

FIVE FATAL DESIGNS

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Chicago USA and Christchurch NZ

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MANAGING ENGINEERING DESIGN

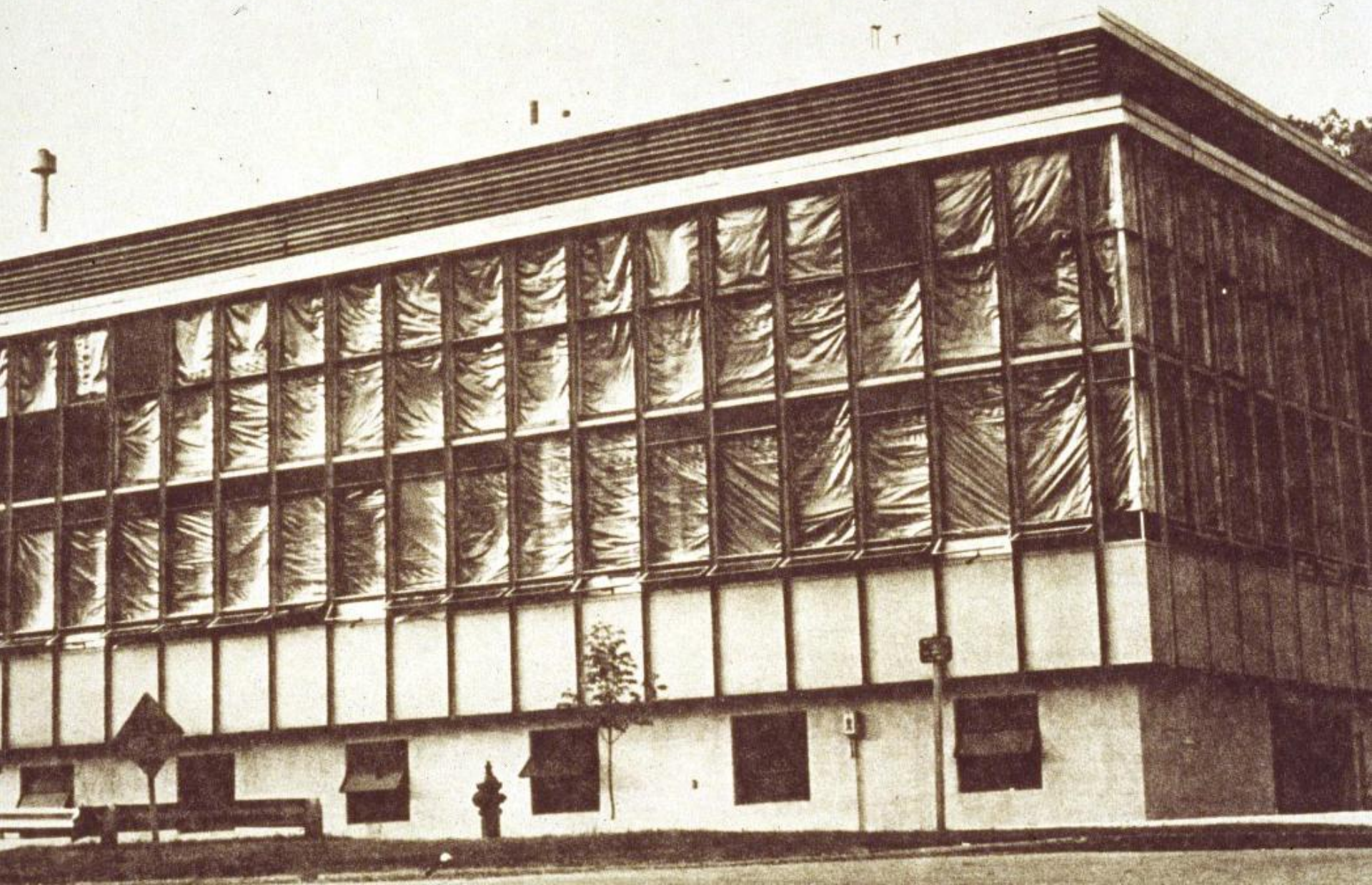
FIVE EXAMPLES:

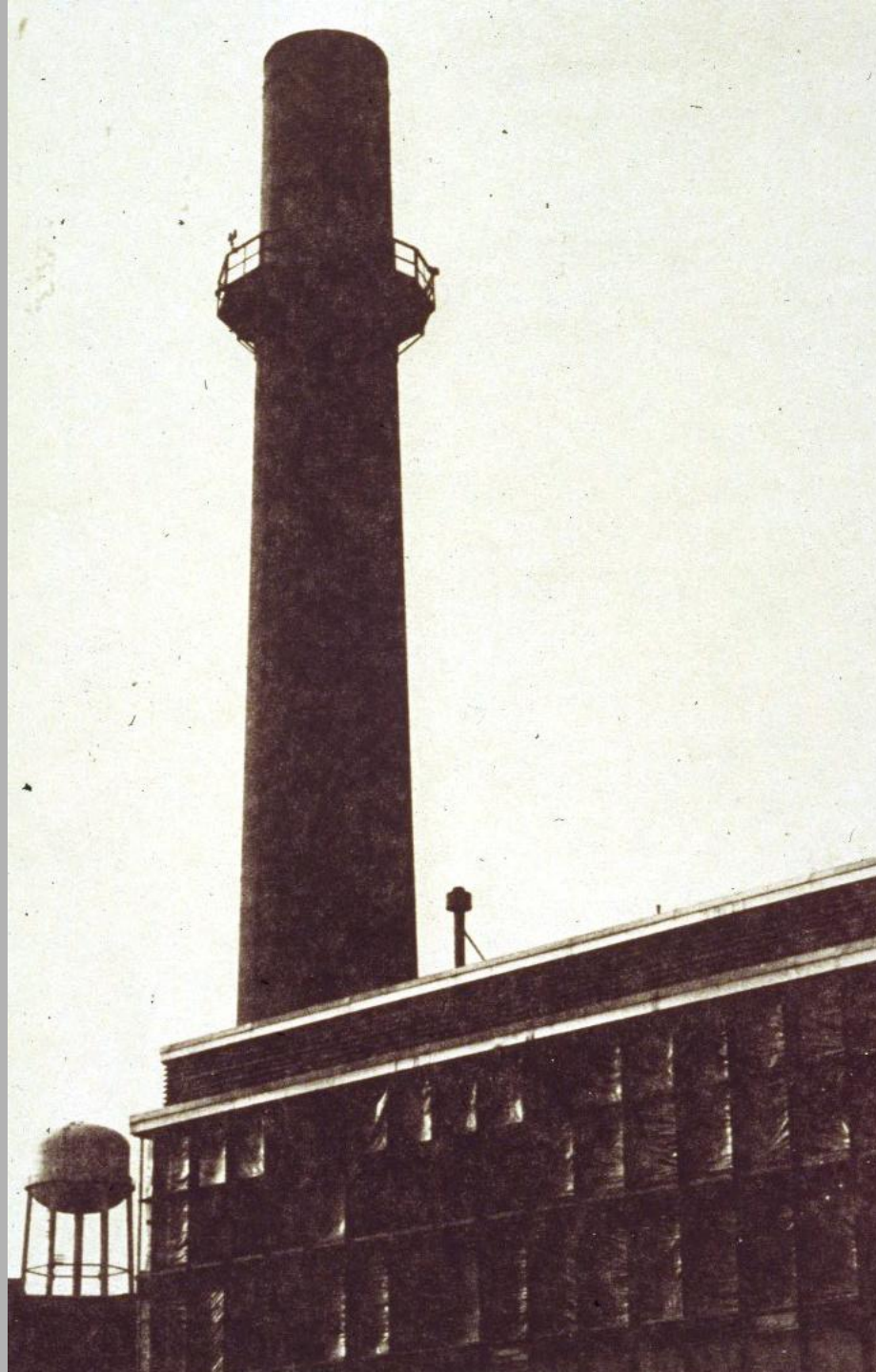
- The Exploding Boiler: **Specification**
- The Swinging Door: **Concept**
- The Falling Kingpin: **Embodiment**
- The Hanging Thread: **Detail**
- The Vibrating Press: **Communication**

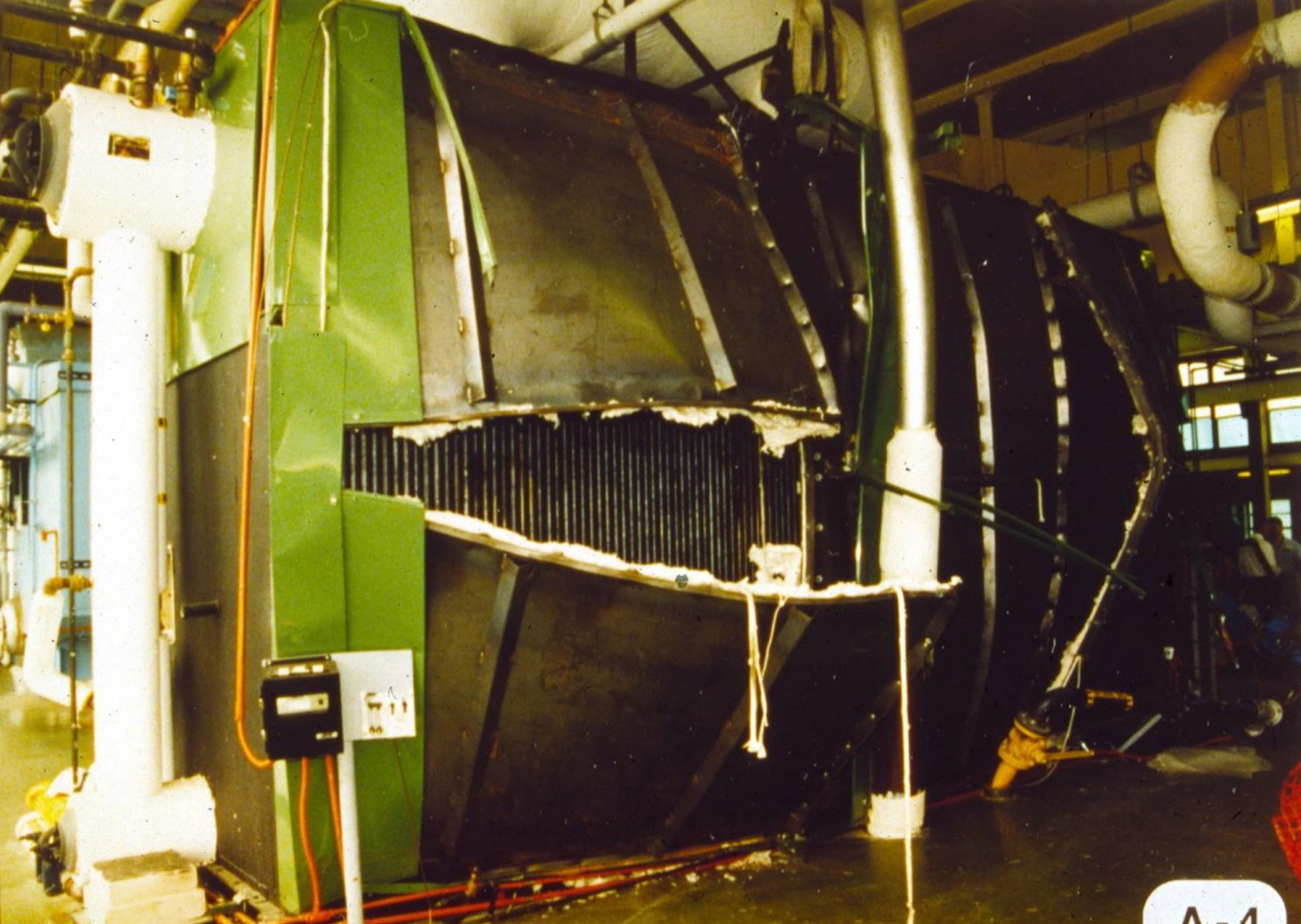
THE EXPLODING BOILER

- Prison boilerhouse with glass windows
- Four boilers and a high brick chimney
- Old boiler replaced - low NOx burner
- No damper controlling the induced draft
- Mixture set in winter, explosion in spring
- \$500,000 claim - settled by mediation
- Boiler manufacturer out of business

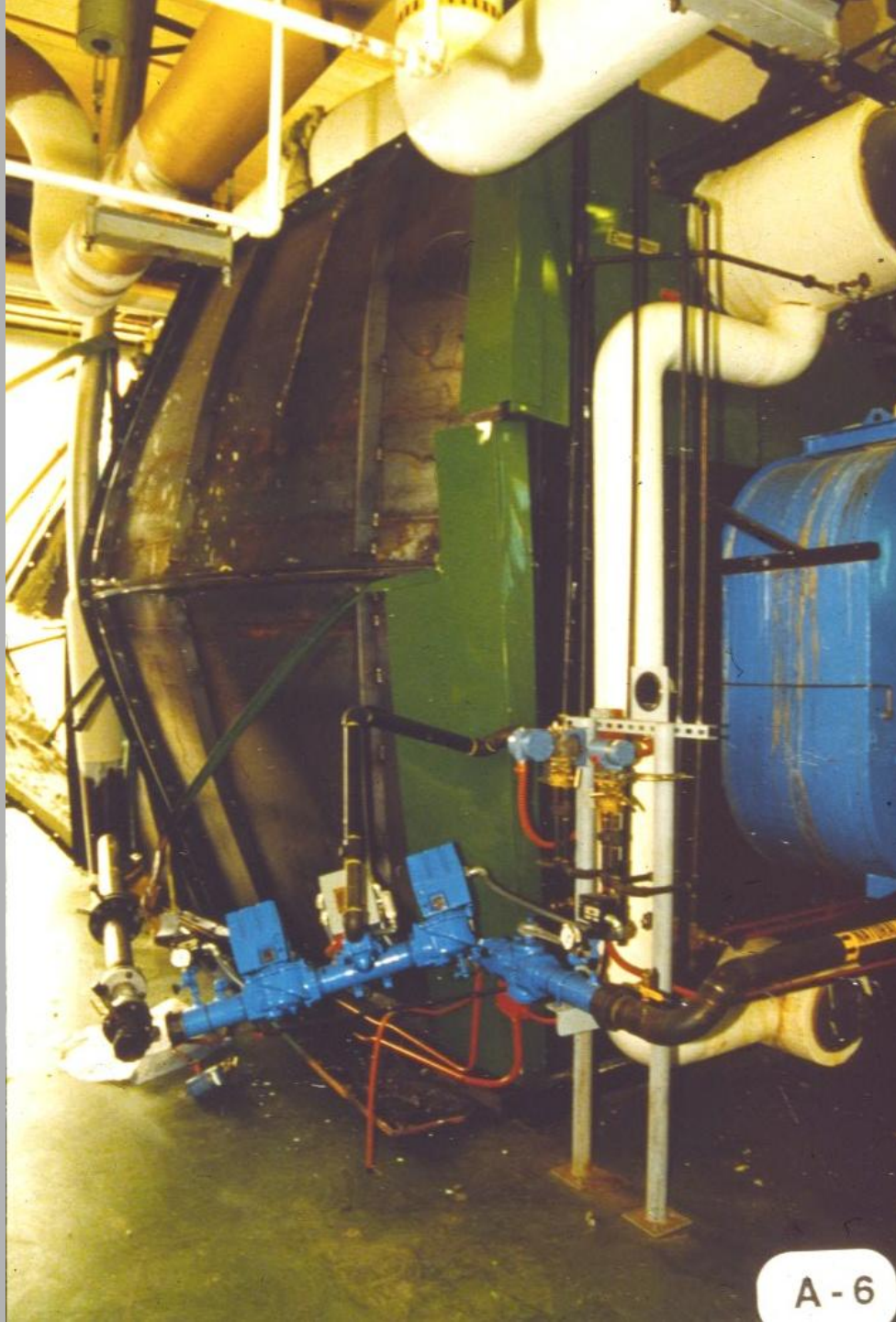
Deficient **design specification**



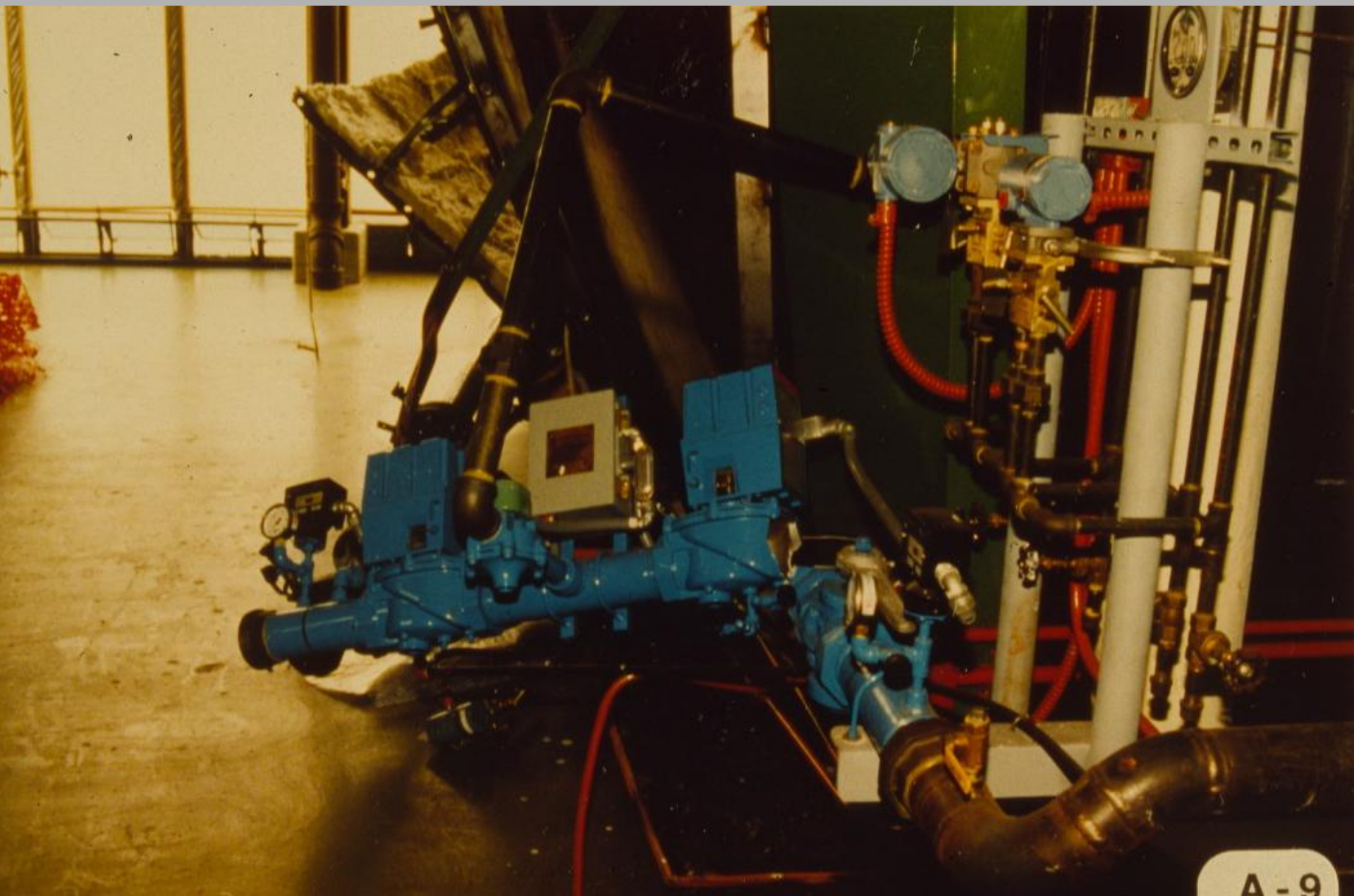




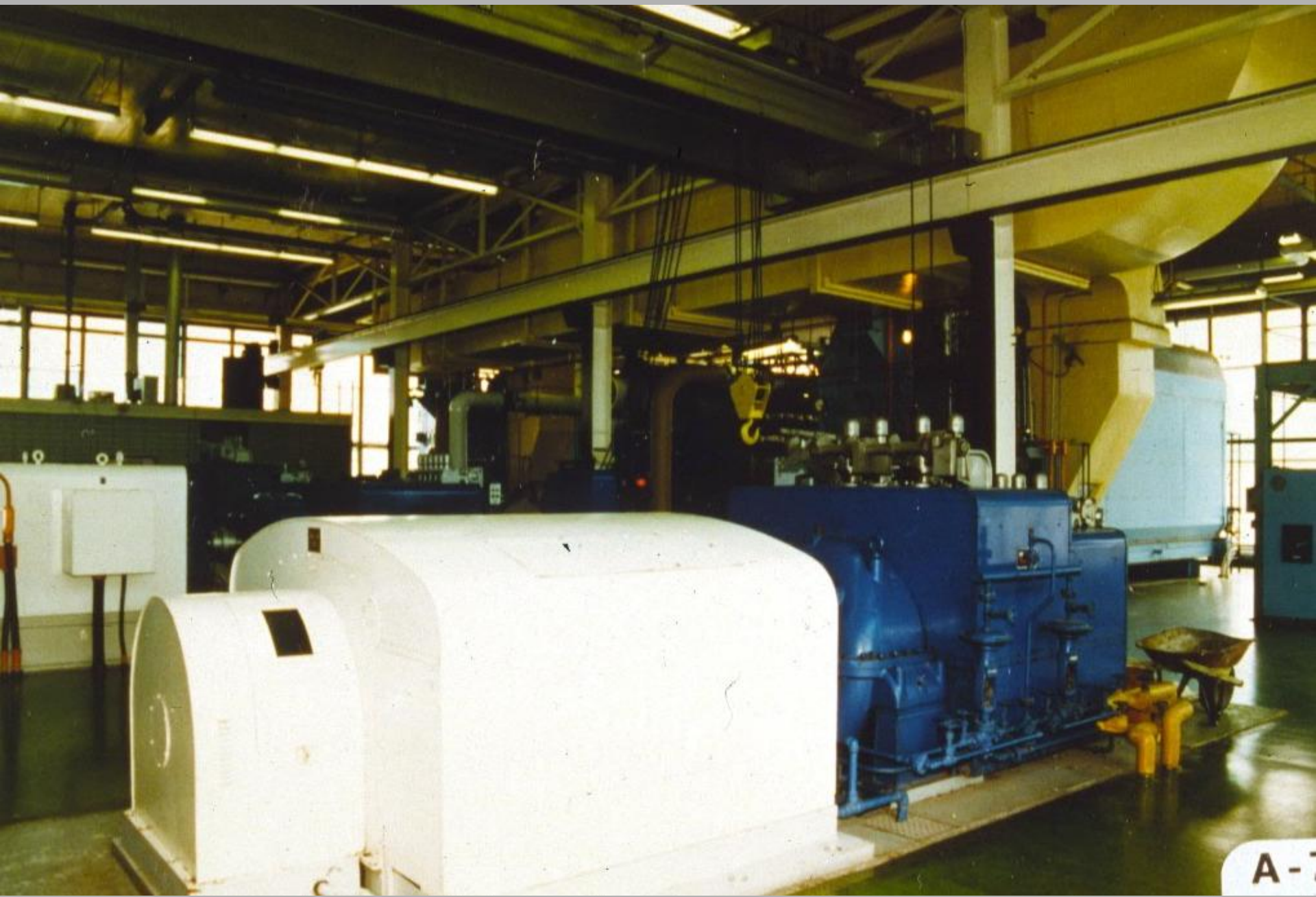
A-4



A - 6



A-9



A-7

THE SWINGING DOOR

- Post Office in Michigan
- Windy day - elderly lady comes to door
- Door flies off hinges and kills lady
- Spring-loaded quick-release top hinge
- No positive door/hinge connection

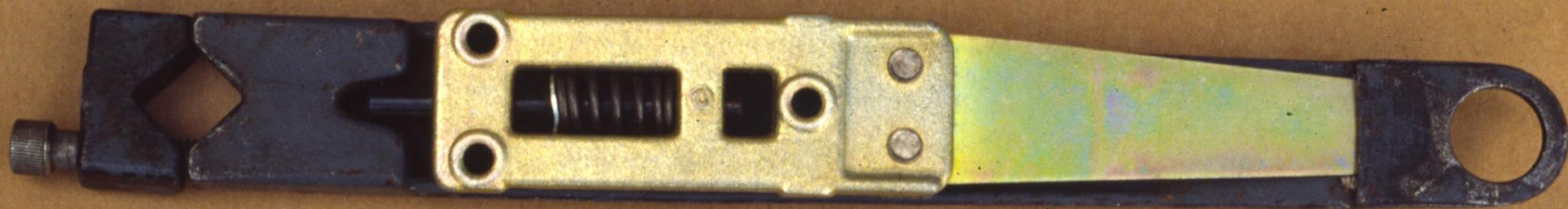
Poor design concept





PATENT APPLIED FOR
DOH-O-LOCK 10102

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Poor design concept:

later model had bolted connection

THE FALLING KINGPIN

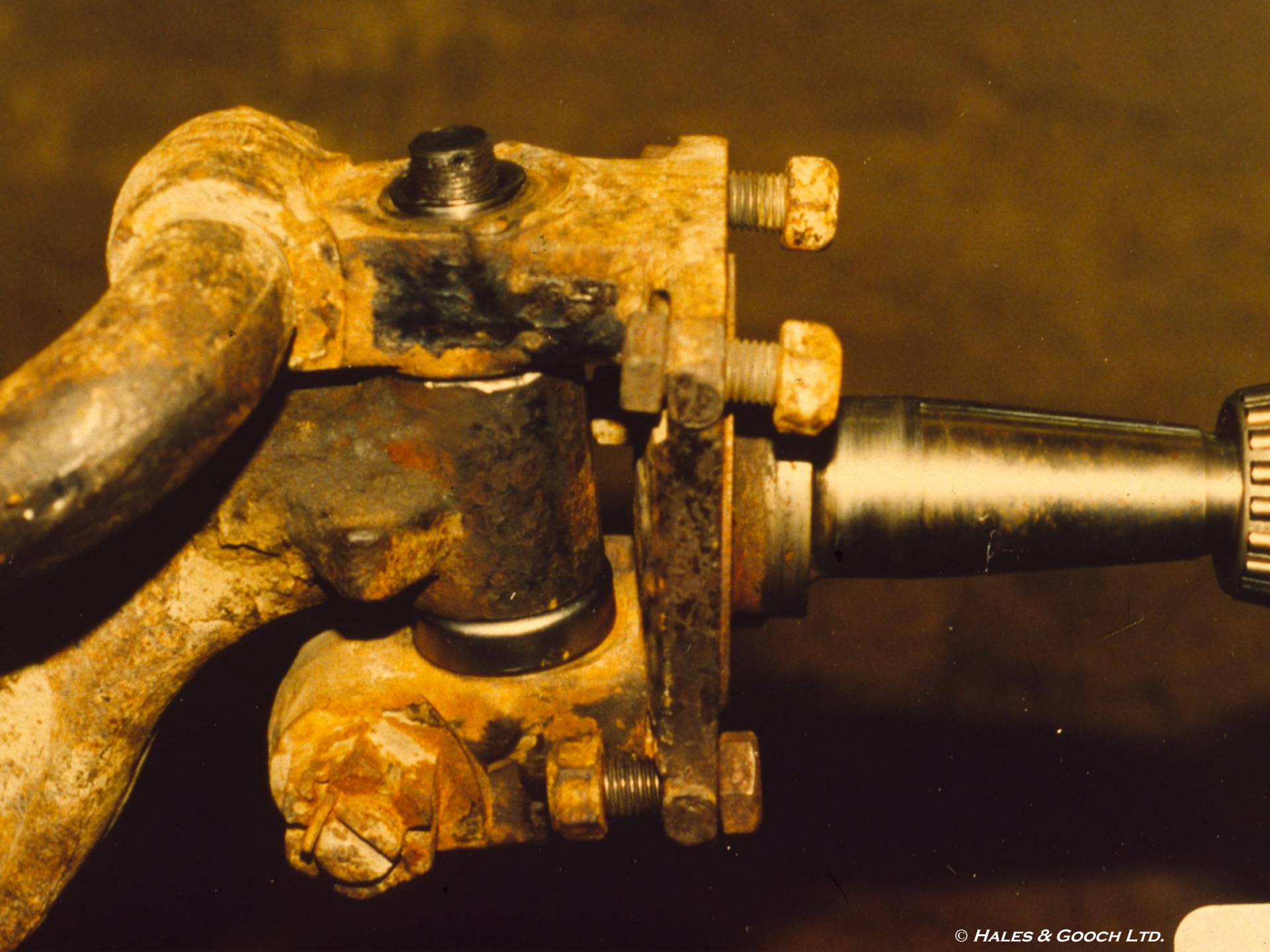
- Dump truck in Ohio
- Front left wheel assembly collapses
- Head-on crash kills van passenger
- Tapered kingpin inserted from bottom
- Worn or failed thrust bearing
- Load path changes to go through nut
- Nut unscrews - kingpin drops out

Deficient **embodiment design**

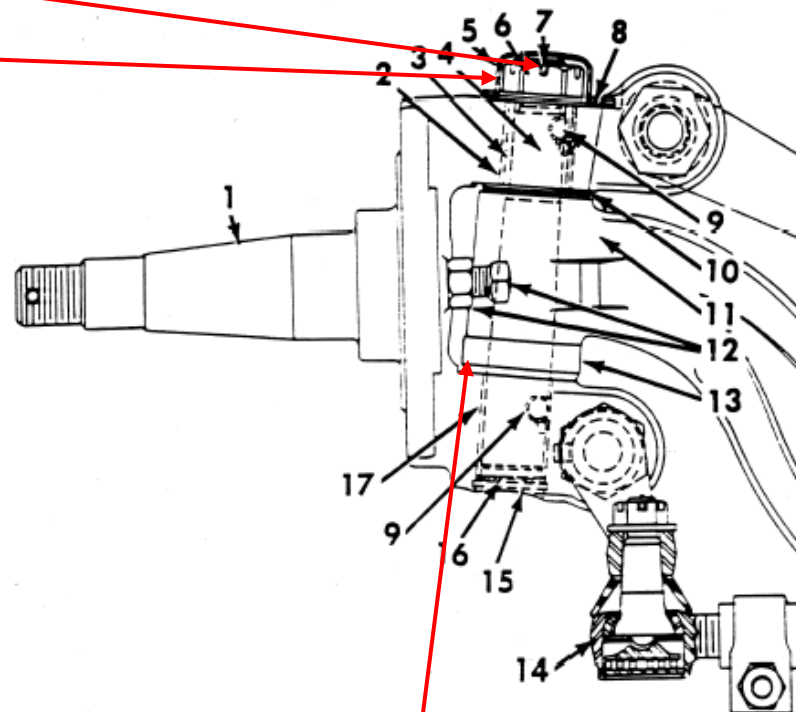








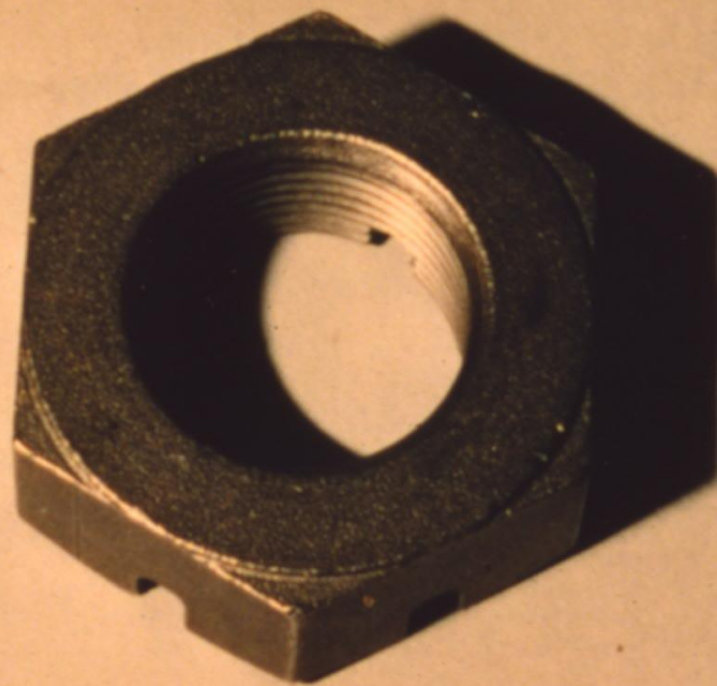
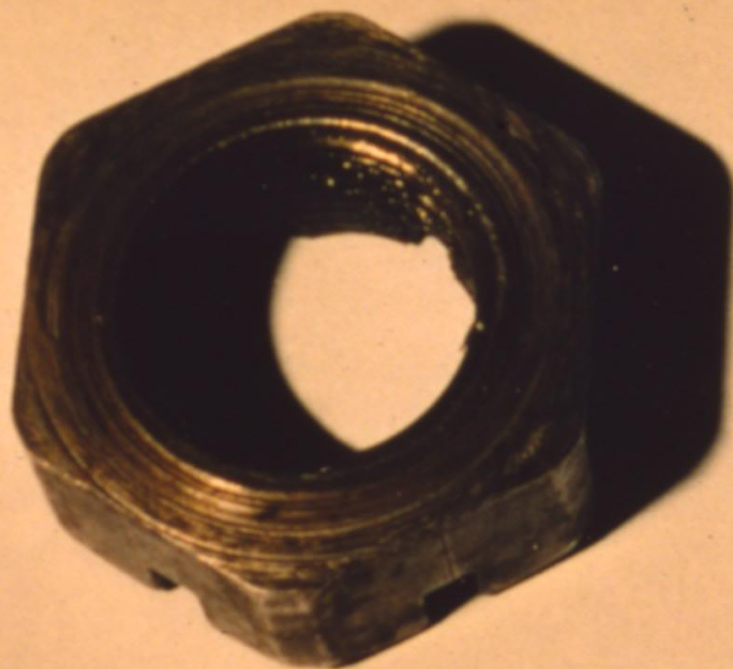
3C-8 FRONT AXLE AND SUSPENSION

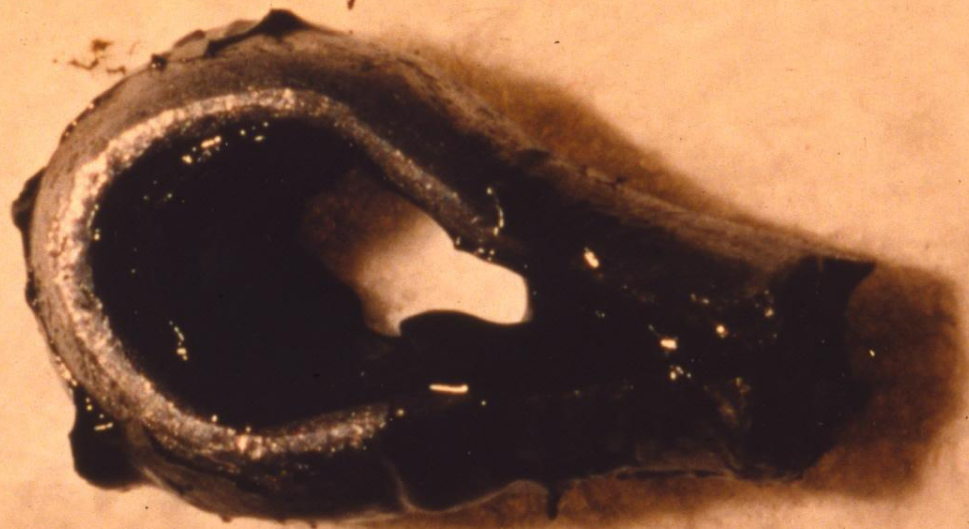


- 1 Steering Knuckle Spindle
- 2 Steering Knuckle Bushing
- 3 Kingpin Bushing (Upper)
- 4 Kingpin
- 5 Dust Cap
- 6 Kingpin Nut
- 7 Cotter Pin
- 8 Gasket
- 9 Lube Fitting

- 10 Washers or Shims
- 11 Axle Center
- 12 Stop Screw and Nut
- 13 Thrust Bearing
- 14 Tie Rod End Assembly
- 15 Plug Retainer
- 16 Expansion Plug
- 17 Kingpin Bushing (Lower)







Deficient embodiment design:

fatal change in load path as the parts wear during use

THE HANGING THREAD

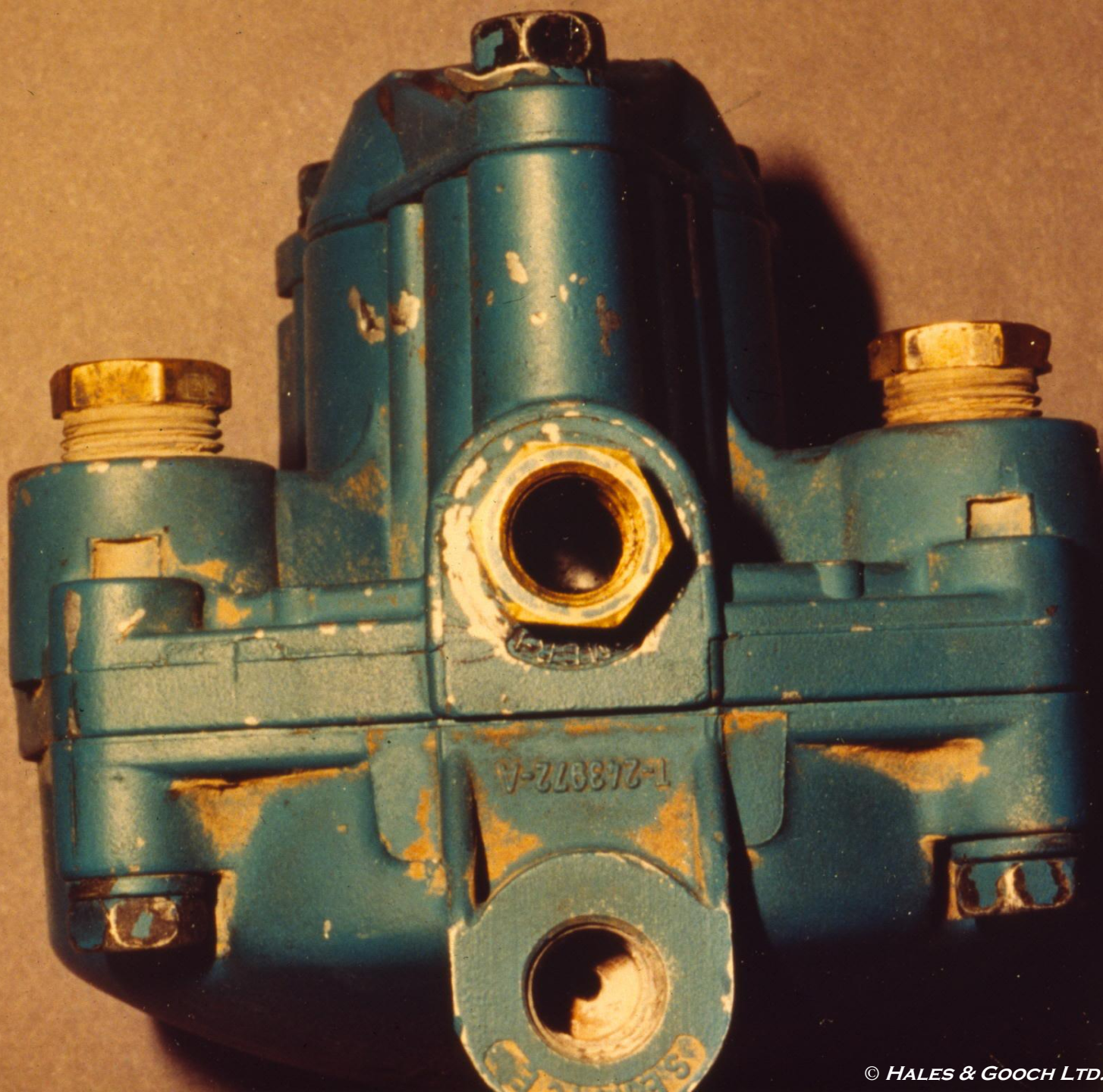
- Low-loading truck in Missouri
- Smoking trailer brakes - readjusted
- Wet road - minor accident up ahead
- Hello! - No brakes! - jackknifes into car
- Head-on crash kills one, injures others
- Trailer brake relay valve - partially closed
- Loose 5mm thread on air release valve

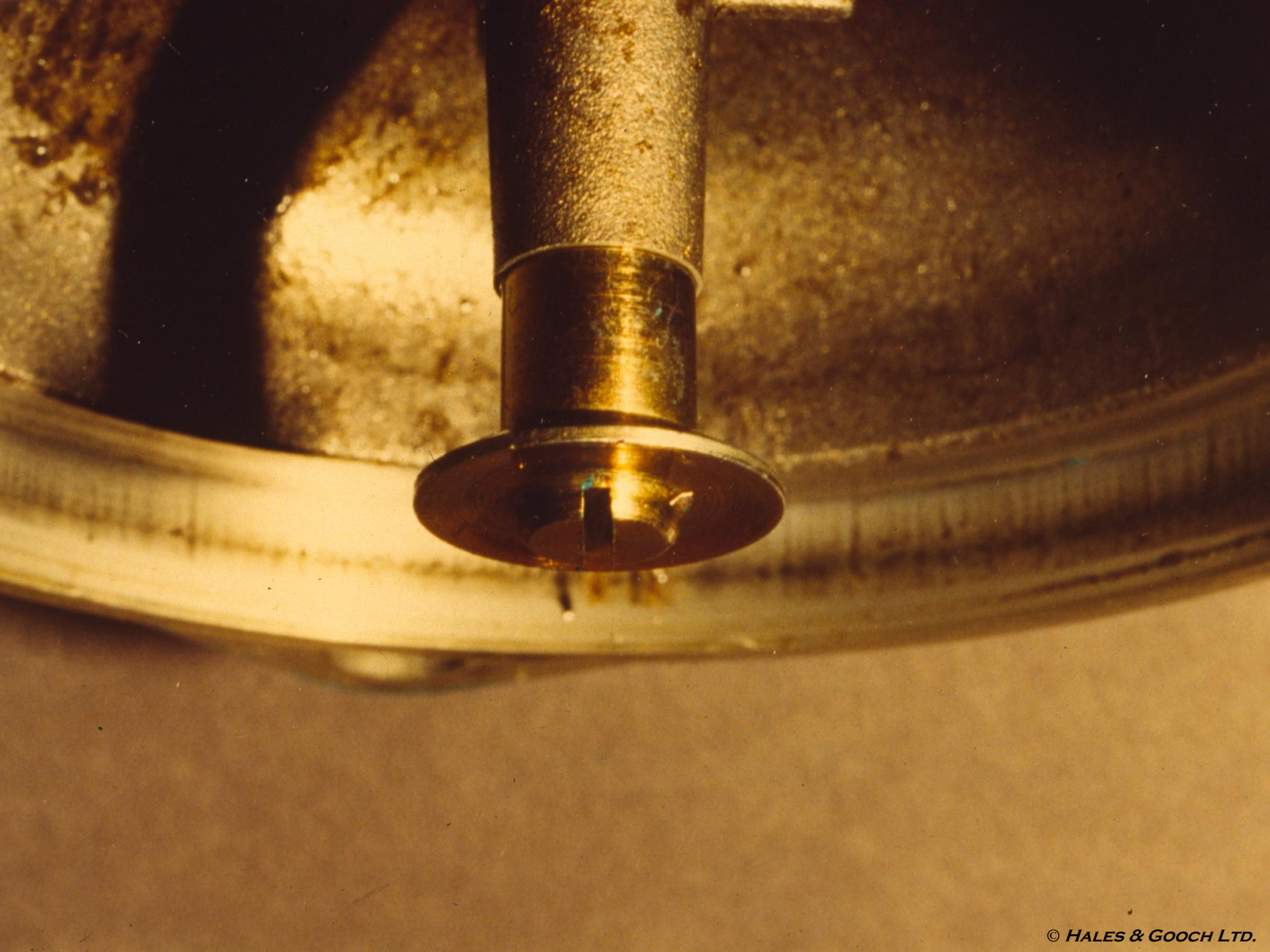
Deficient **detail design**

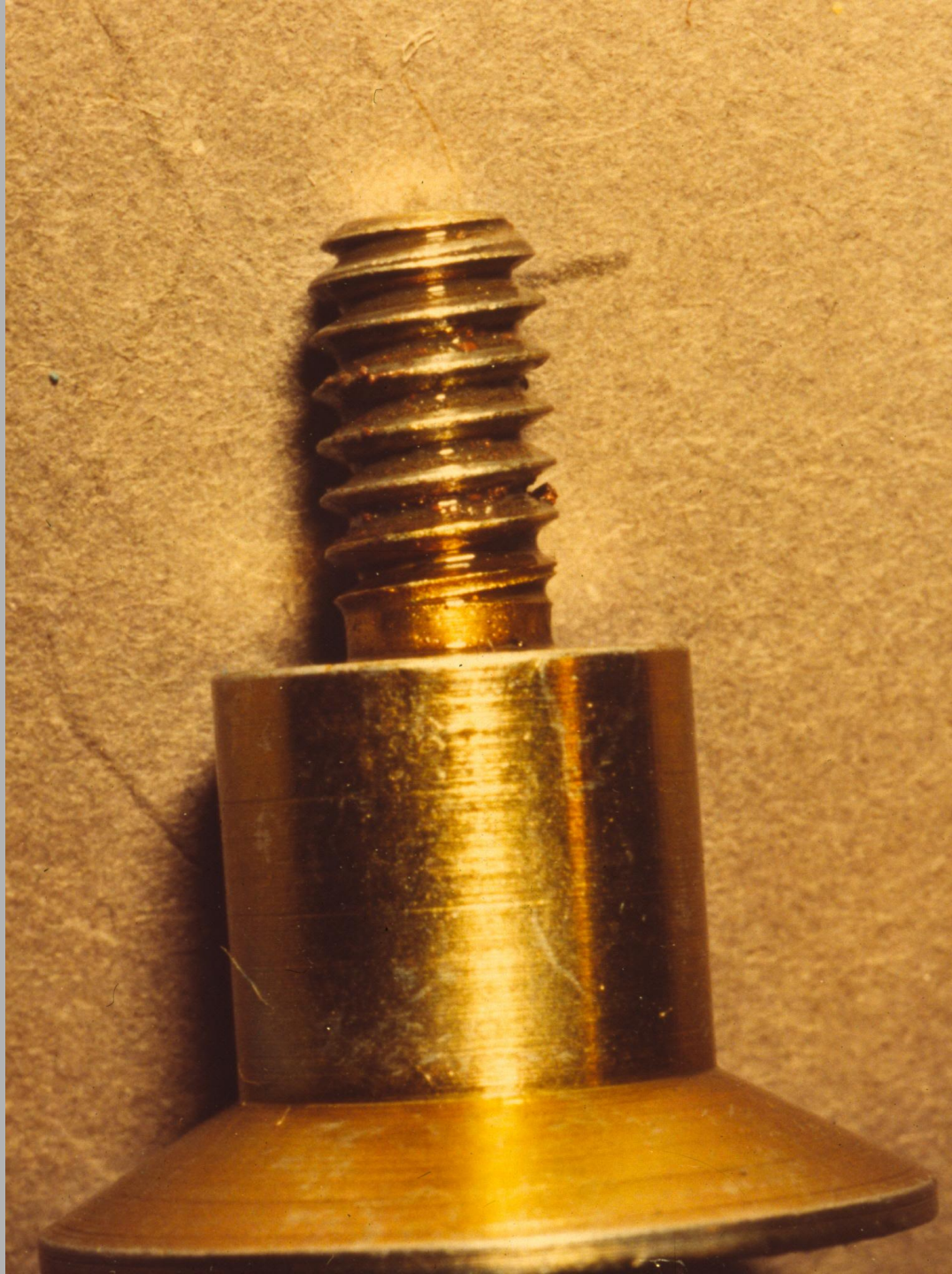












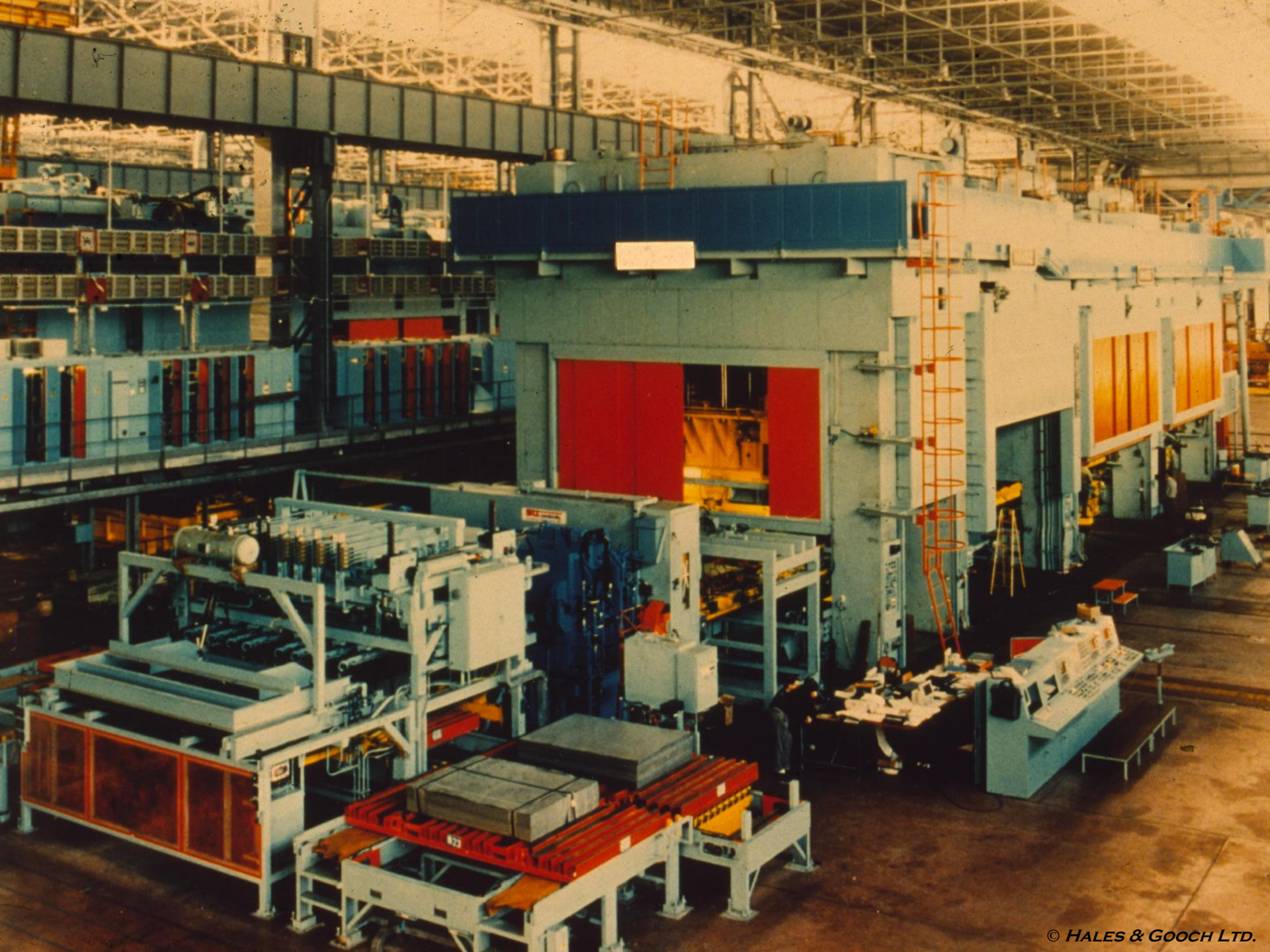
Deficient detail design:

inappropriate part orientation,
thread profile and locking

THE VIBRATING PRESS

- Largest presses ever built
- Customer wanted two presses **ASAP**
- High on scales of novelty and complexity
- Designed in one country - built in another
- 4000 drawings - translated units/words
- No time for testing or commissioning
- Dynamic problems - poor performance

Deficient **design specification**
Lack of **communication**
Design **separated** from manufacture



PROJECT PROFILE WORK SHEET

PROJECT: Tri-Axis Transfer PressDATE: 1990

LEVEL	INFLUENCES	CONTRIBUTING FACTORS	CURRENT STATUS	REQUIRED ACTION																																																																	
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Failure primarily due to lack of communication:

- specifications + expectations
- culture + language
- imperial vs. metric
- whoosh, whoosh vs. bonk, bonk

SUMMARY

- Engineering design management needs:
 - understanding
 - involvement
 - enthusiasm
 - persistence
 - communication
- The engineering design process needs:
 - an adequate design specification
 - a practicable design concept
 - a systematically developed layout
 - careful attention to detail design

MANAGING ENGINEERING DESIGN

SOME GUIDELINES

- Consider engineering design process in context
- Review influences at five different levels of resolution
- Profile the project to establish how work is to be done
- Use phase diagrams to overlap phases & shorten timescales
- Build a strong and appropriate team
- Negotiate for enough money and time to do a quality job
- Use a systematic approach to the engineering design process
- Use checklists to review progress during each project phase
- Review design prior to manufacture