TRIM LINE

STEEL BRIDGE

PORTLAND OREGON

1912

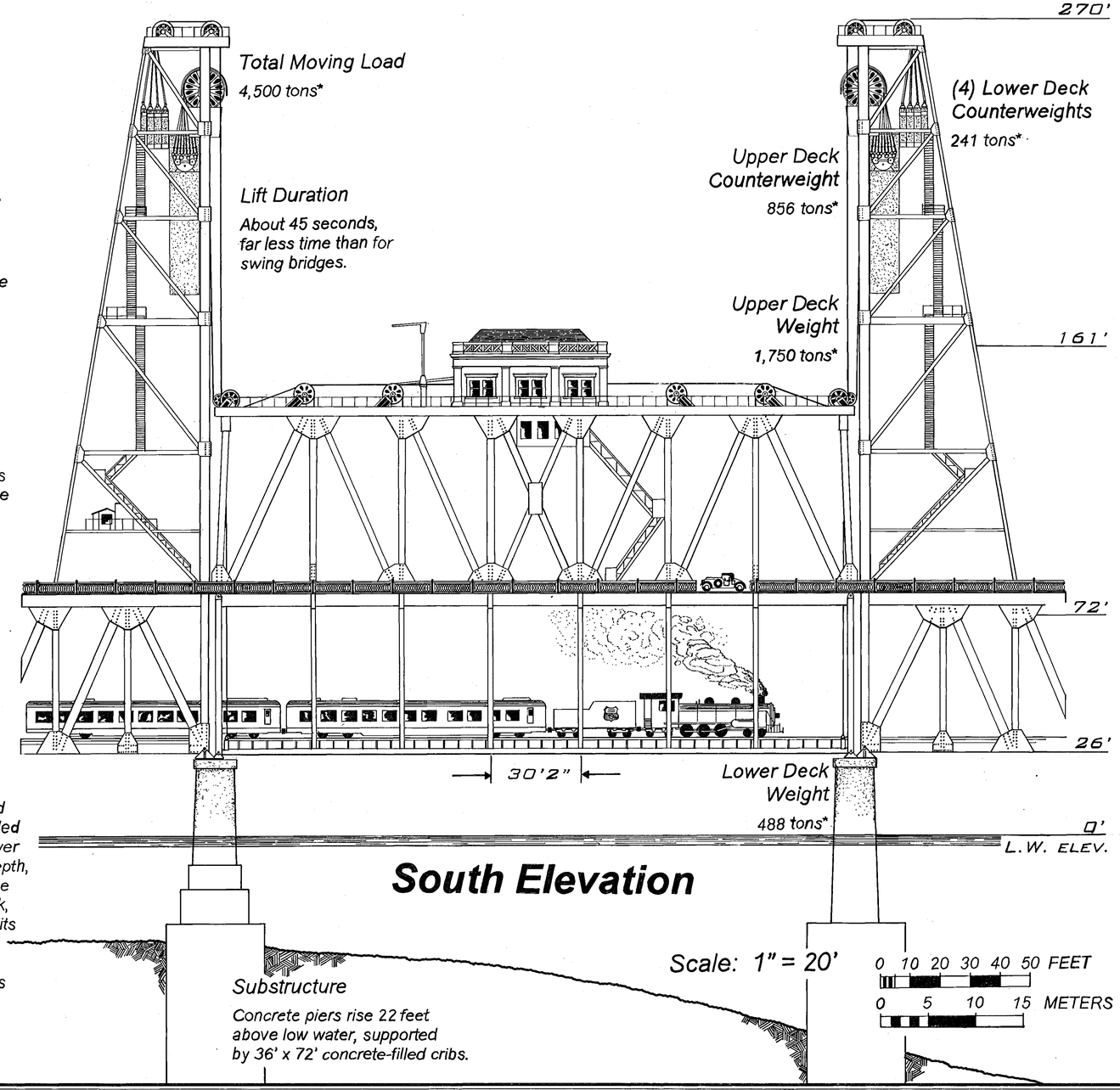
The Steel Bridge captures the engineering genius of John Lyle Harrington, who created the mechanisms that translated J. A. L. Waddell's pioneering vertical lift bridges into solid, reliable structures. With two independent, moveable decks, it is unique and, simultaneously, an elegant culmination of Waddell & Harrington's design innovations. It survives in part because Harrington refined both small components, such as the equalizers that distribute weight among the ropes and the guides that keep the spans in alignment as they move, and large features, such as the telescoping vertical members and the system of ropes, sheaves, and counterweights. Decades after its completion, engineering textbooks consistently portrayed it as exemplary.

Many original components tell additional tales as the bridge lifts and lowers. Band brakes with an oak block wearing surface smell "like a barbecue" when a new operator trains, revealing, by contrast, the skill of experienced men who cut the motor at the right moment and allow the bridge to coast to a stop. The bridge operates through the friction of metal against metal, so the "right moment" varies from day to day and hour to hour as the weather changes and the oiler makes his rounds. Heat, for example, expands metal, but also softens grease, making the bridge run faster. The oilers let us in on an important reality when they say the bridge "runs on grease."

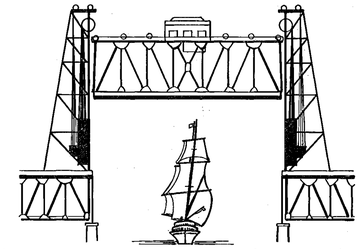
Knowing how much grease is also an art. The machine room's colorful paint job includes small numbers painted at points of lubrication, indicating grease gun shots. But a "friction bridge" squeezes grease back out. Experienced hands, whose job includes wiping off extruded lubricant, can respond to what the mechanism is saying, modifying input to reflect changing output. Colorful paint harks back to the decorative impulse in early American machine rooms, but also functions to make grease visible.

Like other surviving Willamette River bridges of its vintage, the Steel Bridge reminds us of the moment when people in Portland decided they wanted bridges that would last. The record-setting near 9 million pound combined load of counterweights and liftspans demanded innovative engineering to erect. Massive posts and lower chords, each measuring a yard or more in width and depth, help the almost ninety-year-old structure safely carry the latest freight and passenger trains across its lower deck, while heavy trucks, buses, and light-rail trains traverse its upper span. Periodic renewal of decks and cables, occasional paint jobs, and daily lubrication help fulfill Harrington's claim that, properly maintained, his bridges would be "permanent."

*Note: See overview information, HAER no. OR-21, Willamette River Bridges. *Weights are approximate.*



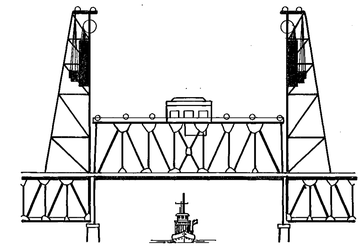
South Elevation



Upper Lift Deck: Raised Position

Vertical lift distance: 93 feet
Low water clearance: 165 feet

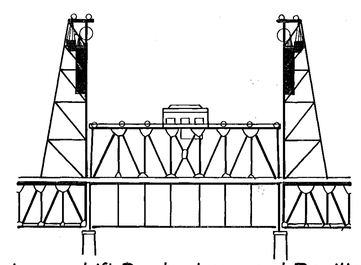
Permits passage of large, ocean-bound ships.



Lower Lift Deck: Raised Position

Vertical lift distance: 46 feet
Low water clearance: 72 feet

Lower deck "telescopes" into the upper deck columns to allow passing of higher masted vessels without disrupting traffic on upper deck (see sheet #3).



Lower Lift Deck: Lowered Position

Low Water Clearance: 26 feet

Permits passage of small vessels.

HISTORIC AMERICAN ENGINEERING RECORD OR-21

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OREGON

STEEL BRIDGE - 1910-12
OREGON 99W SPANNING THE WILLAMETTE RIVER
MULTNOMAH COUNTY

PORTLAND

WILLAMETTE RIVER BRIDGES RECORDING PROJECT
NATIONAL PARK SERVICE
UNITED STATES DEPARTMENT OF THE INTERIOR

DELINEATED BY: ERIC B. KENYON, MANUEL HERNANDEZ, 1999

TRIM LINE

609423

Tower and Lift Deck Configuration

A
Main Tower Sheaves

- Made of cast steel and resting 245 feet high on the main sheave girder, the tower sheave is 14 feet in diameter and weighs 24 tons.
- Pitch diameter of sheaves is approximately 75-times the diameter of cables.

B
Counterweights, Lower Lift Deck

- 4 @ 482,000 lbs.
- Each counterweight is attached to a pair of lower-deck panel points by 1 1/4-inch cables.
- Preferable cable material for vertical lift bridges was plow steel (six strands of 19 wires each) around a hemp center.

C
Counterweight, Upper Lift Deck

- Approximate weight: 856 tons.
- Made of concrete framed in steel.
- Bridge is span-heavy; i.e. counterweight is about 5% less than weight to be balanced.
- Two wells are constructed in the top of the counterweight to accommodate 360 individual balancing weights not exceeding 200 lbs. per unit or 10% of weight to be balanced.

D
Machinery House

- Two 200-horsepower electric motors power each deck exclusively.
- Reduction gears maximize motors' efficiency with various gear sizes, driving larger gears from torque generated by smaller gears.

E
Upper Lift Deck

- Steel grid decking filled with concrete. (orig. creosoted wood block on wood plank)
- Pedestrian, bicycle, and vehicle access up to the GVWR* of double tractor trailers.
- MAX light rail added in 1985.

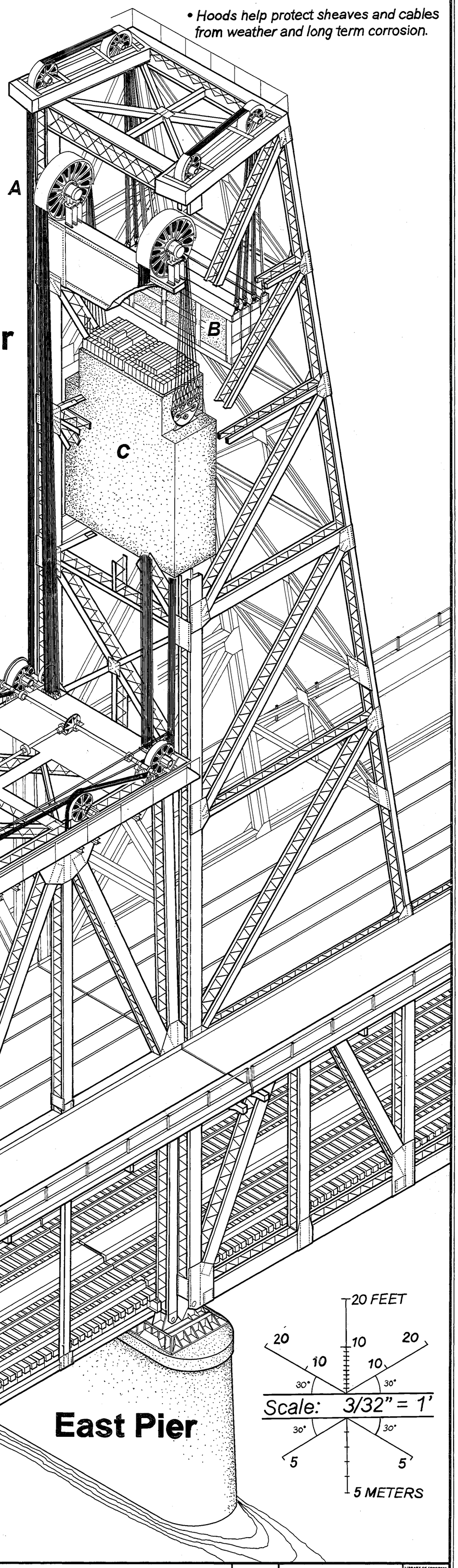
F
Lower Lift Deck

- Oregon-Washington Railroad and Navigation Company / Union Pacific / Southern Pacific Railroads.

*Gross Vehicle Weight Rating

Tower Sheave Platform

- Hoods help protect sheaves and cables from weather and long term corrosion.



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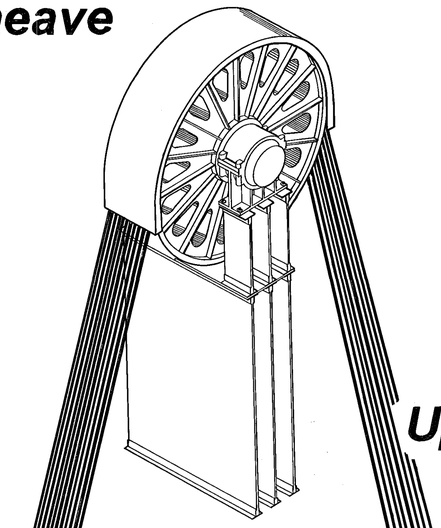
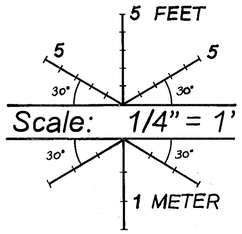
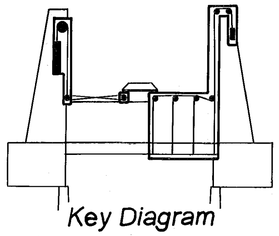
WILLAMETTE RIVER BRIDGES RECORDING PROJECT NATIONAL PARK SERVICE UNITED STATES DEPARTMENT OF THE INTERIOR	STEEL BRIDGE - 1910-12 OREGON 99W SPANNING THE WILLAMETTE RIVER MULTNOMAH COUNTY PORTLAND OREGON	SHEET 2 OF 3	HISTORIC AMERICAN ENGINEERING RECORD OR-21	LIBRARY OF CONGRESS INDEX NUMBER

Lift Components

Main Tower Sheave






Key Diagram

Upper Lift Deck

Deflecting Sheave, Upper Lift Deck

Directs lifting (Up Haul) and lowering (Down Haul) cables from the machinery house to upper and lower deadman connections fixed to the main tower.

Power Drive Drum, Upper Lift Deck

Spools up the distance of Up-Haul Cable when lifting the upper span while feeding an equal distance of Down Haul Cable.

Down-Haul Cable

Up-Haul Cable

Transverse Driveshaft, Upper Lift Deck

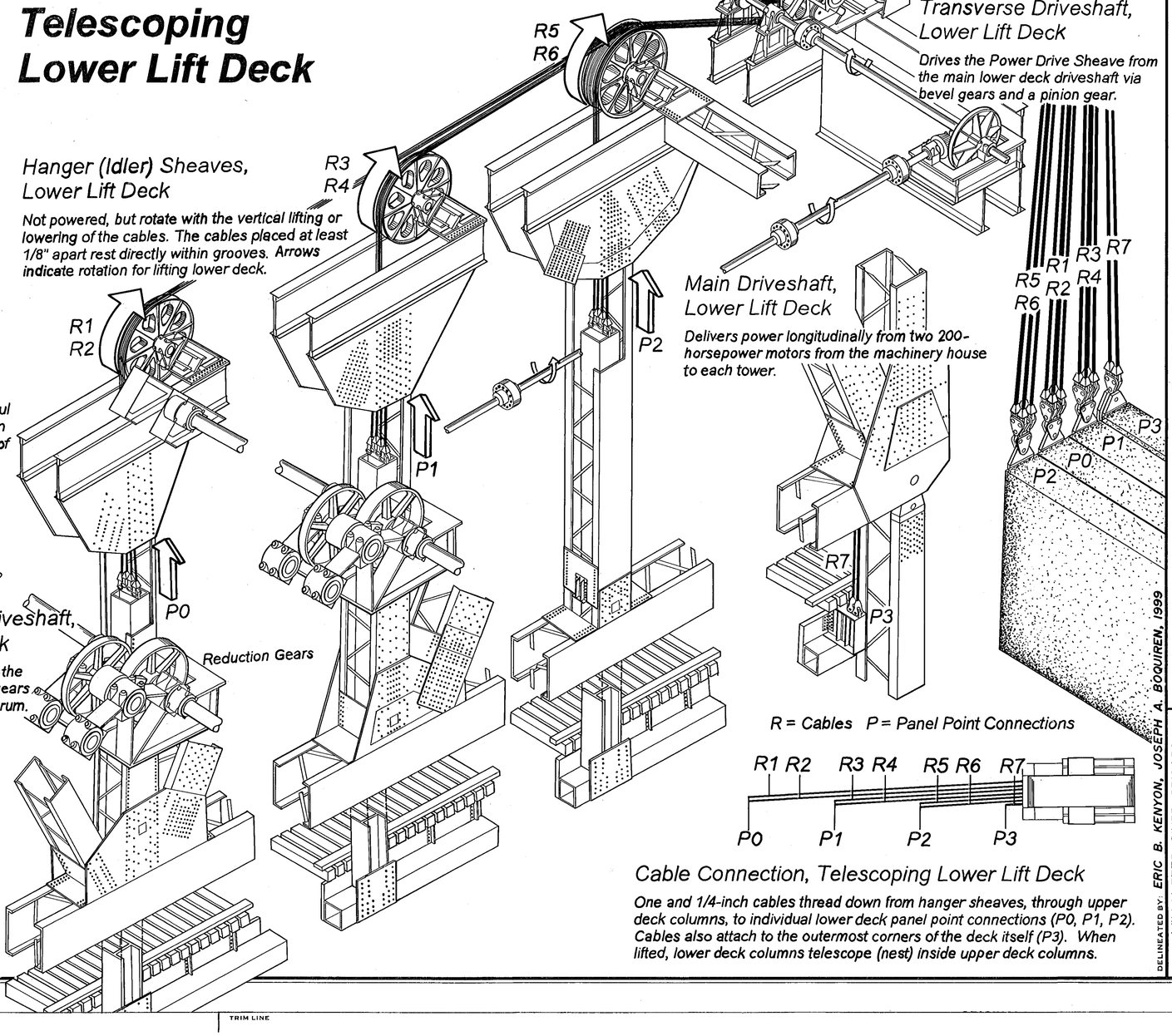
Provides power from the motor via reduction gears to the Power Drive Drum.

Reduction Gears

Cable Connection, Upper Lift Deck

Upper deck suspends from 2 1/4" cables attached at each corner and connected to the main counterweight, via the main tower sheave.

Telescoping Lower Lift Deck



Hanger (Idler) Sheaves, Lower Lift Deck

Not powered, but rotate with the vertical lifting or lowering of the cables. The cables placed at least 1/8" apart rest directly within grooves. Arrows indicate rotation for lifting lower deck.

Power Drive Sheave, Lower Lift Deck

Delivers lift power to cables joining lower deck and counterweights, via traction.

Transverse Driveshaft, Lower Lift Deck

Drives the Power Drive Sheave from the main lower deck driveshaft via bevel gears and a pinion gear.

Main Driveshaft, Lower Lift Deck

Delivers power longitudinally from two 200-horsepower motors from the machinery house to each tower.

R = Cables P = Panel Point Connections

Cable Connection, Telescoping Lower Lift Deck

One and 1/4-inch cables thread down from hanger sheaves, through upper deck columns, to individual lower deck panel point connections (P0, P1, P2). Cables also attach to the outermost corners of the deck itself (P3). When lifted, lower deck columns telescope (nest) inside upper deck columns.

DELINEATED BY: ERIC B. KENYON, JOSEPH A. BOQUIREN, 1999

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