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Tapered Roller Bearing Test Rig: Axially Loaded Application to Accelerate Bearing Failure

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Tapered Roller Bearing Test Rig
Axially Loaded Application to Accelerate Bearing Failure

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Sponsor: Amsted Rail Company, Inc.
Sponsor Advisors: Michael Mason, Martin Reed, Mark Fetty

Current Testing Method

- Railcar Tapered Roller Bearings Manufactured by: Amsted Rail

  Fig 1: Railcar bearing
  Fig 2: Conventional cup/cone tapered roller bearing diagram

- Applied Load:
  - Other companies have the ability to test small scale bearings (with reduced fatigue life) using a multitude of test rigs to obtain failure data. Amsted Rail however, desires to have a new type of testing method to analyze larger bearings and to produce failure in a short amount of time.

  Fig 3: Load distribution using conventional testing method

Proposed Testing Method

- Project Goal:
  - To design an accelerated fatigue life test rig that will study Association of American Railroad Class K, 6⅜ x 9 inch double row tapered roller bearings by applying an axial load instead of the conventional radial load

  Fig 4: New loading distribution - axially loaded

- Applied Load:
  - Axially applied loads cause failure to occur at a more rapid pace in Class K bearings due to characteristic simultaneous loading on each roller while in motion (depicted in Fig. 4)

  Fig 5: Extended (Running) Position
  Fig 6: Retracted (Disassembly) Position

  Components:
  1. Electric Motor – rotates the main driven cone shaft via a gear box
  2. Main Driven Cone Shaft – rotates press-fitted cone assembly and secondary cone spline shaft
  3. Cone Assembly – rotates inside of the static cup
  4. Cup – supported, cooled, and held statically by the split pillow block
  5. Secondary Cone Spline Shaft – rotates secondary cone assembly inside of cup
  6. Hydraulic Piston – supports secondary cone spline shaft and applies load (19,942 lb) from hydraulic cylinder via slip-fitted thrust bearings

Specifications and Results

- Testing Method Specifications
  - Bearing Specifications:
    - 23 rollers per row          46 total rollers
    - Class K
    - 6⅜ x 9 inch
    - Double row
    - Tapered

  - Axial Load Required:
    - Total Load required by Piston: 19,941.9 lb
    - Ram Selection: 30,000 lb to allow for increased loading in future applications

  - Heat Generated:
    - Per roller = 22.12 BTU/min
    - Total = 1017.4 BTU/min

  - Torque Required:
    - 43.99 lb·in. per roller
    - 2023.76 lb·in. total = 168.65 lb·ft

  - Motor HP:
    - Total Required: 23.99 HP
    - Motor Selection: 40 HP to allow for increased loading in future applications

  - Cooling Method:
    - Custom designed oil cooled jacket to allow operating temperature to remain at or below 100 °F

- Results:
  - L10 Rating:
    - 14.75 million cycles
    - 1.1 months or 34.3 days

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