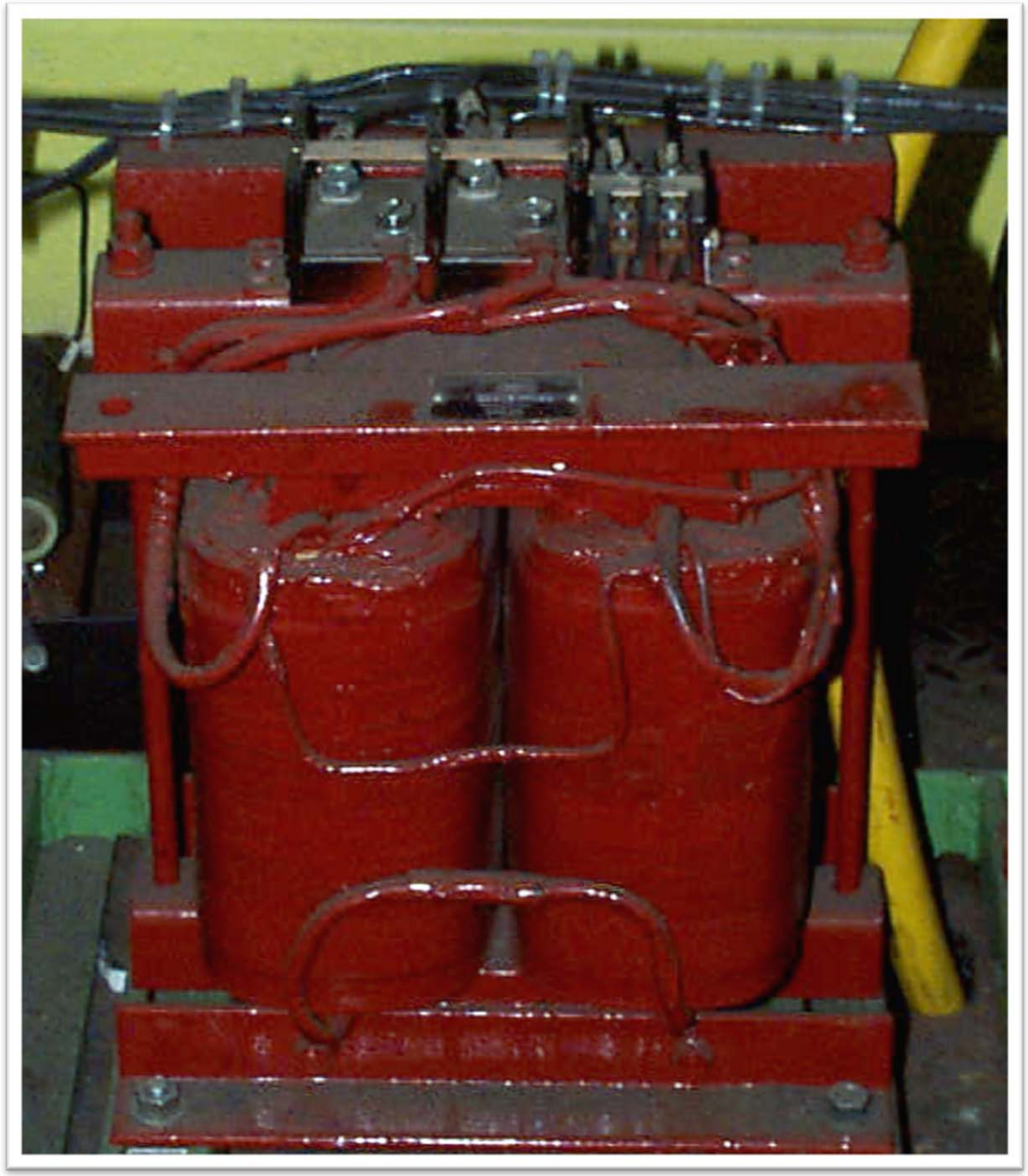
Edgewound



Stamped Steel Plate



Wirewound



Old Resistors

Motor Holding Brakes (Disc)

Reference:

- ASME B30.2-2.1.5
- ASME B30.16-2.1.5(c)(7)
- ASME B30.11/B30.17-2.1.5(e)(5)
- OSHA 1910.179(f)

INSPECT:

- Disc wear / glaze (OSHA 1910.179(f)(2)(v))
- Armature
- Coil (shading coil on AC units)
- Pressure plates
- Brake driver / Hub / Adapter
- Gap (OSHA 1910.179(f)(4)(iii))
- Torque (if adjustable) (OSHA 1910.179(f)(4)(vii))

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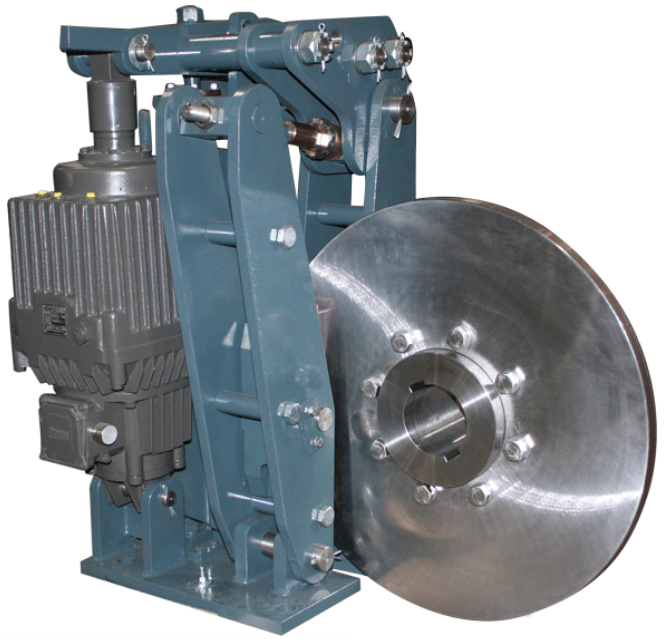
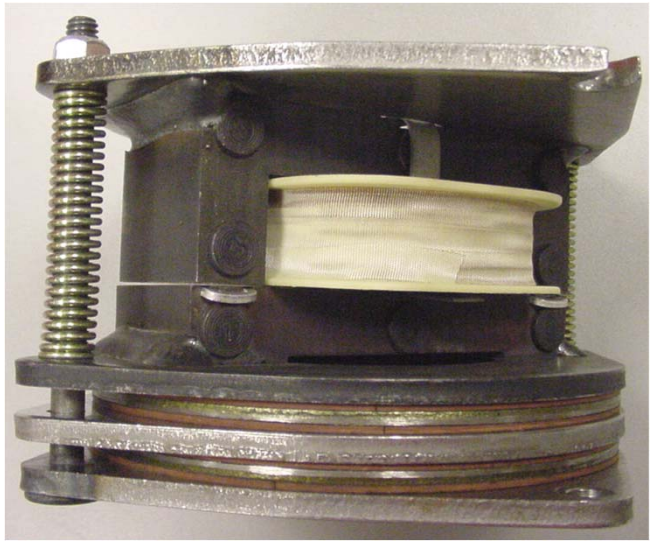
Disc Brakes





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Shoe & Drum Brakes

Reference:

OSHA 1910.179(j)(3)(x)
ASME B30.2-2.1.5(c)(6)
ASME B30.16-2.1.5(c)(6)
ASME B30.11/B30.17-2.1.5(e)(5)
OSHA 1910.179(f)
NEMA 2-220

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Shoe & Drum Brakes

INSPECT

- Pad wear
- Air gap (other adjustment setting) (OSHA 1910.179(f)(4)(ii))
- Torque (1910.179(f)(2)(i)) (OSHA 1910.179(f)(4)(vii))
- Condition of torque spring
- Equalization
- Brake drum retaining nut
- Condition / Diameter of drum
  (OSHA 1910.179 (f)(2)(ii) & (f)(2)(v)), (NEMA 2-220)
- Hydraulic fluid (level / leakage / lines / pedal effort)
  (OSHA 1910.179(f)(4)(i), (v), (vi))

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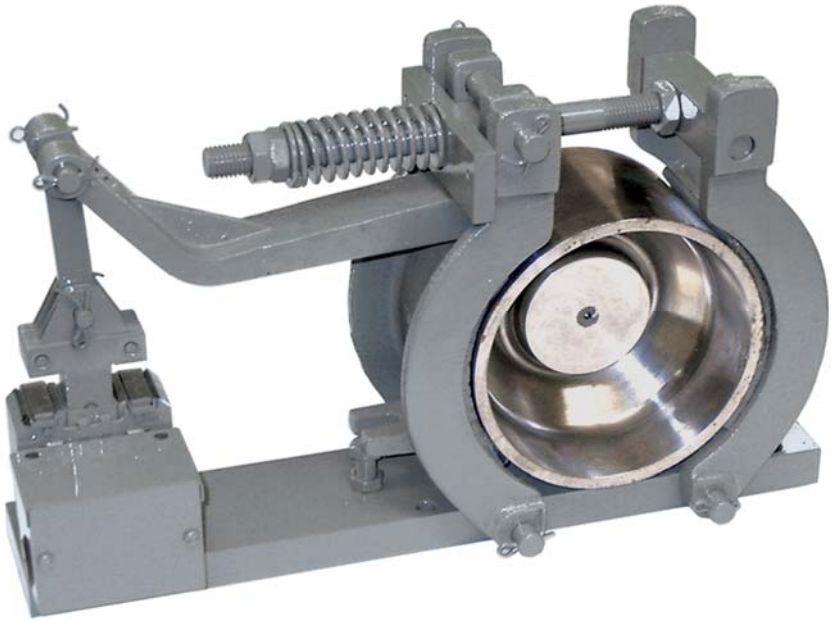
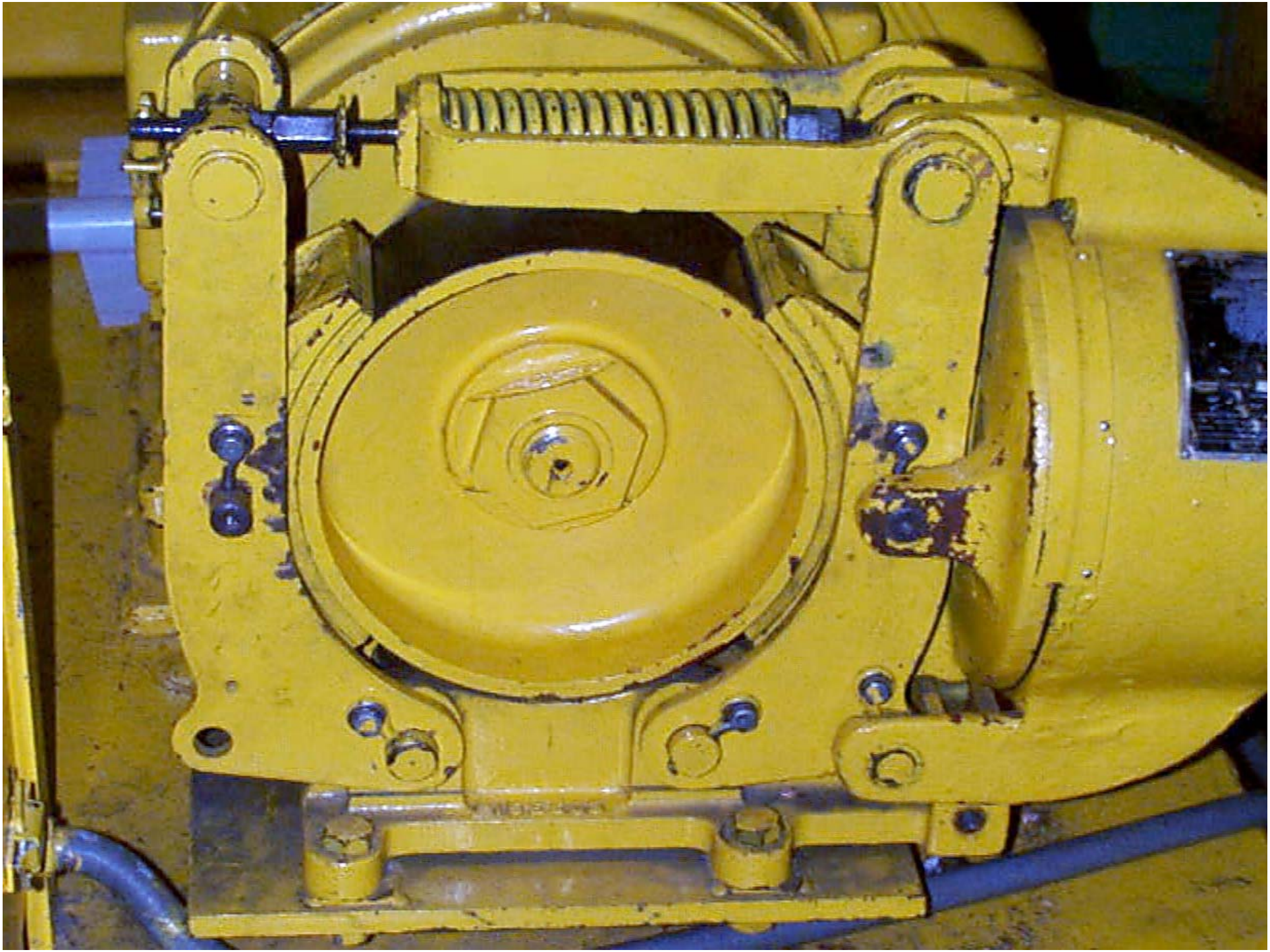
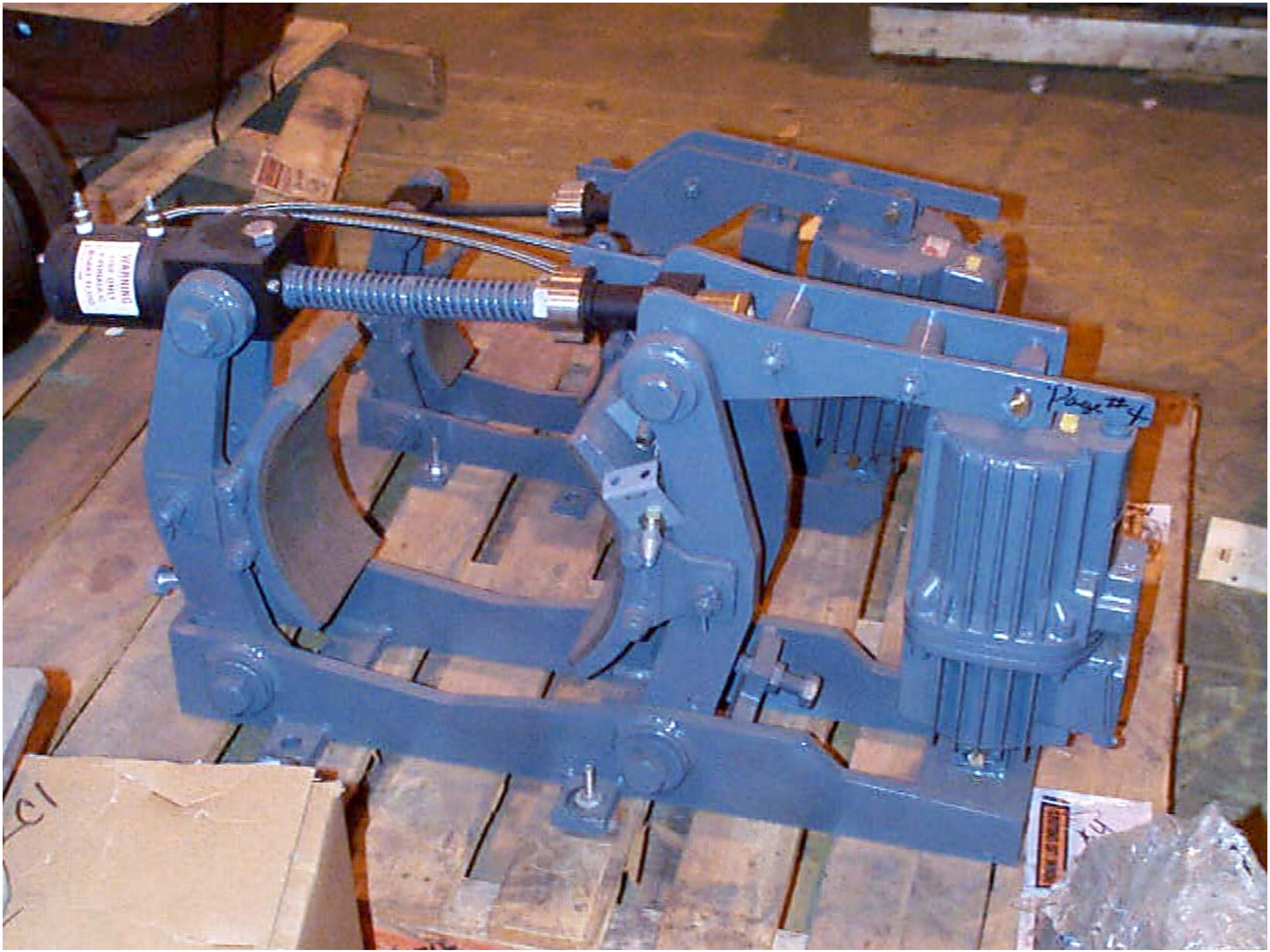
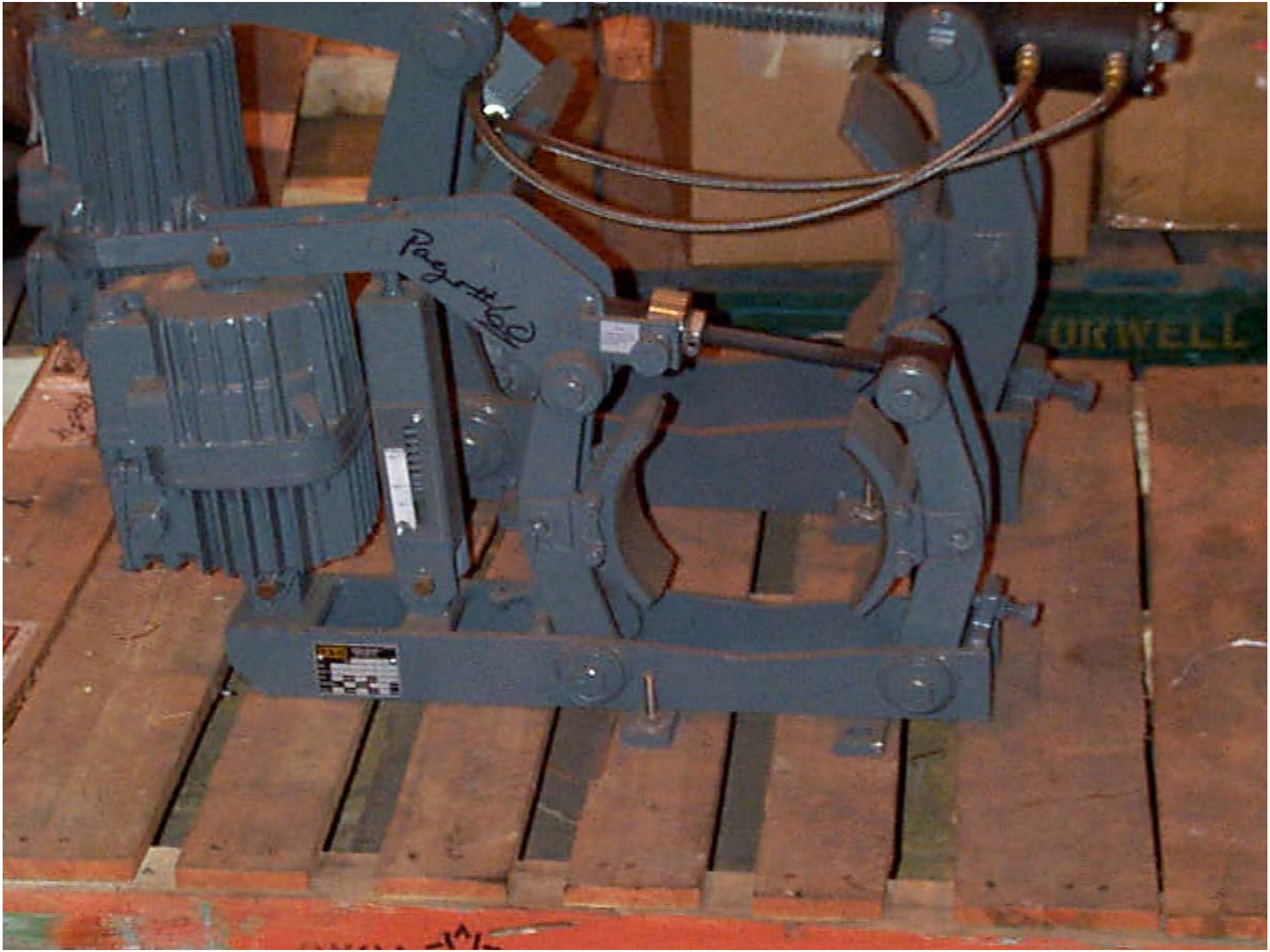
Shoe & Drum Brakes








ORWELL

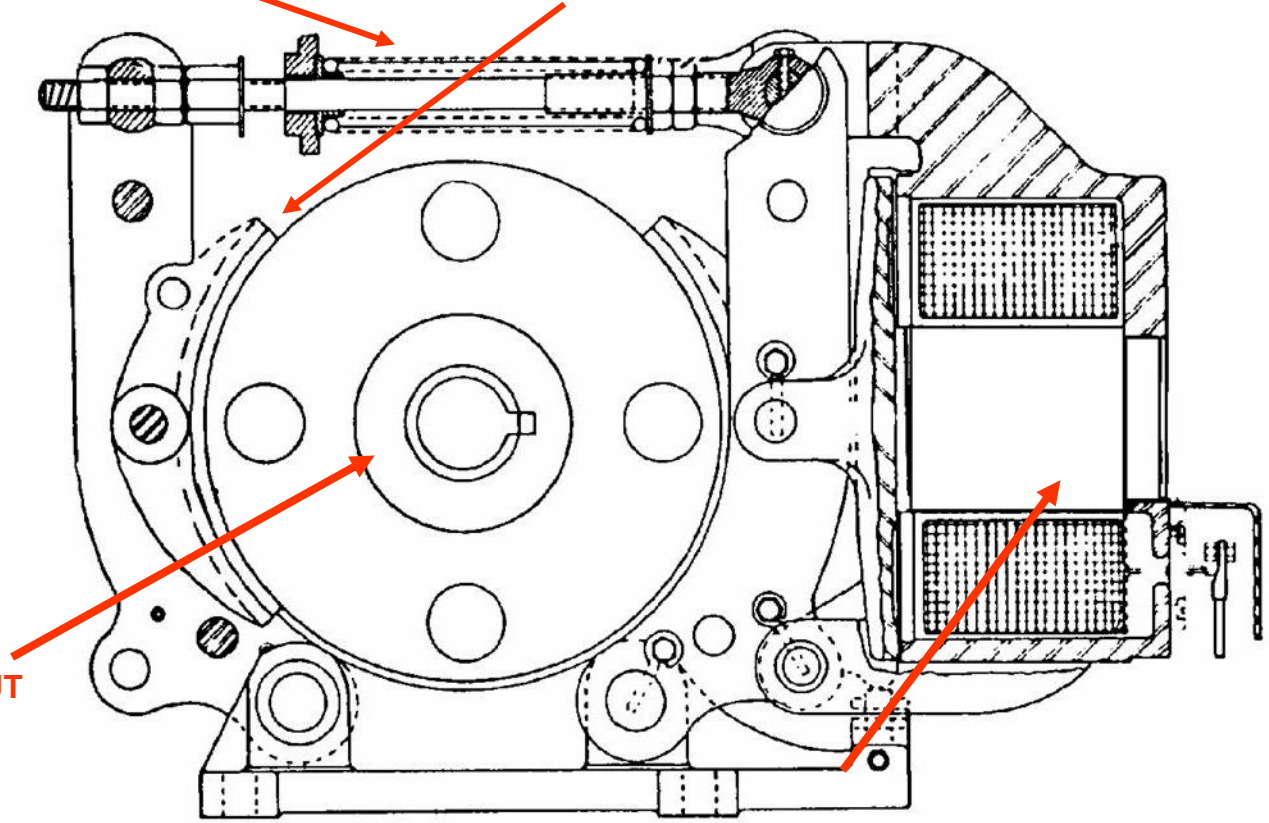
Shoe & Drum Brake

CHECK TORQUE SPECIFICATION

MINIMUM PAD THICKNESS

BONDED LINING 1/16”

RIVETED LININGS 1/2 ORIGINAL THICKNESS



RETAINING NUT

AIR GAP - FOLLOW MFG GUIDELINES

NEMA 2-220 BRAKE WHEEL WEAR

Maximum allowable reduction in brake wheel diameter is ¾ of 1% of the original diameter up to a maximum of .130”

NEMA 2-220 Brake Wheel Wear

Maximum allowable reduction in brake wheel diameter is ¾ of 1% of the original diameter up to a maximum reduction of .130”

Example

- Original wheel diameter 10”
- ¾ of 1% = .0075
- 10 X .0075 = .075”

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Load Brakes / Control Brakes

Reference:

- OSHA 1910.179(j)(3)(v)
- ASME B30.16-2.1.5(c)(6)
- ASME B30.21-2.1.5(c)(6)
- OSHA 1910.179(f)(1)(ii)
- ASME B30.2-1.12.2

INSPECT:

- Pawls
- Springs
- Discs
- Ratchet

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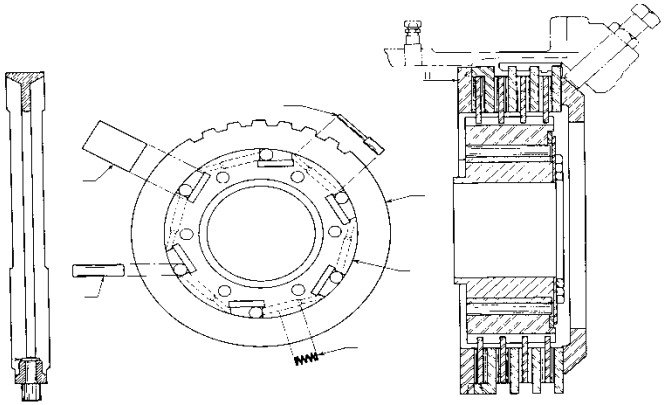
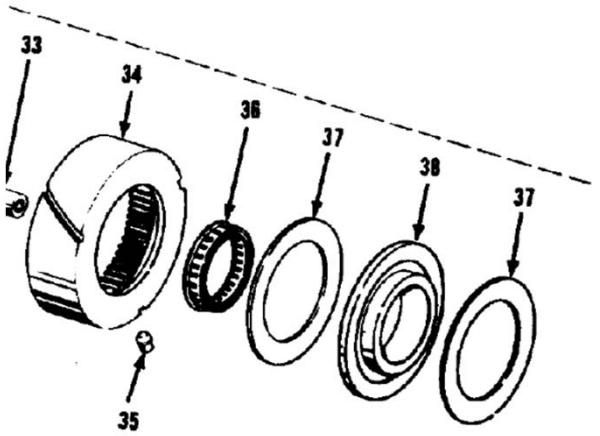
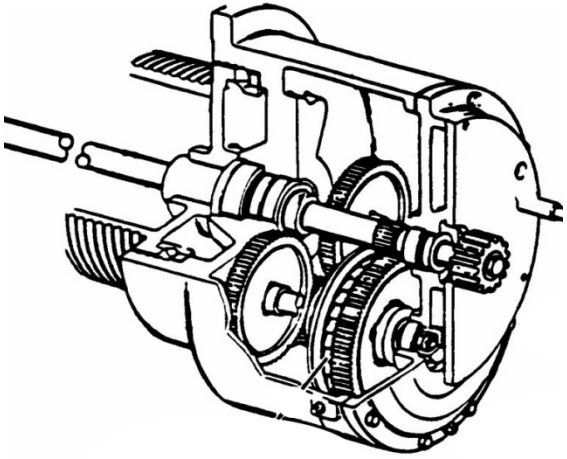
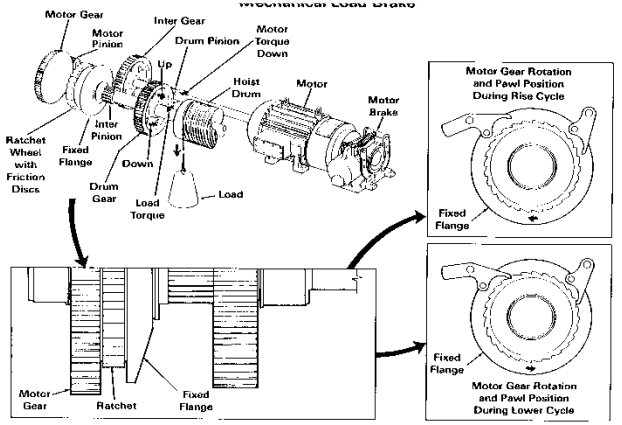
Various Mechanical Load Brakes









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Mechanical Hoist Load Brakes

- Mechanical control or load brakes vary in design. When present, they are an integral part of a hoist gear system. The most common type of mechanical load brake is the Weston style. They all work on a pressure, friction, or both principle. Since these devices are a part of the transmission they require lubrication. Specialized lubricants, specified by the hoist or crane manufacturer, may be required.

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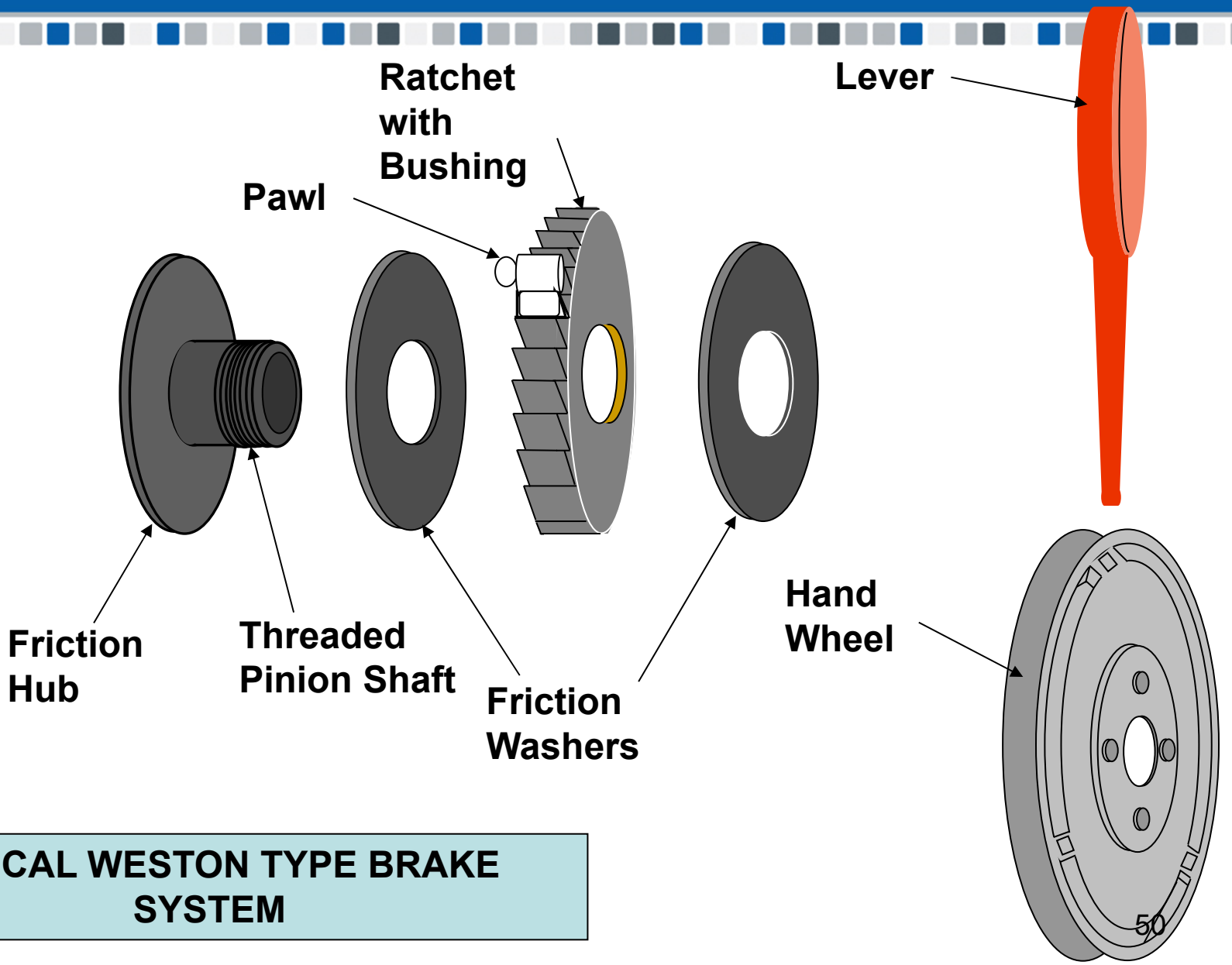
Weston Style Brake

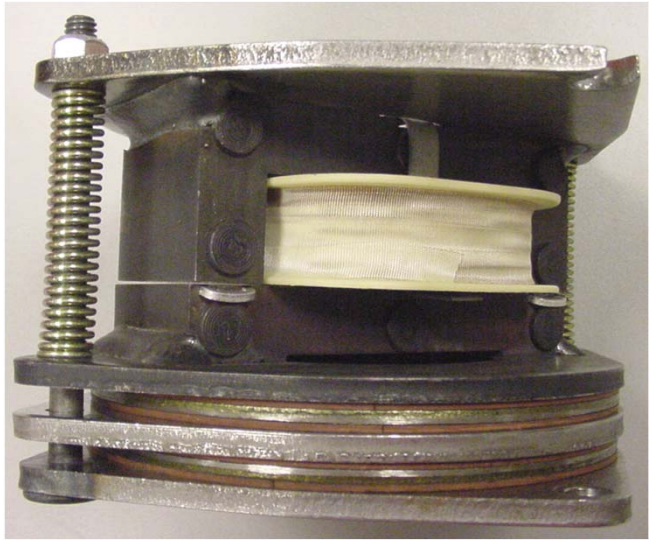


TYPICAL WESTON TYPE BRAKE SYSTEM

Electric Hoist Load Brakes

- OSHA 1910.179(j)(3(v) requires inspection of pawls and ratchets on a periodic basis. A functional test, on a periodic basis, will allow the inspector to determine if the brake is operating properly

- Power control brakes such as eddy current, dynamic and regenerative systems require inspection in accordance with the crane or hoist manufacturer's recommendations. All power control braking means produce heat. If it is working properly, it should be HOT!



Limit Switches

Reference:

OSHA 1910.179(h)(2)(iii)(a) (setting)
OSHA 1910.179(j)(3)(x)
OSHA 1910.179(k)(1)(ii)
OSHA 1910.179(l)(3)(ii)(b)
OSHA 1910.179(n)(3)(viii) (operator)
ASME B30.2-2.1.4(c)(2)
ASME B30.2-3.5
ASME B30.2.2.1
ASME B30.16-1.2.14
ASME B30.16-2.1.3(b)(2)

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Limit Switches

INSPECT:

- Control or power interrupt
- Trip settings (Daily, Frequent and Periodic)
- Two limit switches (wire rope electric and air hoists)
- ASME B30.16-1.2.14
- Minimum wraps on rope drum **(CONFLICT OSHA vs B30.2)**
- Running rope guides
- Tiller Ropes
- Pins
- Contacts
- Traveling gear
- Weight, counter weight and pivot shaft

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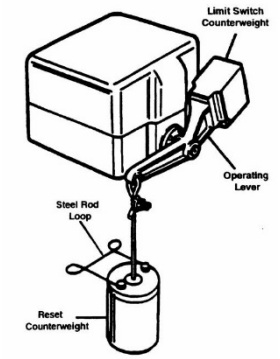
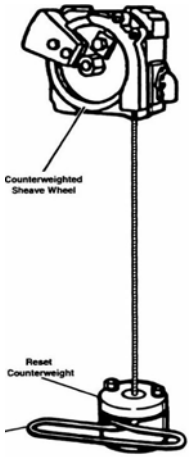
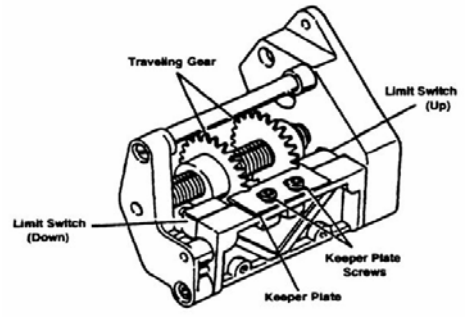
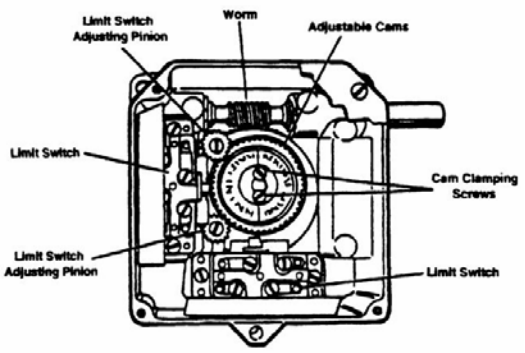
Power Circuits



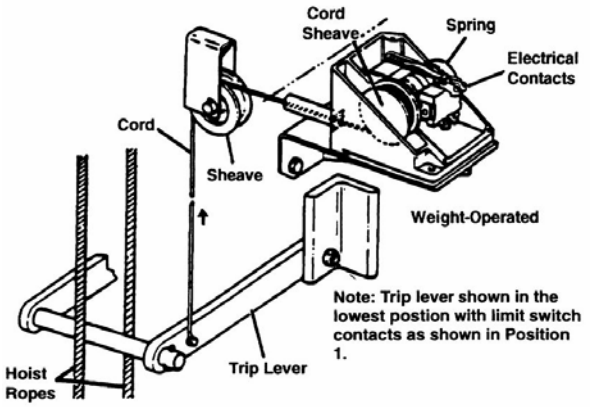


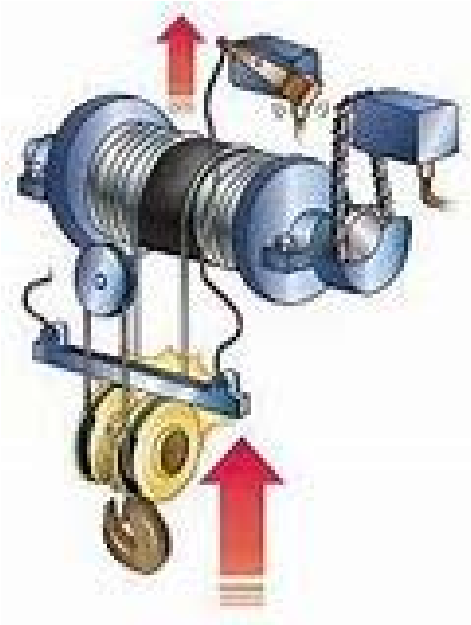
Control Circuits

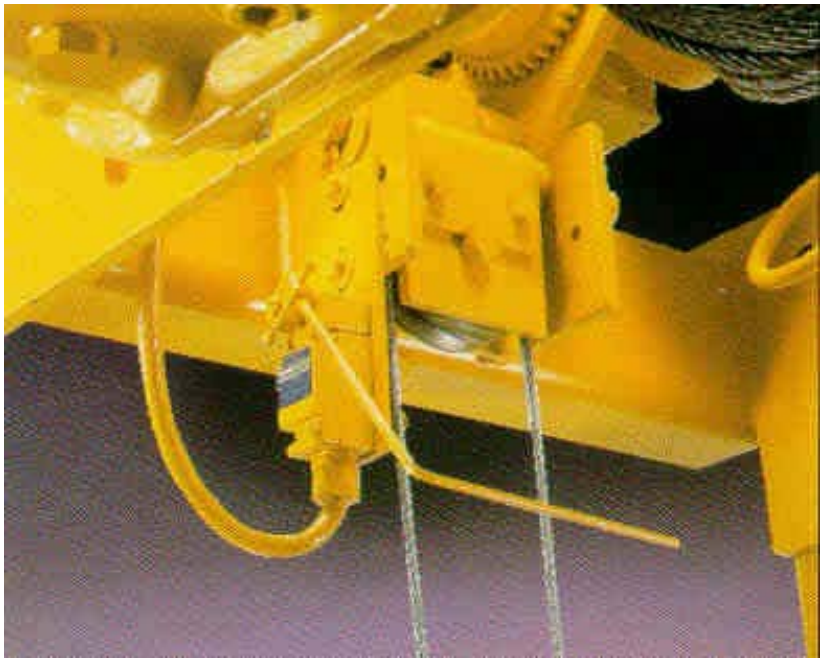


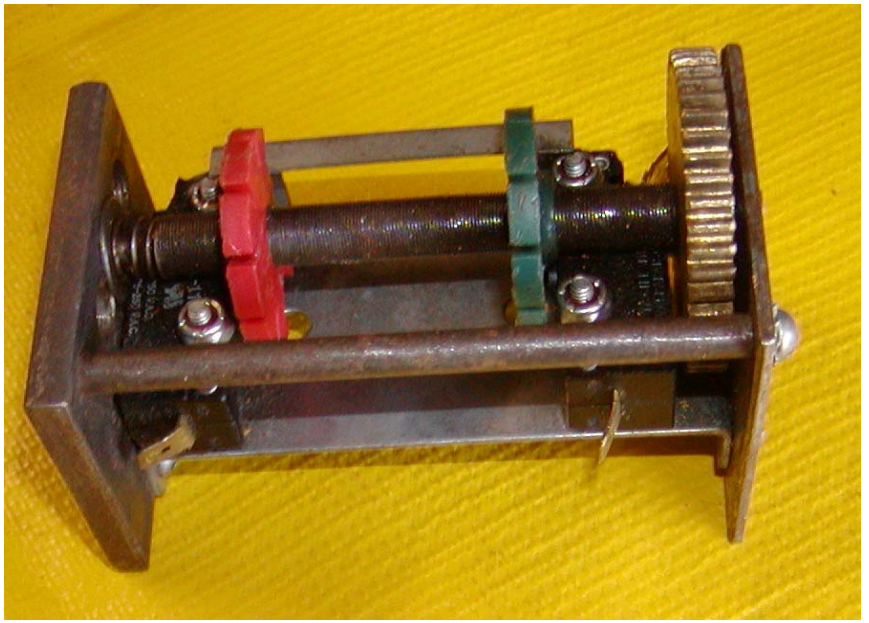


Control Circuits









Questions??

Thanks for your attention,
let's take a break!

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