

# FTA

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## **Vintage/Heritage Trolley Cars** *Past, Present, and Future*

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# Training Goals

Enhance Industry Knowledge/Technical Assistance:

- Origins of vintage/heritage vehicles
- Applicability to present operations
- Unique features
- Shortcomings
- Future & Opportunities

# Disclaimer

This presentation does not constitute any official opinion, recommendation, or statement of policy by FTA or USDOT.

Part I:

# ORIGINS OF VINTAGE/HERITAGE TROLLEY CARS

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# Predecessors

- The earliest form of urban rail transportation dates to the opening of the first horsecar line in New York City in 1832.
- Animal-powered transportation had definite shortcomings.
  - Working lifespan of animals, food, and sanitation issues.
- Attempts were made to utilize steam propulsion, followed by cable power in 1873 in San Francisco.
  - Steam power was expensive and unwieldy in crowded streets, frightening horses.
- Cable power also had shortcomings, and despite somewhat large systems in several cities, including Chicago, Baltimore, and Philadelphia, a better method was sought.
  - Cable propulsion was mostly gone by 1910; by 1940 San Francisco was the last system in the USA.

# Oldest Surviving New York Horsecar



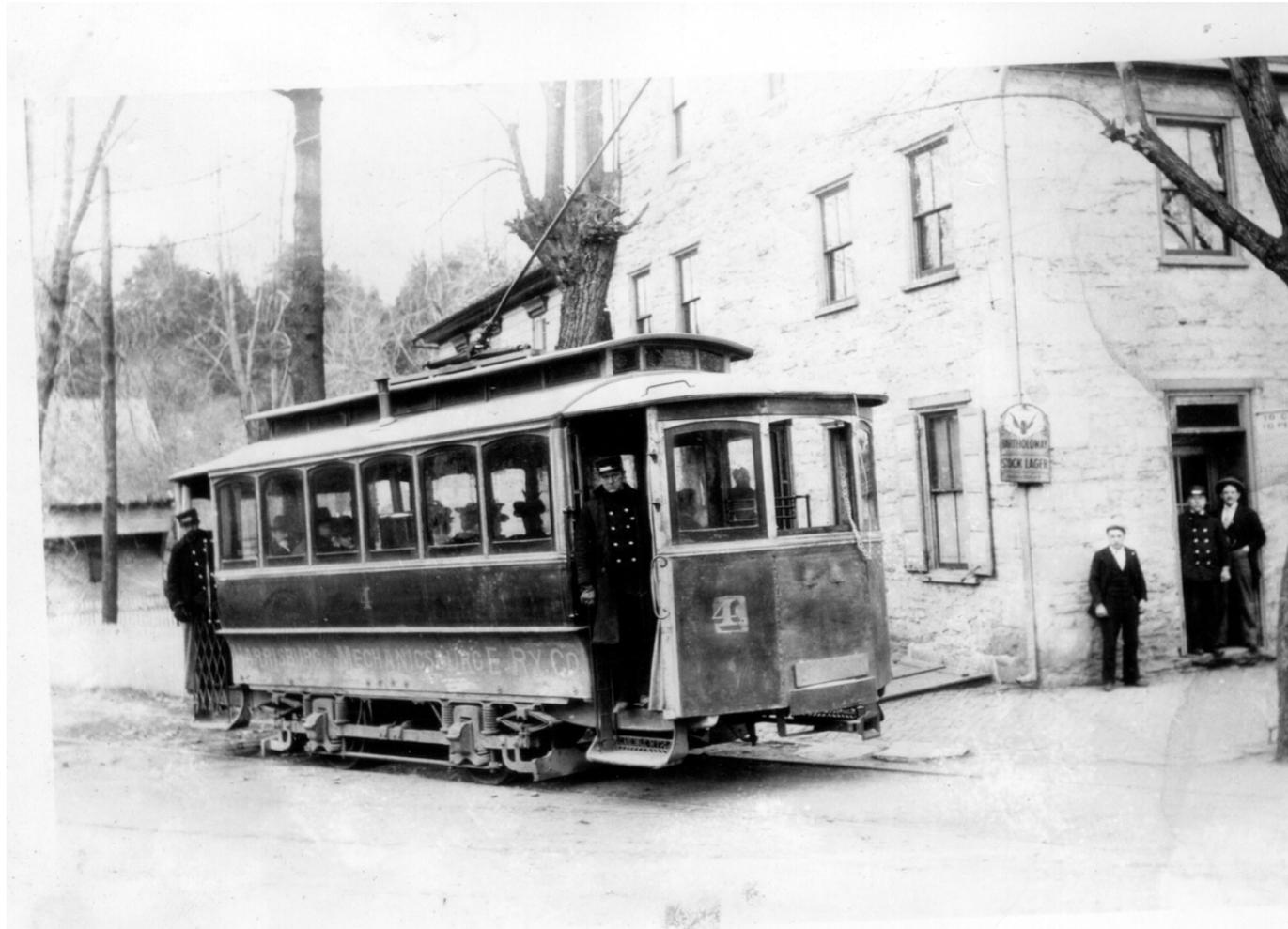
# San Francisco Cable Car



# Development of the Electric Trolley Car

- The need for a better method than animal or steam propulsion led to early experiments with electricity.
- Early experimental operations occurred in 1885-1887 in several cities.
  - Baltimore initiated service on a demonstration line in 1885.
  - Montgomery, Alabama and Scranton, Pennsylvania started regular operations in 1886; these systems retained electric operation for decades.
- The Sprague system, opened for service in Richmond in 1888, became the most successful and the standard which other systems adopted.
  - Montgomery and Scranton modified their systems to utilize the Sprague technology perfected in Richmond.

# Typical Early Electric Trolley Car





This vehicle, dating from 1896, is the oldest operable electric trolley car available for transit service in the United States. It is operated occasionally in San Francisco.

# Boom and Bust

- The shift from public to private transportation came with popular acceptance of the automobile.
  - Public policy promoted and financed construction of highways
    - Transit operations were still privately held corporations, with fixed assets such a facilities, rails, and distribution systems subject to taxation.
  - Economy measures, such as reduction of operating crews to a single operator did not reverse the trend.
  - Cities saw slow moving trolley cars and their tracks as obstacles to the private automobile.
  - An industry effort to produce a modern, relatively fast, sophisticated yet maintainable, vehicle prolonged the life of some systems in major cities, but the decline continued.

# Boom

- The electric trolley car reached its apex in the United States in 1917
  - 60,000 vehicles in operation
  - 26,000 miles of track
  - 11 billion passengers carried per year
  - Over 1000 operating entities
  - Combined annual operating revenue of \$600M
  - Investment value \$4B (\$75B in 2015 dollars)



# Bust

- By 1967, only a handful of systems remained in the USA.
  - Boston, MA
  - Newark, NJ
  - Philadelphia, PA
  - Upper Darby, PA (Philadelphia suburbs - separate system from city)
  - Pittsburgh, PA
  - Cleveland, OH (Shaker Heights)
  - New Orleans, LA
  - San Francisco, CA
- Philadelphia provides an example:
  - 1911: 3,399 vehicles, 86 individual routes
  - 2011: 130 vehicles, 6 routes

# Typical 1920s Trolley Car



# “Modern” 1930-era Design



# The industry tried to fight back...

Alarmed by the decline of their industry, a committee was formed to design a “modern” trolley car.

- The design utilized features of the automobile.
- It was a technological leap forward in an industry that needed innovation to survive.
- The basic design could be adapted to unique conditions in different cities.
- Sophisticated, yet maintainable, controls provided greater comfort and speed.
- Named the “PCC Car” after the Electric Railway Presidents’ Conference Committee.



**The first production PCC cars were delivered to Brooklyn in 1936.**

# PCC Cars Served from Coast to Coast





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# 1952 – Final domestic PCC car produced



Part II:

# APPLICABILITY TO PRESENT OPERATIONS

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# What is a Vintage/Heritage Trolley?

- As defined by APTA and CPUC General Order 143B:
  - An electrically propelled rail vehicle for the conveyance of passengers.
  - Originally manufactured prior to January 1, 1956.
  - A new vehicle designed to replicate the appearance and function of such vehicles.
  - Term also used to describe similar rail vehicles which are not electrically propelled, but have the same appearance and function.

# National Transit Database

- 12 Rail Fixed Guideway Public Transportation Systems (RFGPTS) overseen by the FTA and the SSO Program have Heritage Vehicle Operations.
- NTD reporting shows that there are 204 Heritage Vehicles (less than 2% of the approximately 12,000 rail transit vehicles of all modes nationwide).
- NTD Classifications for these vehicles:
  - Replica
  - Heritage
  - PCC

# Replica Vehicles - Example



# Heritage Vehicle – Example restored to like new condition



# PCC Car – Example restored to like new (vintage) condition



# PCC Car – Example rebuilt to modern standards



# Examples of Operating Entities

- NOTE: This is not an all-encompassing list.
- Stand-alone systems targeted primarily to tourists and serving entertainment venues:
  - Memphis, TN (heritage and replica vehicles)
  - Tampa, FL (replica vehicles)
  - Little Rock, AR (replica vehicles)
- Serving both tourists and commuters:
  - San Francisco, CA (F & E lines) (heritage vehicles and PCC cars)
  - New Orleans, LA (heritage and replica vehicles)
  - El Paso, TX (PCC cars)

## Examples of Operating Entities (continued)

- Operation of vintage vehicles on portions of Light Rail System:
  - San Jose, CA (heritage vehicles; operations now infrequent)
  - San Francisco, CA (very limited areas of mixed operation)
  - San Diego, CA (PCC cars)
- Unique conditions preclude use of more modern vehicles:
  - Boston, MA (PCC cars)
    - Until recently, infrastructure on Mattapan-Ashmont High Speed Line precluded use of vehicles heavier than a PCC car.
  - Philadelphia, PA (PCC cars)
    - At time of reconstruction of Trolley Route 15, no bidder was interested in constructing a small quantity of vehicles (18) compatible with Philadelphia's unique operating conditions. Thus, 18 retired PCC cars were reconstructed with modern propulsion and service components installed in overhauled car shells.

Part III:

# UNIQUE FEATURES OF REPLICA/HERITAGE/PCC CARS

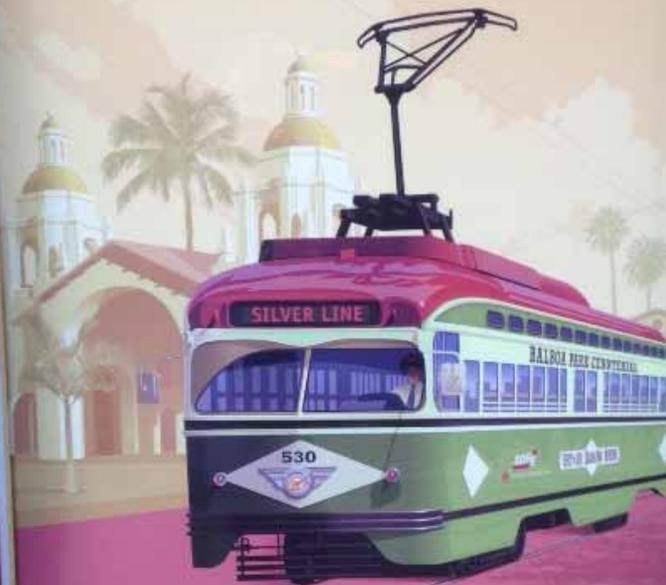
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# The Experience vs. Convenience

- Replica/Heritage/PCC vehicles convey a different message to the customer.
  - Materials not found in modern vehicles, such as wood, rattan seat upholstery, etc.
  - Discernable noise from wheels, air compressor, (if equipped), gears
  - Opening windows and lack of air conditioning (in some instances)
  - Typically lower speeds than modern Light Rail Vehicles (except for PCC cars)

Restoring the magic...



SAN DIEGO'S VINTAGE  
**SILVER LINE**

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# Interior Example – Vintage Trolley



# Interior Example – PCC Car



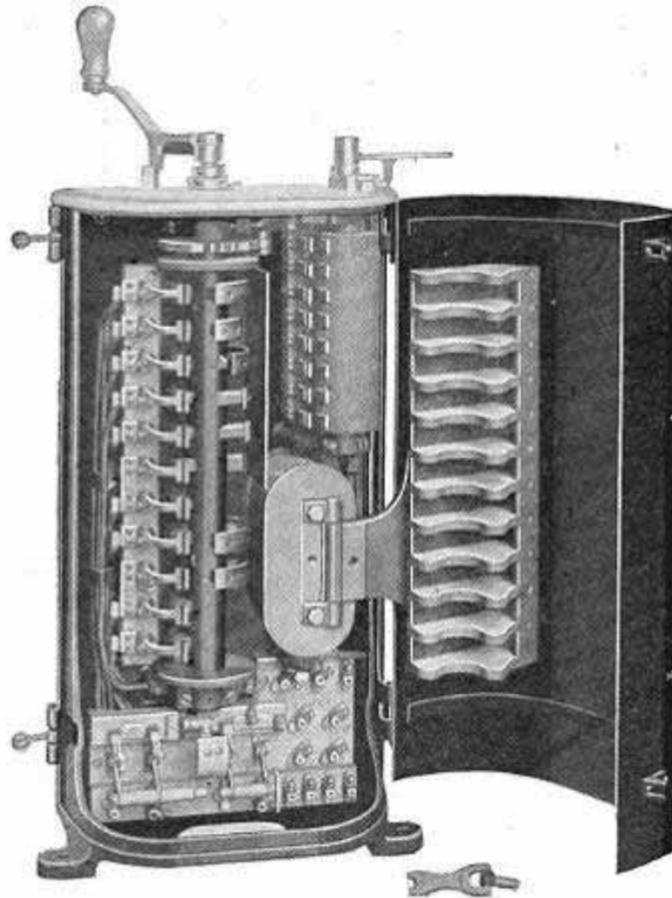
# Rugged Simplicity of Components

The most simple types of heritage vehicles have a manually accelerated controller that mechanically opens/closes electrical contacts contained inside. Brakes are controlled by a straight-air valve that admits/releases air to an underfloor cylinder to control braking rate and speed.

Control of auxiliaries (lights, heat, etc.) mounted slightly below roof line and utilize manual circuit breakers, rotary snap switches, or knife switches (or a combination thereof).



# The inside of a typical K-type controller



# Hands-Free Control in a PCC car

- Controls are set up in a configuration similar to an automobile.
- Left pedal: Interlock (or deadman) pedal. If released, car makes an emergency stop. Must be depressed at all times car is operating.
- Center pedal: brake pedal.
- Right pedal: power pedal.
- Forward/Reverse controlled by a floor mounted lever (typically).
- Toggle switches control doors, heat, lights, gong, horn, etc.



Part IV:

# **SHORTCOMINGS OF REPLICA/HERITAGE/PCC CARS**

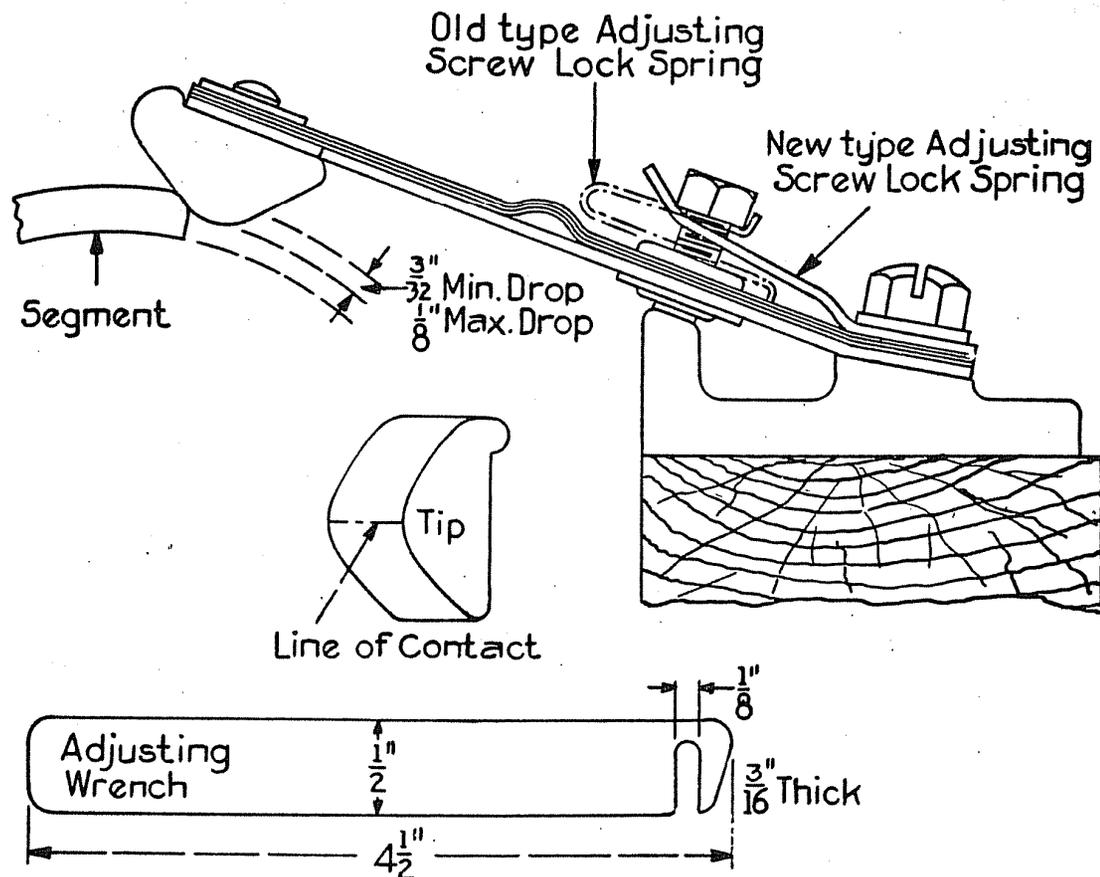
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# Technology Obsolescence Challenges

- While a fairly robust network of component vendors exists, many parts needed for vintage and PCC cars are difficult to obtain.
  - Components for certain types of control and braking apparatus
  - Truck assembly components
  - Some carbody hardware
- Retrofitting of older cars with more obtainable hardware is somewhat common
  - Reverse engineering
- Older components restored to like-new condition are still technologically obsolete

# Obsolescence Example #1: K-35 controller (circa 1905) finger



## Improper maintenance can have fatal consequences

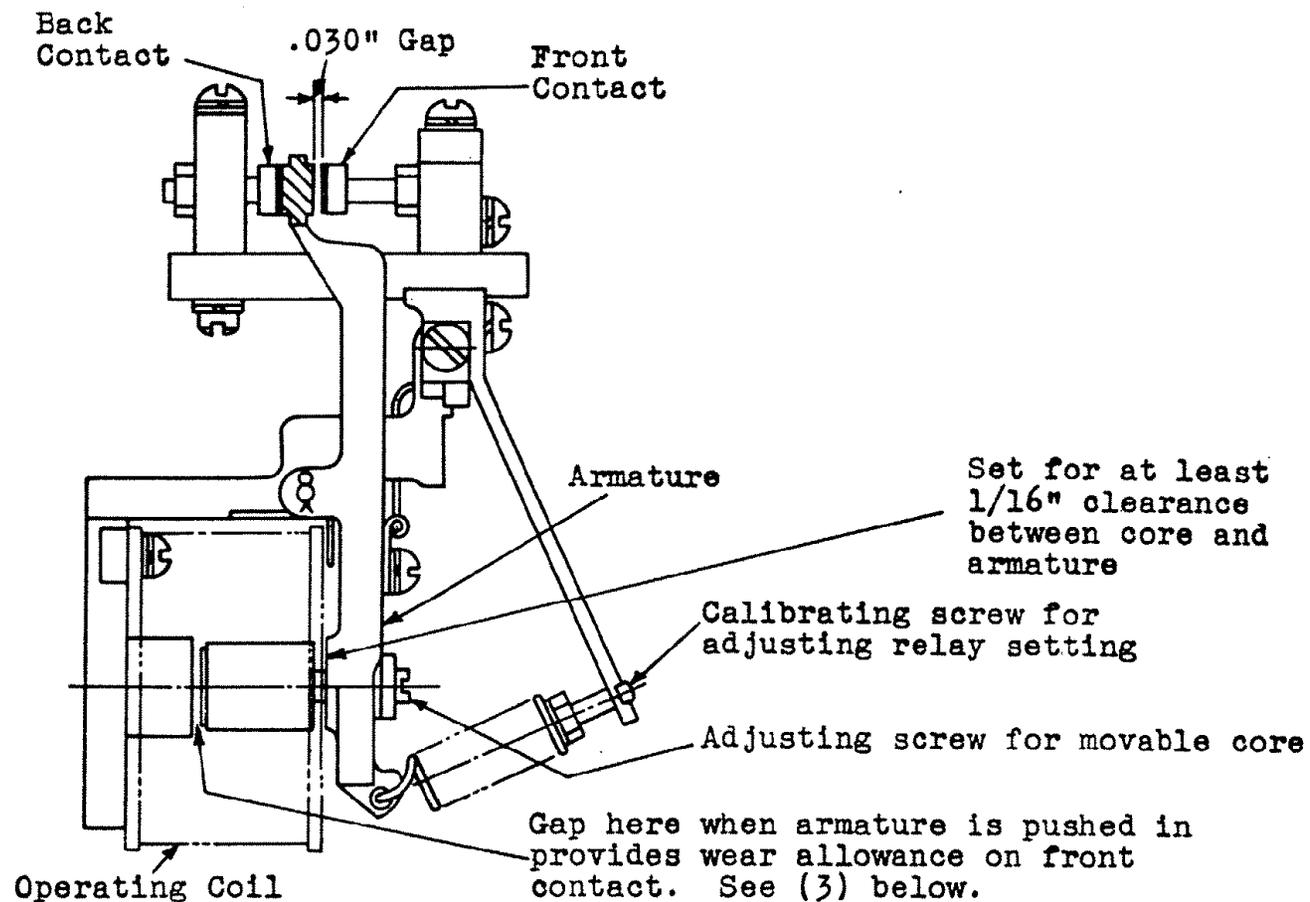


## Increased risk potential with older equipment

- Photo at right is a K-35 controller that flashed over catastrophically due to improper maintenance and operation.
- Controller circuits are 600VDC, as opposed to 24-36VDC in contemporary equipment (and certain circuits in PCC cars).



# Obsolescence Example #2: PCC Car Electro-mechanical Voltage Regulator (circa 1946)



## Difficult to comply with present standards

- Variety of materials, construction/restoration methods, etc. found in vintage trolley cars makes complying with modern standards extremely difficult.
  - NFPA 130 specifically excludes “tourist, scenic, historic, or excursion operations”.
  - APTA Vintage/Heritage Trolley Equipment Standards are recommended, but not required.
  - CPUC GO 143B includes specific considerations for vintage equipment.
- Vintage equipment pre-dates ASME crashworthiness standards.

## Crashworthiness differs between modern and vintage vehicles



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# Accessibility Challenges

ADA compliance can be a challenge with vintage vehicles due to their construction methods (i.e. narrow doors, exit stanchions, tall steps, etc.).



# Maintainability of vintage equipment

- Technologically simple compared with modern microprocessor controlled equipment, but a generational gap exists.
  - Vehicle diagnostics features not available; effective troubleshooting determined by hands-on aptitude and experience.
  - Ergonomics and modularity of components largely not considered.
  - While much of the equipment is very rugged, trade-off is larger requirement for frequent maintenance. Examples:
    - Plain (non-roller) bearings packed with oil-soaked pure wool waste (yarn) that must be inspected and oil levels checked. Not uncommon to have 24 of these bearings in the running gear of one car.
    - Electro-mechanical components that need periodic recalibration and manual renewal of contact surfaces.
    - Door and step mechanisms that have multiple levers that must be manually adjusted, individually.

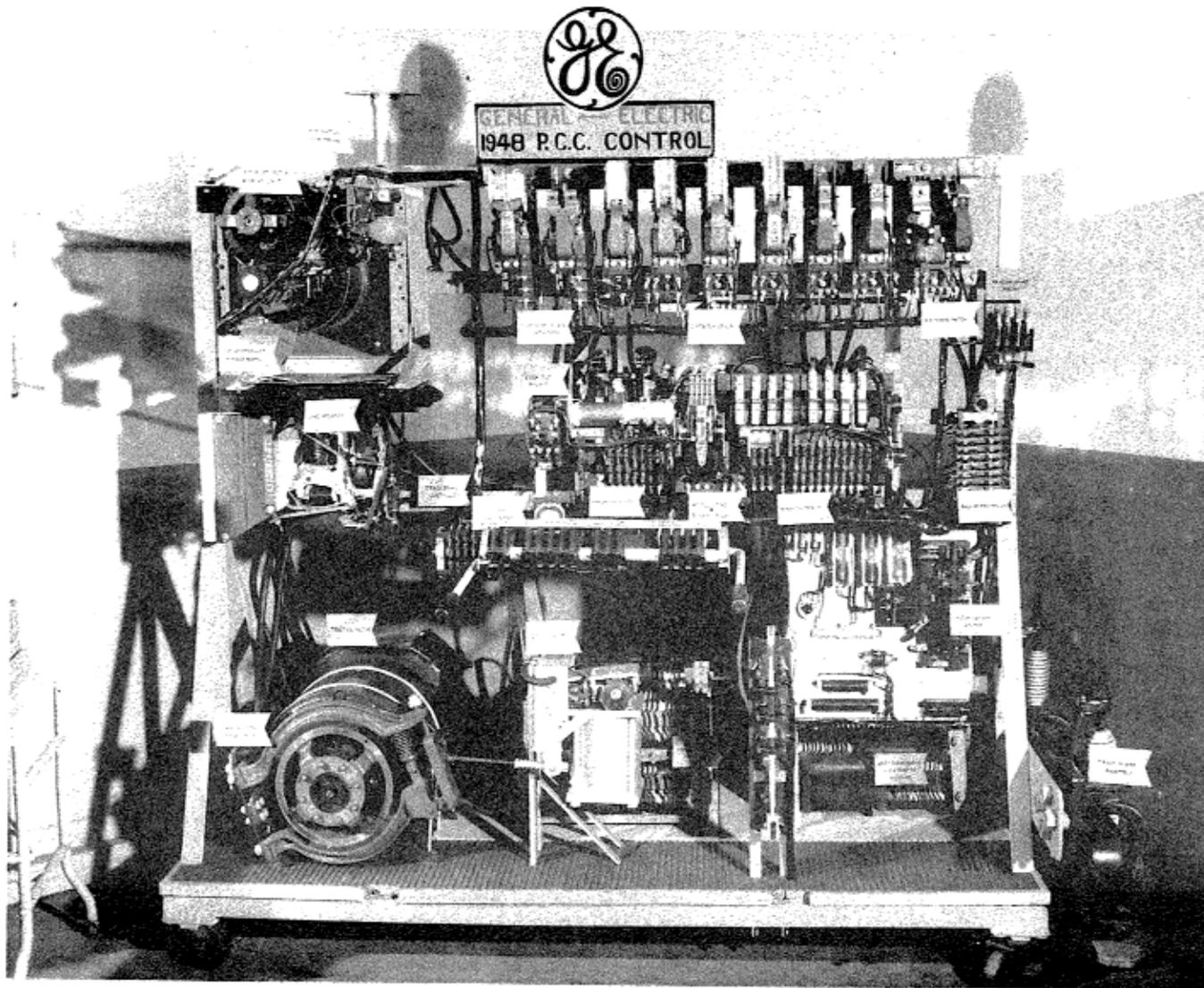


FIGURE #9—COMPLETE GENERAL ELECTRIC P.C.C. CAR CONTROL EQUIPMENT WITH MOTOR, ACTUATOR, DRUM BRAKE ASSEMBLY AND TRACK BRAKE

# Availability of Vintage Equipment

- Presently there is one domestic builder of “new” heritage equipment.
  - Uses many running gear components salvaged and rebuilt from dismantled vintage cars.
- Several entities offer full or partial overhaul services for vintage equipment.
  - Examples include moderate rehabilitation to complete reconstruction.

# Availability (continued)

- Limited supply of vintage and PCC cars
  - With few exceptions, existing stocks of unused PCC cars need complete reconstruction, and number of available cars continues to dwindle.
  - Stock of available vintage cars even smaller.
  - Obtaining cars from trolley museums is usually not a solution.
    - The majority of cars preserved in operating condition by museums are not suitable for service demands and conditions of transit-type operation.
    - General reluctance of museum industry to offer preserved artifacts for use as daily conveyances.



Part V:

# **FUTURE & OPPORTUNITIES**

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# Vehicle Availability Opportunities

- Two fleets of PCC cars maintained for transit operations could become available in the foreseeable future:
  - Boston: 10 PCC cars (being overhauled but considered for eventual retirement from Mattapan-Ashmont service)
  - Philadelphia: 18 extensively rebuilt PCC cars slated for replacement as part of fleet-wide trolley replacement program in next 5-10 years.
    - Note: Philadelphia's unusual track gauge will require costly modification for most potential users.
- If the past is any indication:
  - PCC cars retired from Philadelphia in 1990s now in operation in two cities (besides Philadelphia).
  - PCC cars retired from NJ Transit in 2001 now in operation in two cities.

# Cost effective acquisition?

- Costs for a new streetcar or Light Rail Vehicle:
  - \$4-5M per vehicle
- Overhaul costs for an existing PCC car:
  - \$2-3M per vehicle
- Several caveats and a recommendation:
  - Costs can vary substantially dependent upon options chosen, extent of rehabilitation, configuration needed to meet unique local conditions, etc.
  - Research needed into total Life Cycle Costs and an associated comparison between new and heritage/vintage/PCC vehicles is warranted.

Question:

**DOES THE DEFINITION OF  
“VINTAGE” CHANGE WITH TIME?**

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## Brief Case Study: San Diego U2 vehicles

- Purchased in several orders; oldest vehicles date from 1981.
- Entire fleet has been retired from active service and replaced with new vehicles.
- Some cars sold for future transit service in Argentina.



# U2 Light Rail Vehicles (continued)

- Recognizing the historical nature of these vehicles and the need to connect with younger generations, several vehicles were donated to trolley museums in California and in Pennsylvania.



# U2 Light Rail Vehicles (continued)

- San Diego MTS, taking a cue from the museum industry, has preserved its first U2 vehicle (seen at left) for operation on its heritage line (Silver Line – operated with PCC cars).
- Is this a sign of things to come?
- Will the oldest “new” Light Rail Vehicles become the next category of “vintage” equipment?





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# References

## Books:

- “PCC The Car That Fought Back” by Stephen P. Carlson and Fred W. Schneider III.
- “PCC From Coast To Coast” by Fred W. Schneider III and Stephen P. Carlson.
- “The Time of the Trolley” by William D. Middleton.
- “Urban Mass Transit: The Life Story of a Technology” by Robert C. Post.

## Papers:

- FTA Report No. 0085, “TriMet Streetcar Prototype - Final Report”; [http://www.fta.dot.gov/documents/FTA\\_Report\\_No.\\_0085.pdf](http://www.fta.dot.gov/documents/FTA_Report_No._0085.pdf)

# Additional References:

- Museums:
  - Baltimore Streetcar Museum; [www.baltimorestreetcar.org](http://www.baltimorestreetcar.org)
  - The Friends of Philadelphia Trolleys, Inc.; [www.friendsofphiladelphiatrolleys.org](http://www.friendsofphiladelphiatrolleys.org)
  - Market Street Railway, Inc.; [www.streetcar.org](http://www.streetcar.org)
  - National Capital Trolley Museum; [www.dctrolley.org](http://www.dctrolley.org)
  - Rockhill Trolley Museum; [www.rockhilltrolley.org](http://www.rockhilltrolley.org)
  - Shore Line Trolley Museum; [www.shorelinetrolley.org](http://www.shorelinetrolley.org)
  - Western Railway Museum; [www.wrm.org](http://www.wrm.org)
- Special Thanks:
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# Future Questions/Comments

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