ALTERNATIVES TO COAL FIRING

Presented by Roger Waller, DLM Ltd.

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UK to finish with coal power after 142 years

BBC-News, October 1, 2024: The country's last coal power station, at Ratcliffe-on-Soar, finishes operations on Monday after running since 1967.

Traditional steelmaking in Port Talbot ends

BBC-News, October 1, 2024: Tata Steel removed the last usable liquid iron from blast furnace 4 - which will eventually be replaced with electric arc furnaces - on Monday afternoon.

Global Coal Consumption

- Global consumption amounts to 8 billion metric tons per year (China: 50% thereof)
- Coal is (still) the world's largest source of energy for electricity generation and the production of steel and cement.
- Coal consumption of steam locomotives and steam road vehicles is marginal
- Coal mines will not continue for locomotive coal only **> alternative fuels are needed**

Problems of Coal Firing

1. Fundamental Disadvantages

- **Fuel quality varies, no guarantee of quality**
- **Poor combustion efficiency, unburnt fuel losses**
- **Fire risk, smoke, soot, sparks, ash, slag, clinker**
- **Usually a fireman is necessary, dirty work**

2. Recent additional Disadvantages

- **Good locomotive coal is currently difficult to get**
- **The price of coal per ton has drastically risen**
- **Climate change increases fire risk further**

► Driving bans for coal-fired steam locomotives

Black smoke *is* nowadays a *real* problem

Clean steam traction is essential to ensure a future

In today‘s clean environment, black smoke means fire, so people call the firebrigade

Dampflok sorgt für Feueralarm

STEINEN. Weil er eine Rauchsäule sah und einen Brand vermutete, rief ein Anwohner die Polizei. Es war aber bloss eine Dampflok.

Aufregung um die Jubiläumsfahrt der beiden Dampfloks C 5/6 2978 und C 5/6 2969: Mit zwei Fahrten am Wochenende zwischen Erstfeld und Bellinzona wurde das 100-Jahr-Jubiläum der «Elefanten» gefeiert.

Gegen 17 Uhr am Sonntag sorgte die Nostalgiefahrt jedoch unfreiwillig für einen Alarm bei der Kapo Schwyz. Wie der «Bote der Urschweiz» berichtet, stieg aus dem Rauchfang der Lokomotiven in Brunnen dunkler Rauch auf, als die Lok den Tunnel auf ihrem Rückweg Richtung Olten passierte. Ein besorgter Bürger meldete der Polizei, dass beim Tunnelportal womöglich ein Gebäude in Brand geraten sei. Nach Abklärungen wurde klar, dass die Lok verantwortlich für den Alarm war. Durchgeführt wurde die Fahrt von SBB Historic. «Das haben wir in letzter Zeit nicht erlebt», sagt Geschäftsleiter Stefan Andermatt auf Anfrage.

Ähnliche Vorfälle gab es aber schon: Im August musste der Bahntunnel zwischen Baden und Wettingen vorübergehend gesperrt werden, weil es wegen einer Dampflok im Tunnel zu übermässiger Rauchbelastung gekommen war.

Es kann auch umgekehrt sein. Ende September war am Bahnhof Sursee ein echter Brand ausgebrochen. Dort dachten Passanten am Bahnhof zuerst, dass Rauch von einer Dampflokomotive ausgehen müsse, wie die «LZ» berichtete. Tatsächlich handelte es sich aber um eine Hecke, die Feuer gefangen hatte. Die ausgerückte Feuerwehr konnte den Brand rasch unter Kontrolle bringen. GWA

HERBERT ROSENG/SBB HISTORIC

Ungewohntes Spektakel: Die Loks C 5/6 2978 und C 5/6 2969 können ganz schön rauchen.

DFB: Fire fighting Train

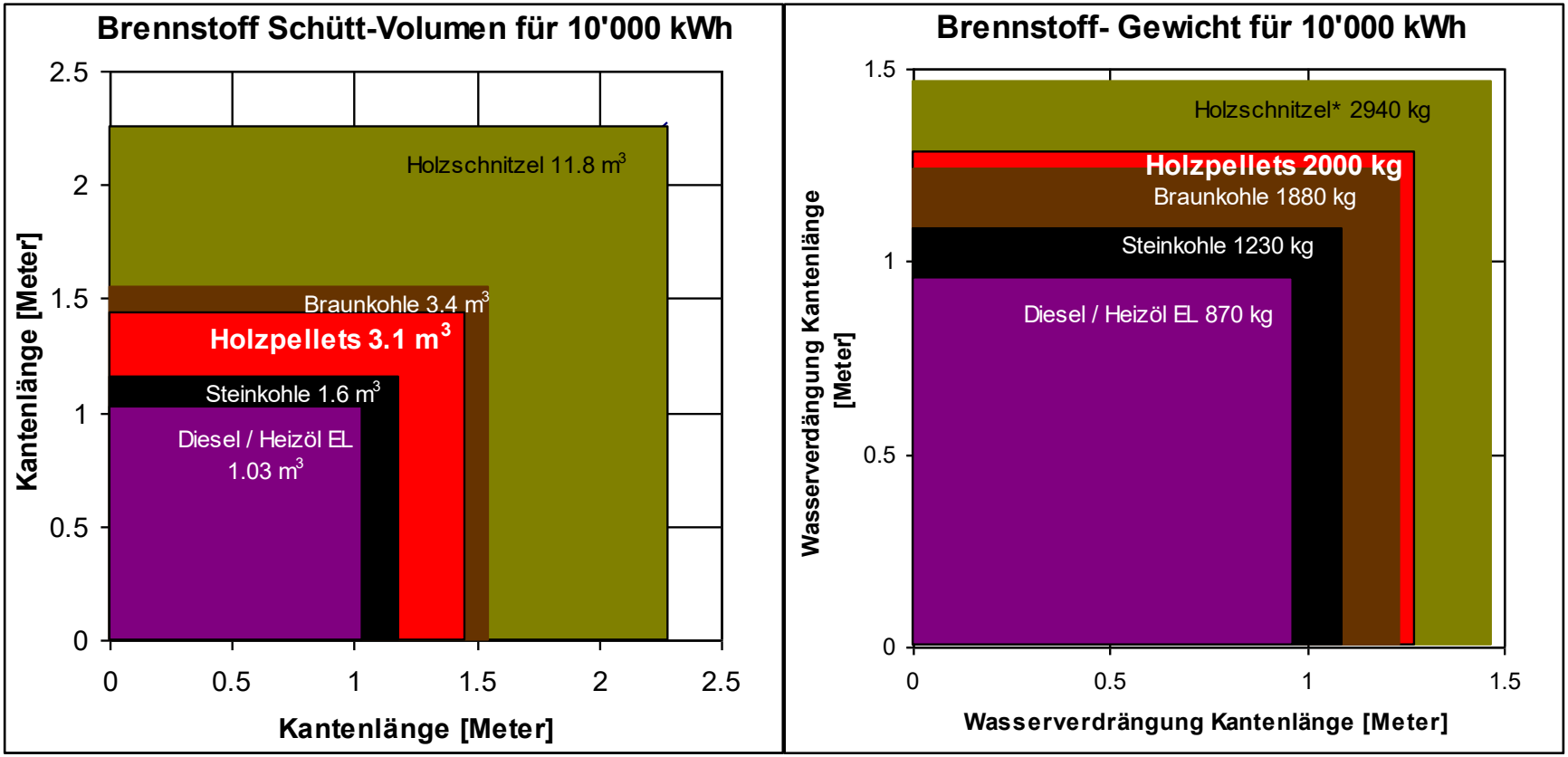
Additional staff required, inefficient, expensive, not possible on busy single lines, no guaranteed protection against lineside fires

Good News: Alternatives already exist

- **Steam can be produced by *any* form of energy**
- **The continued operation of steam locomotives is *not* endangered**

Provided that steam railways and enthusiasts can accept changes

Energy Density of Fuels



The high energy density explains the dominance of oil in transport:

95% of the fuel used for traffic is based on oil!

Alternative Locomotive Fuels

- **Oil**
  - Heavy fuel oil: obsolete technology, not recommended
  - Light fuel oil: *modern DLM light oil firing technology*
- **Biomass**
  - Logs: traditional, few modifications necessary
  - Wood chips: GPCS > tests by Prof. John Sharpe
  - Pellets: GPCS > paper of Maik Drechsel
  - Bagasse, straw, peat: traditional, low calorific value
- **Electricity**: proven Swiss technology!
- **Waste heat** > fireless locomotives
- **Solar power** > fireless locomotives
- **Wind energy** > fireless locomotives

Coal shortage during the war forced Swiss Railways to use wood

Benguela Railway used Eucalyptus Wood even for large Garratts. The Wood was sustainably managed in own Forests.

Australian Paddle Steamers …

are firing local Eucalyptus Wood

Bagasse Firing was very common on Sugar Plant Railways

Fuel Tests with GPCS on the Ravenglass and Eskdale Rw.

Wood Chips burn too

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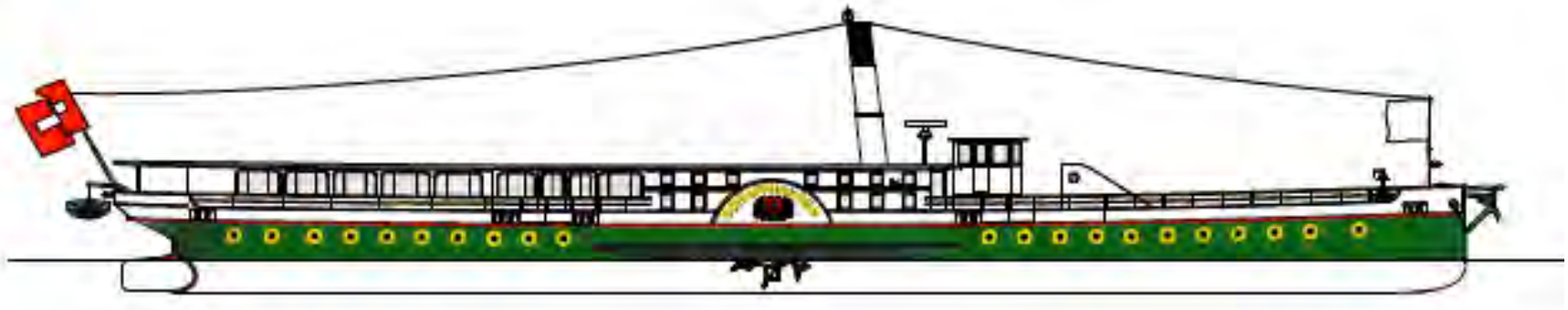
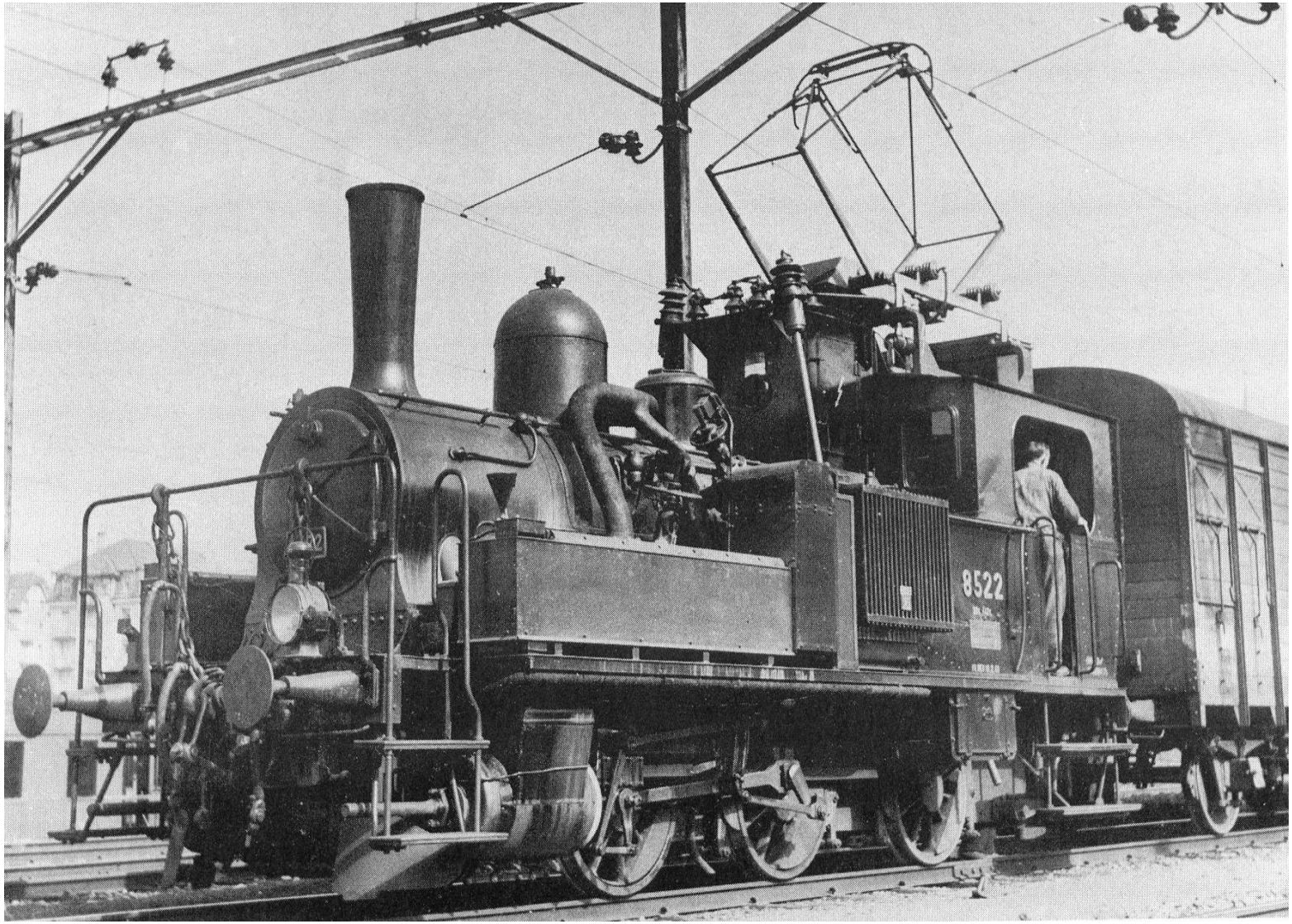
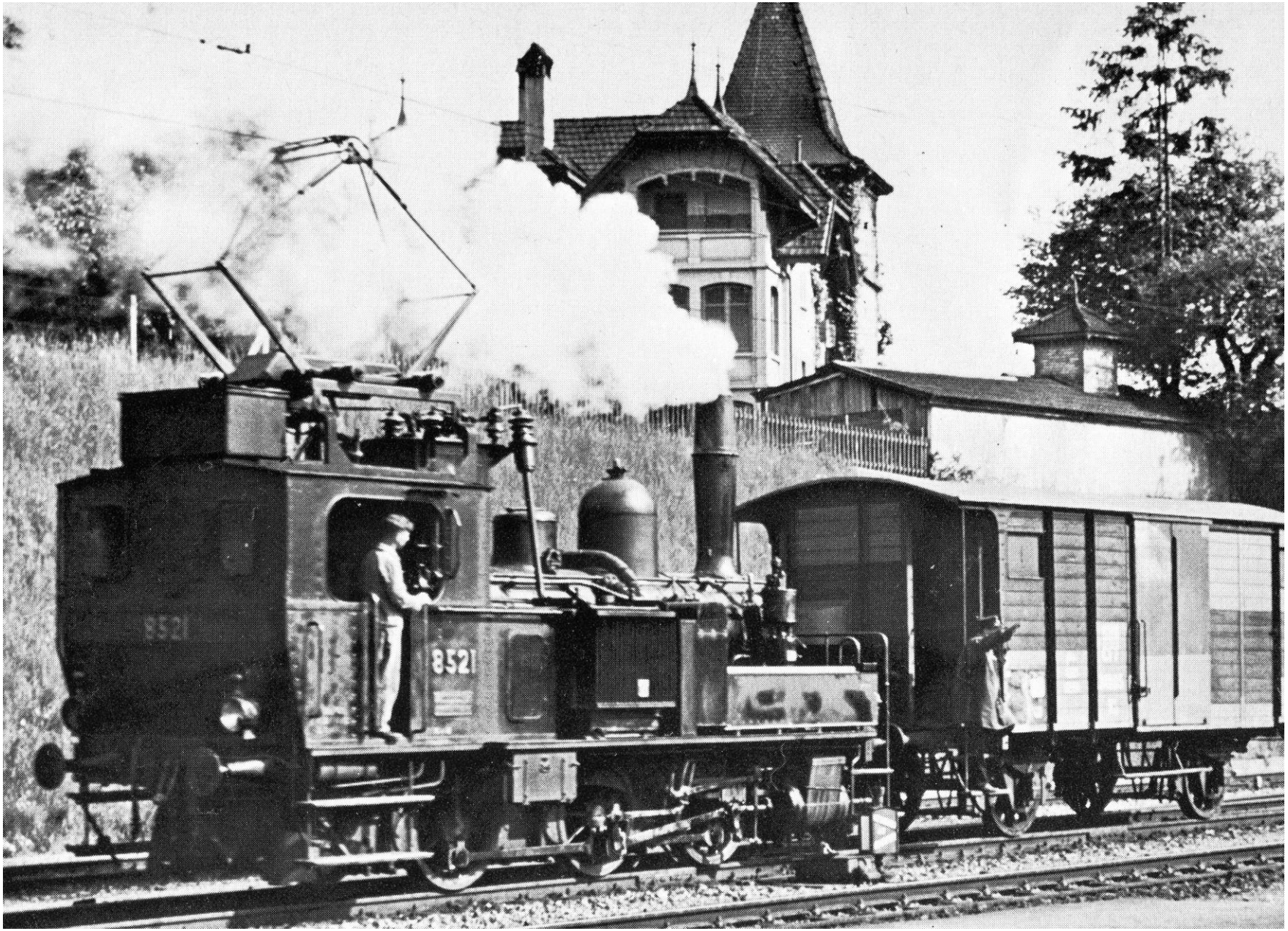
New
Paddle Steamers for Rivers



with CO_2-neutral pellet firing

Swiss Railways rebuilt two 0-6-0 shunting locomotives with electric boilers to save coal

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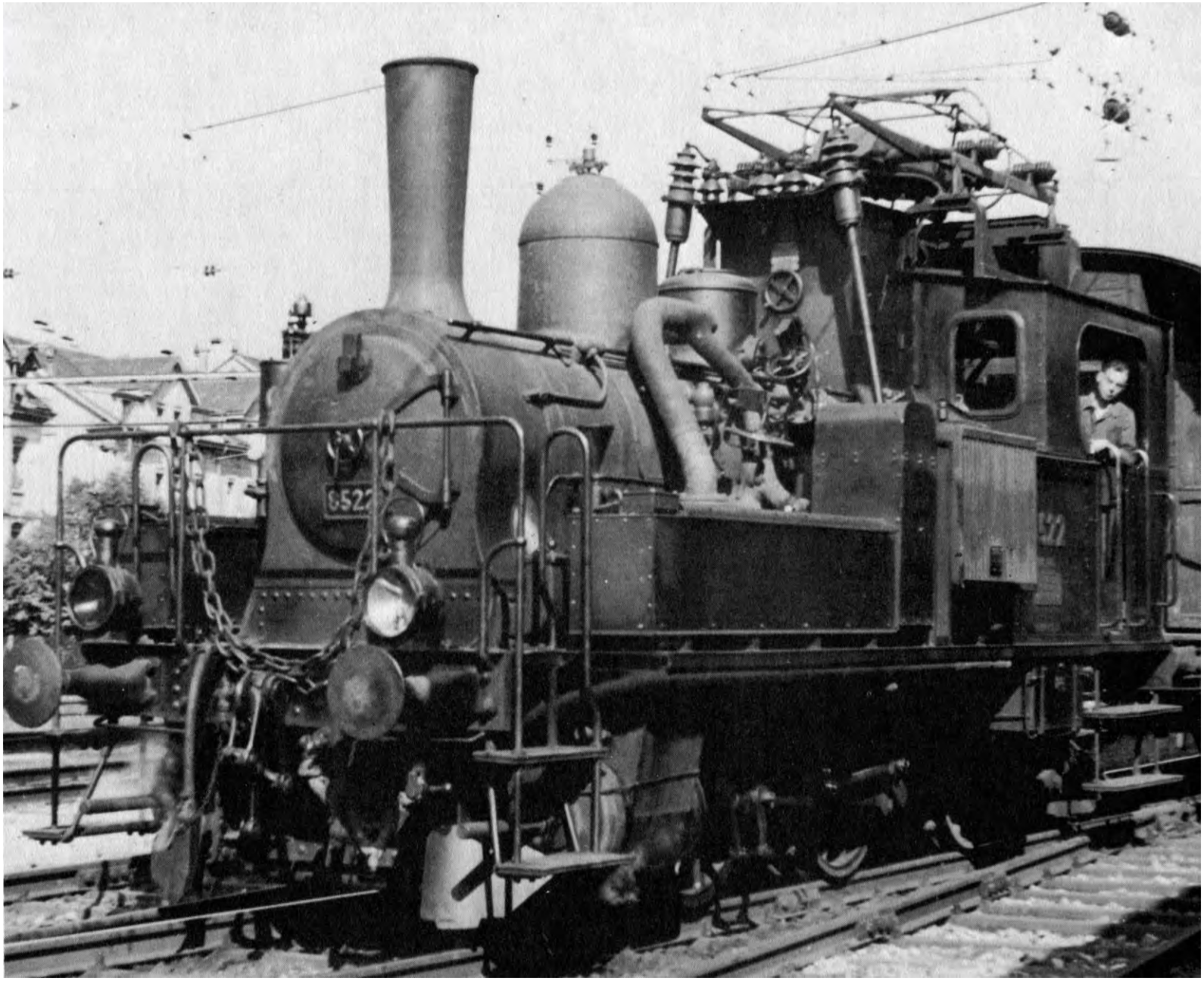


Sursee – Triengen: E 3/3 8522

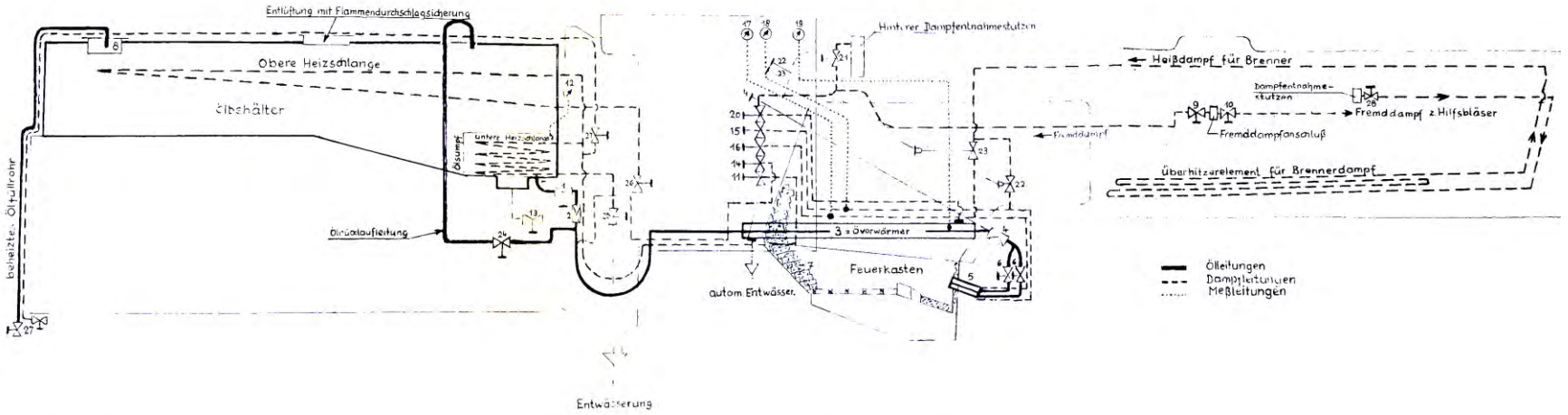
My first cab ride, on a one-man operated, coal-**fired „Tigerli“**

Traditional Oil-Firing Systems

- Heavy fuel oil, usually Bunker C
- Sticky, needs to be preheated to 80°C
- High sulphur content, 1 to 5%
- Combustion efficiency better than coal
- Higher and sustainable evaporation rates
- Power output less dependent on fireman
- Fireman is not physically charged
- No sparks, no danger of lineside fires
- No cleaning of fire, ashpan and smokebox

Two oil-fired class 44 locomotives hauling a 4’000 ton train between Emden and Rheine

Oil-firing was common on DB

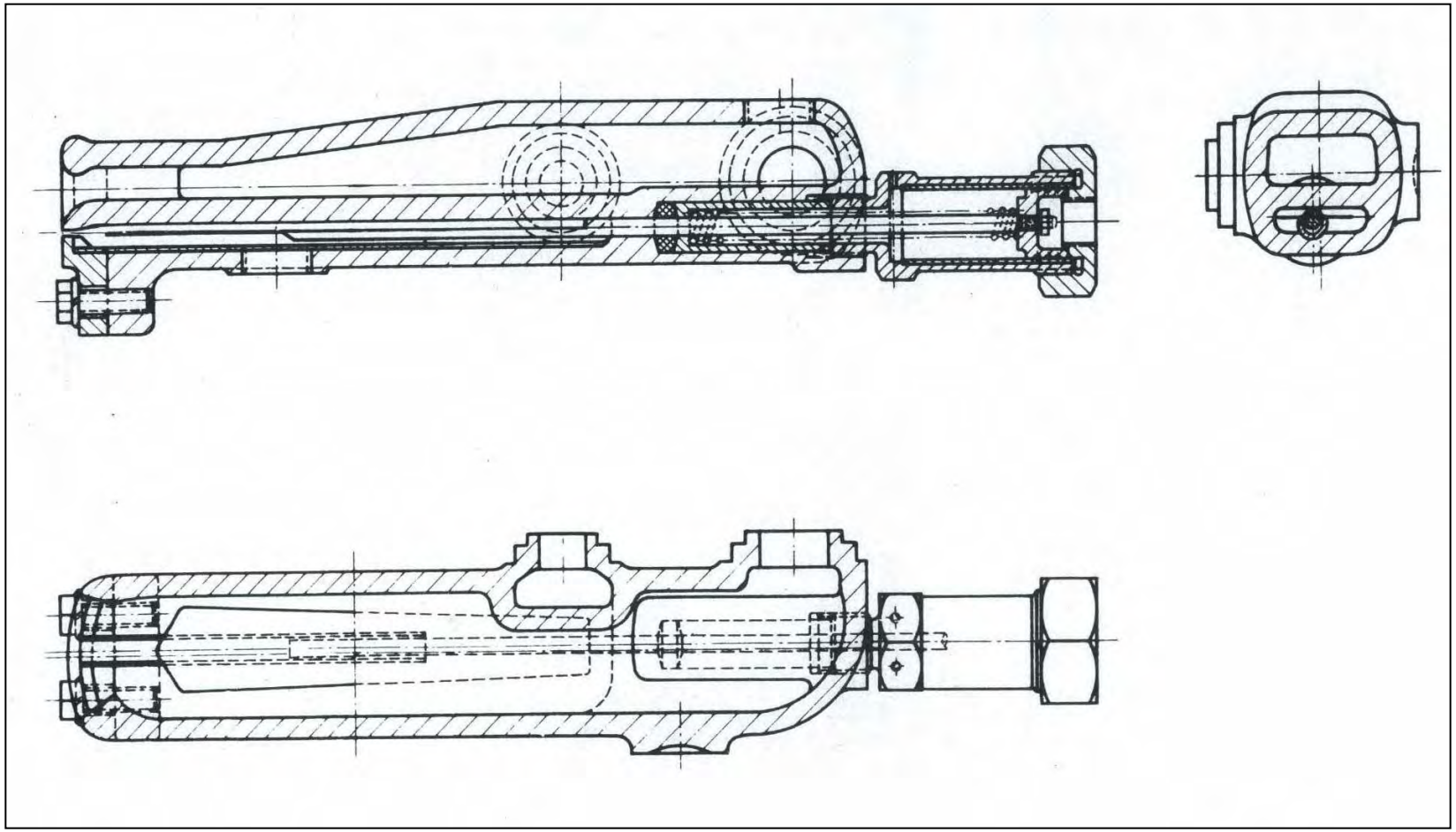


1 Ölabsperrventil
2 Klappendurchgangsventil
3 Ölvorwärmer
4 Ölregulierschieber
5 Doppelbrenner
6 Ölabsperrschieber
7 Ölentnahmekrümmer
8 Öleinlauf
9 Durchgangsventil für Fremddampfanschluß
10 Fremddampfhilfsbläserventil
11 Dampfventil für Ölbehälterheizung
12 Fernthermometer für Öltemperatur im Ölbehälter
13 Ölabschlammventil
14 Dampfventil für Ausblaseleitung
15 Dampfventil (Naßdampf) für linken Brenner
16 Dampfventil (Naßdampf) für rechten Brenner
17 Dampfdruckmesser für Brenner links
18 Dampfdruckmesser für Brenner rechts
19 Fernthermometer für Öltemperatur im Ölvorwärmer
20 Dampfventil für Ölvorwärmer
21 Hauptabsperrventil am hinteren Dampfentnahmestutzen
22 Dampfventil (Heißdampf) für linken Brenner
23 Dampfventil (Heißdampf) für rechten Brenner
24 Absperrventil in der Ölrücklaufleitung
25 Entwässerungsventil untere Heizschlange
26 Entwässerungsventil obere Heizschlange
27 Absperrventile Ölfüllrohr
28 Absperrventil Überhitzerelement Brennerdampf

Schema der Ölfeuerung

Schematic for oil-firing of standard gauge locomotives with tender

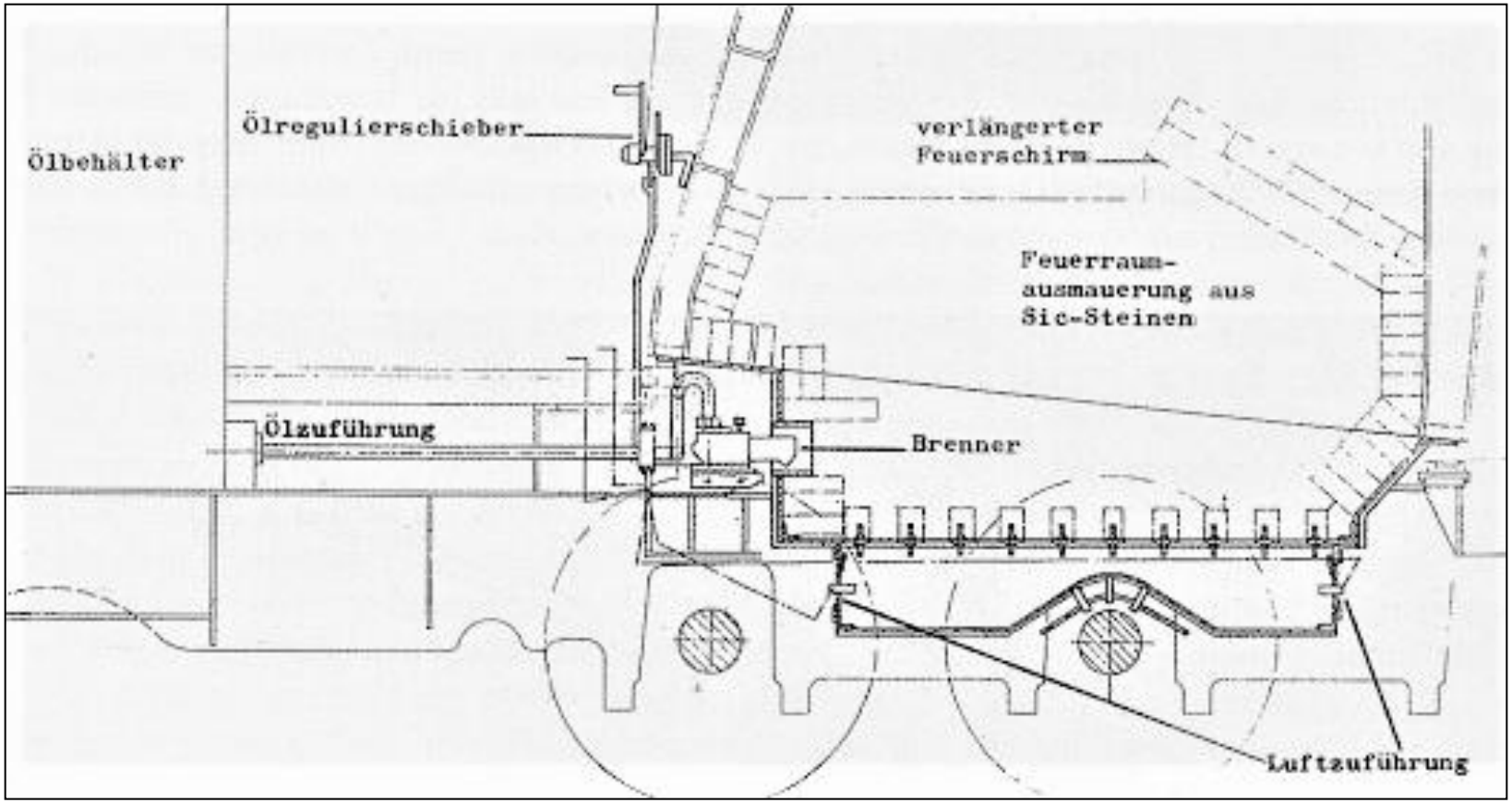
Burner for heavy fuel oil



Superheated steam is used to atomize the oil

East German DR used oil-firing on narrow gauge locomotives too

Oil-firing was different on DR



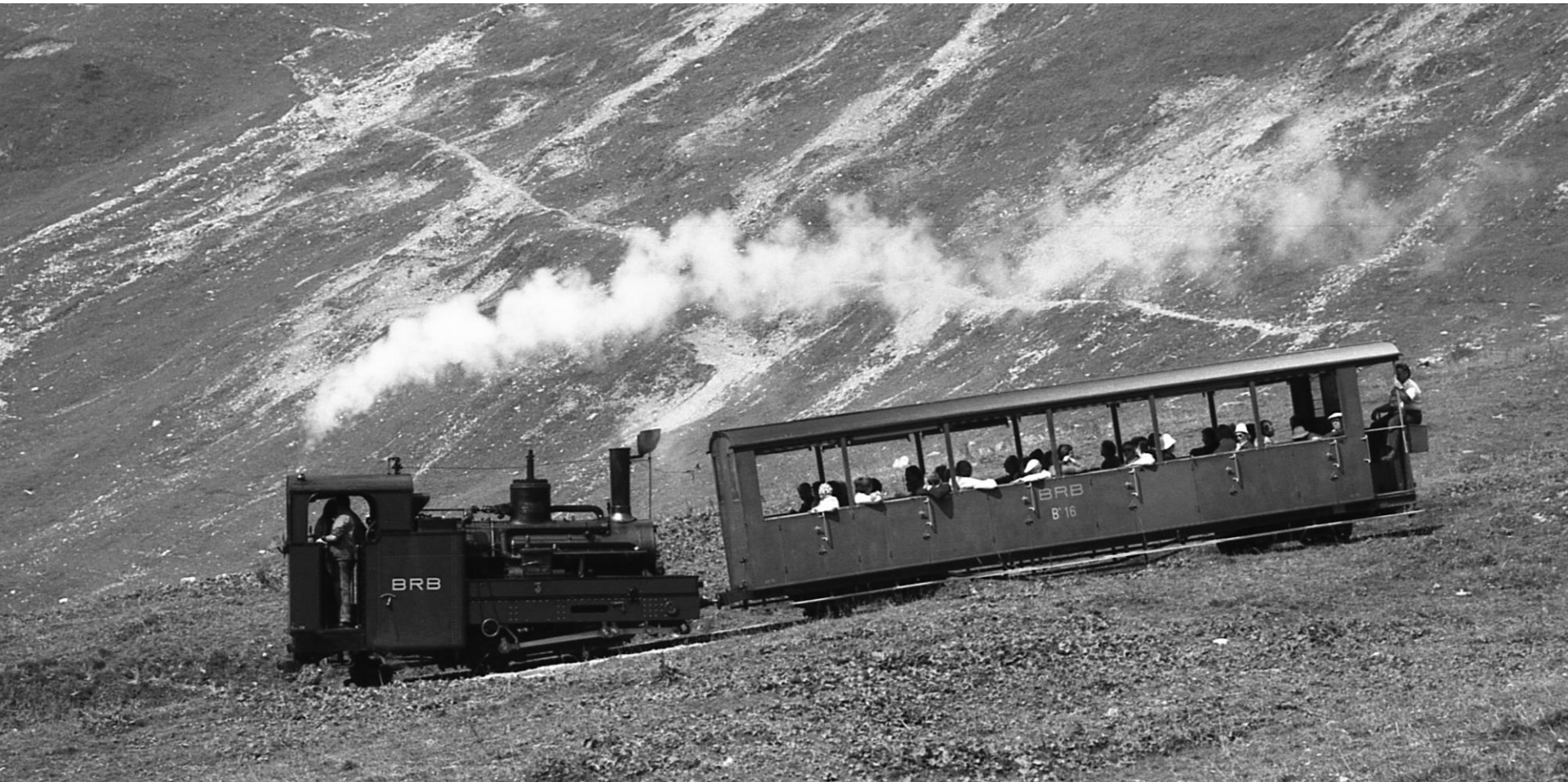
Schematic for East German narrow gauge locomotives

Modern Light-oil Firing Systems

Steam Locomotives No. 1 to 5 built by SLM in 1891/92

Staff per train: 3 (Driver, Fireman, Conductor)

Number of passengers per train: 48



Steam Locomotives No. 6 and 7 built by SLM in 1933/36

Staff per train: 3 (Driver, Fireman, Conductor)
Number of passengers per train: 80

Old steam locomotives couldn‘t cope with demand and were too expensive

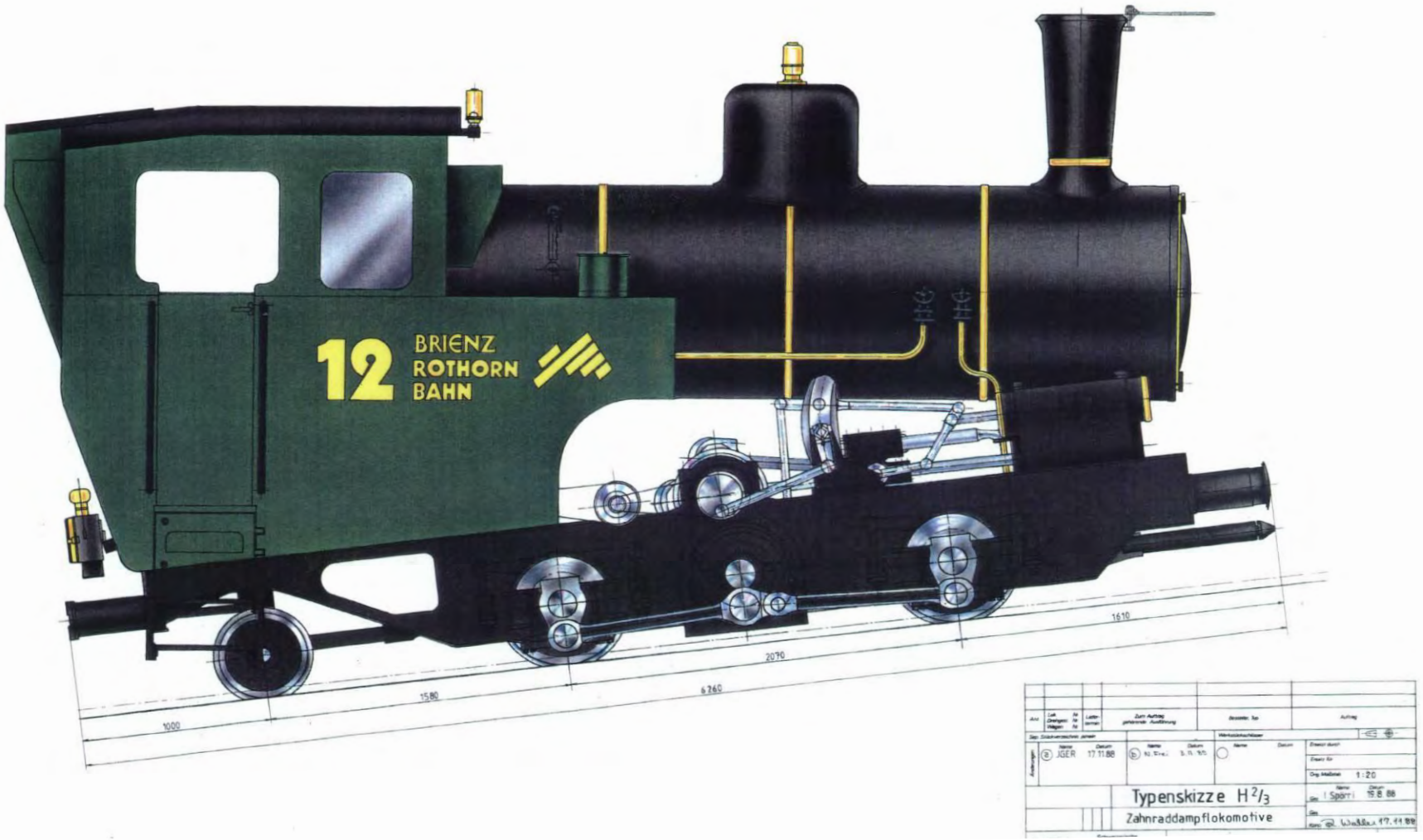
Study 1973: *New steam locomotives would be the most attractive solution.* SLM declined to offer!

Diesel locomotives 9 to 11 built: 1975, 1987

Staff per train: 2 (Driver, Conductor)

Number of passengers per train: 112

In 1986 I proposed new, economic steam locomotives to BRB to stop dieselization



MODERN STEAM

Means real Progress

- **One man operation possible**
- **Oil-firing using light-oil, equal to diesel oil**
- **Smoke free combustion, no sparks**
- **Efficient insulation of boiler and cylinders**
- **Short preparation and shut down times**
- **Much better thermal efficiency**
- **Low operating and maintenance cost**
- **Sealed roller bearings, no oil dripping**
- **Electric preheating device**

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Modern Light-oil Firing System

- **Guaranteed fuel quality**
- **Combustion efficiency of 99,9 %**
- **No smoke, no sparks, no ash and cinder**
- **No cleaning of fire, ashpan and smokebox**
- **Short preparation and shut down times**
- **Easy to operate, quick shut down**
- **Clean cab, clean driver > happy wife**
- **Less CO_2-emissions**
- **No maintenance**

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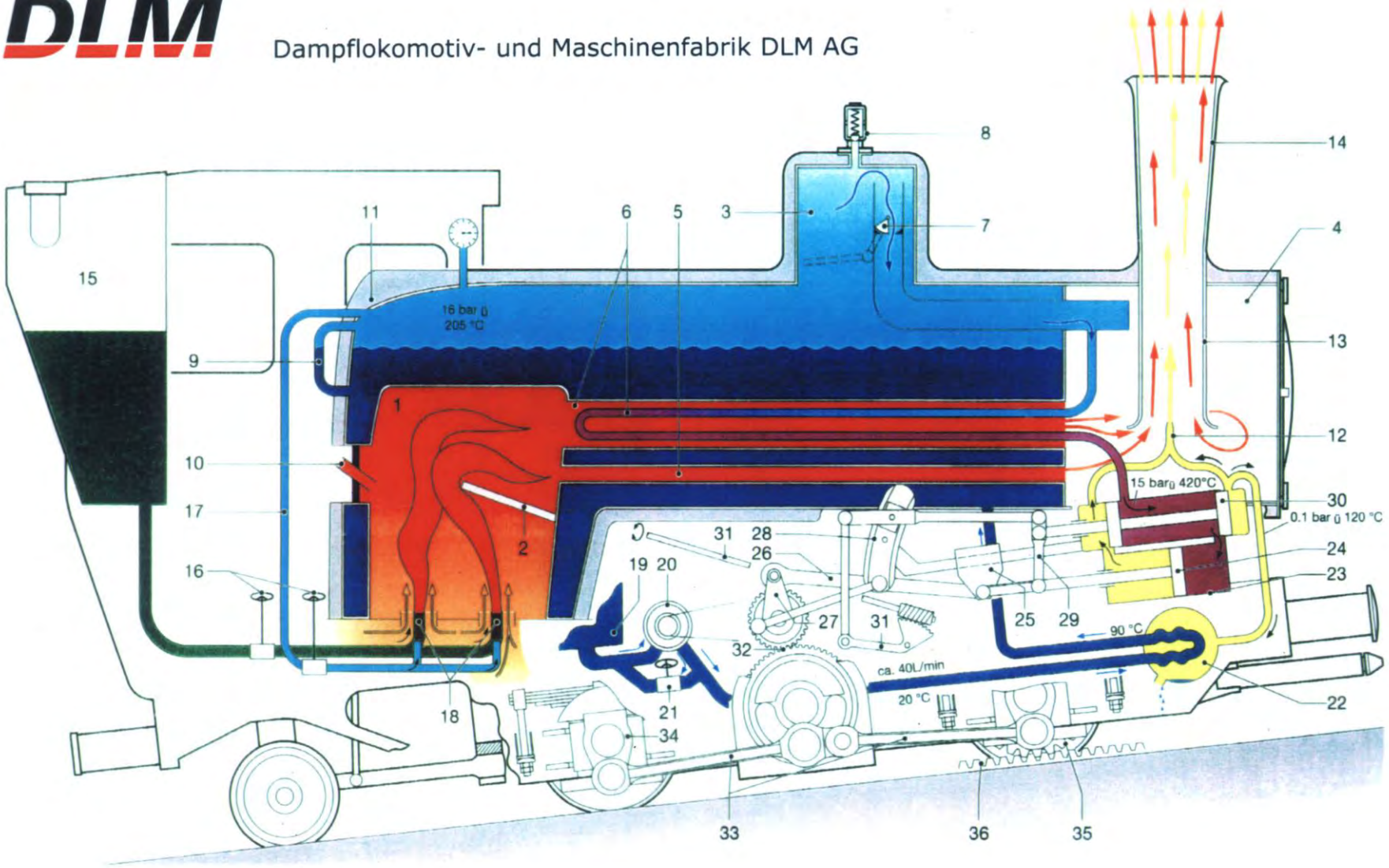
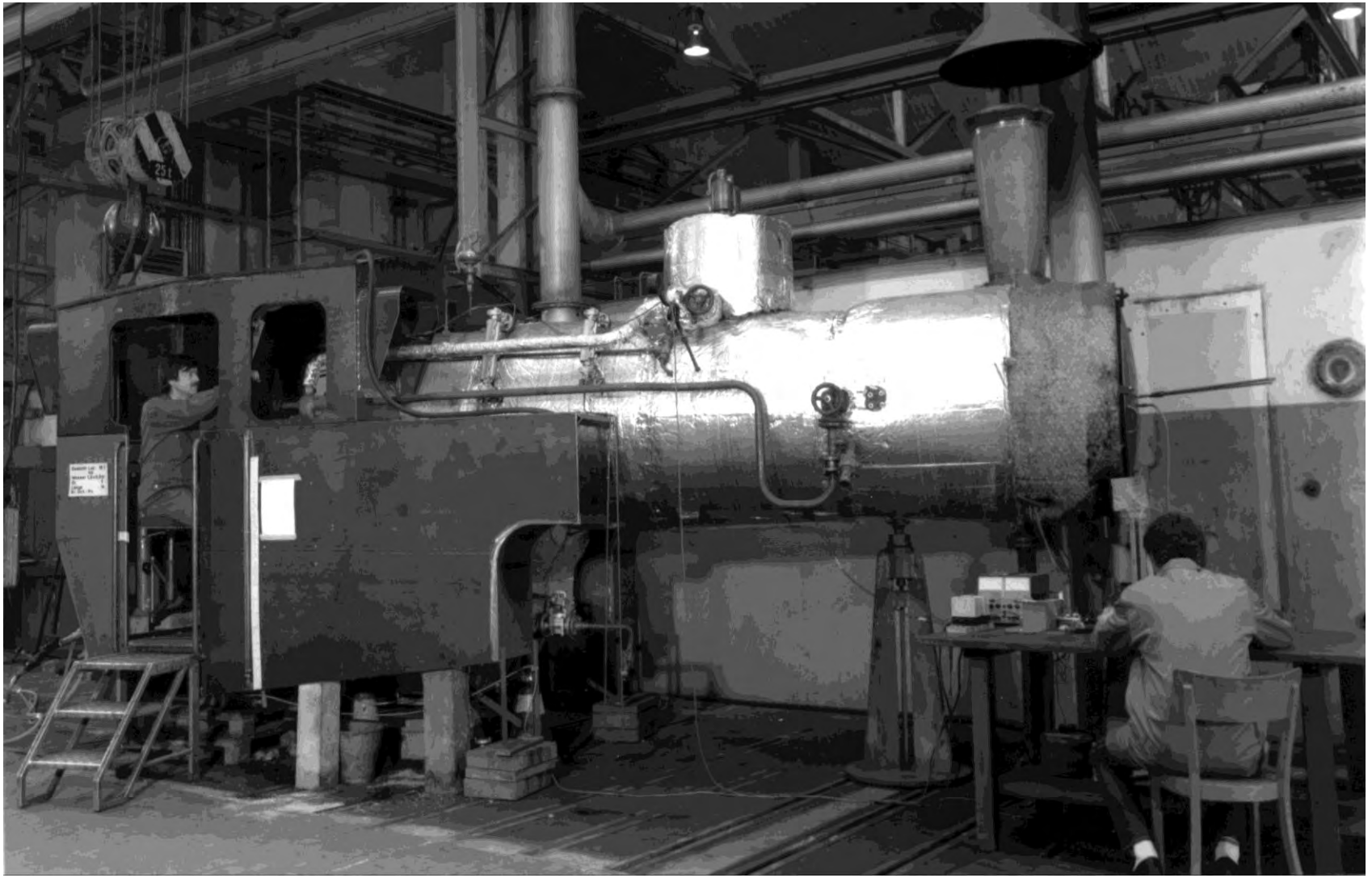


Öl (Brennstoff) Mazout Fuel oil	Luft Air Air	Verbrennungsgas Gaz de combustion Combustion gas	Wasser Eau Water	Nassdampf Vapeur saturée Saturated steam	Überhitzter Dampf Vapeur surchauffée Superheated steam	Abdampf Vapeur détendue Exhaust steam

Zahnrad-Dampflokomotive | Locomotive à vapeur et à crémaillère | Steam Rack Locomotive

Testing the new light-oil firing system



Staff per train: 2 (Driver, Conductor)
Number of passengers per train: 120

Steam Locomotives No. 12, 14 to 16 built by SLM 1992/96


BRB
7
© by F. Geisser, bahnbild.ch

New Steam Locomotive 999.201 for the Austrian Schafbergbahn

New Steam Locomotive 999.204 on the Schafberg

New Steam Locomotive Z 14 (999.204) on the Schafberg

Dampflok «Borkum» mit Leichtölfeuerung

Swiss «Orient-Express Train»

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Modernizing 52 8055

Modernizing 52 8055

52 7596 (Coal) and 52 8055 (Light Oil)

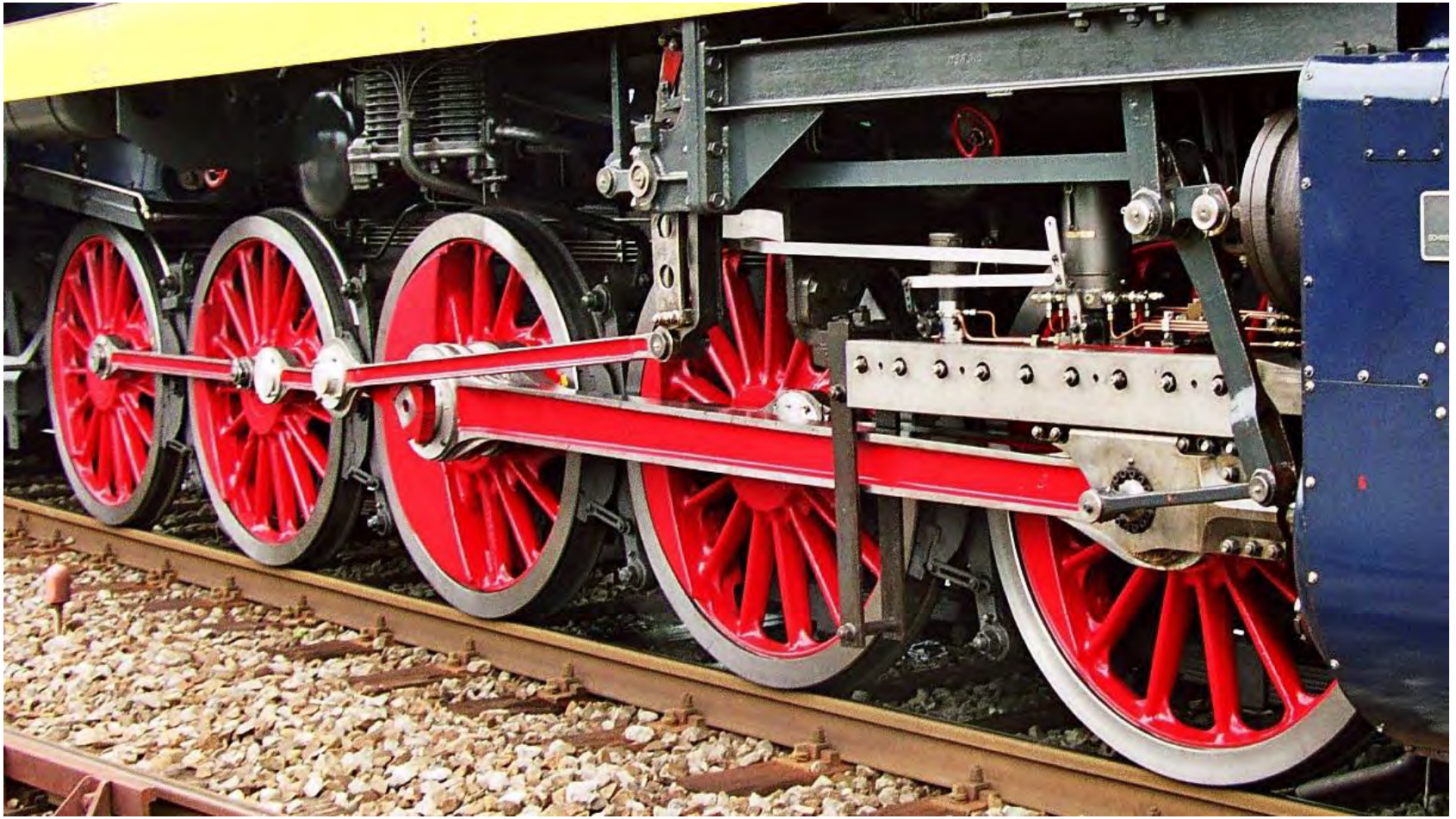
52 8055 pulling Orient-Express


52 8055

52 8055 on a commercial freight train

52 8055 on Roller Bearings

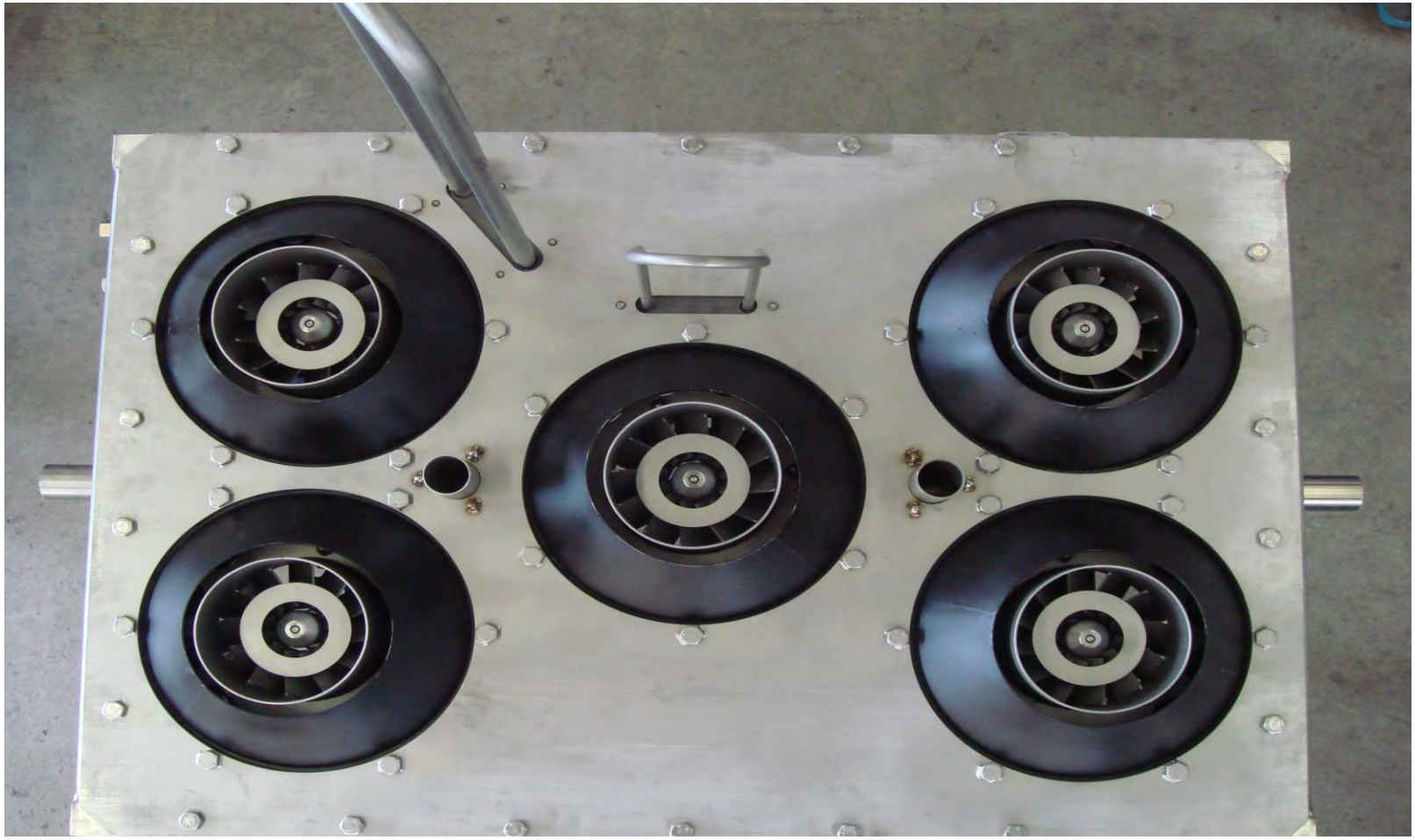
=> clean, no maintenance



Modern Steam could considerably improve the Economics of Steam Railways

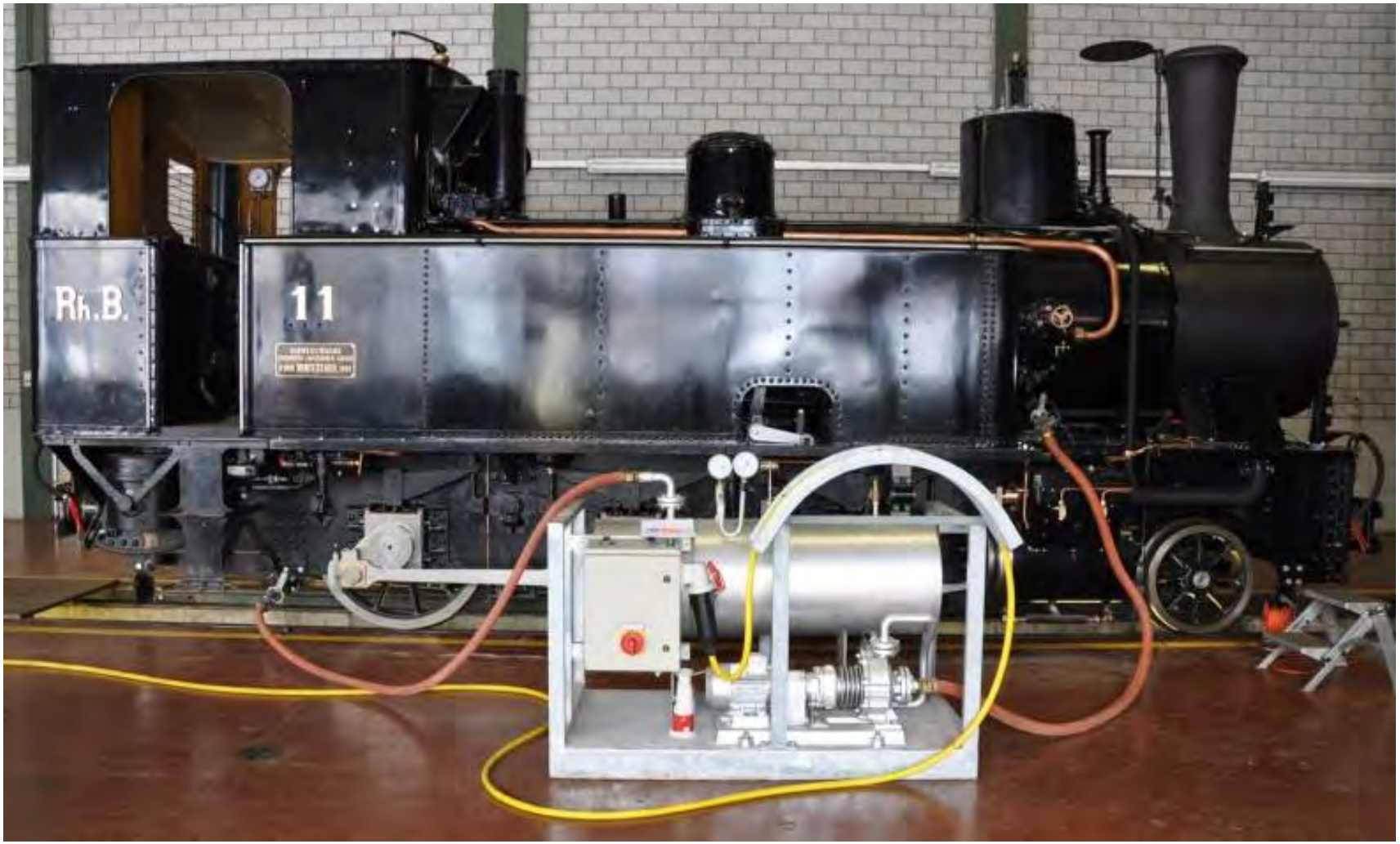
Modernisation of metre gauge steam locomotive «Heidi»

1 central Pilot-, 4 main Burners



Refuelling an oil-fired steam locomotive is as easy as refuelling a car

Electric Preheating



Test Train to St. Moritz

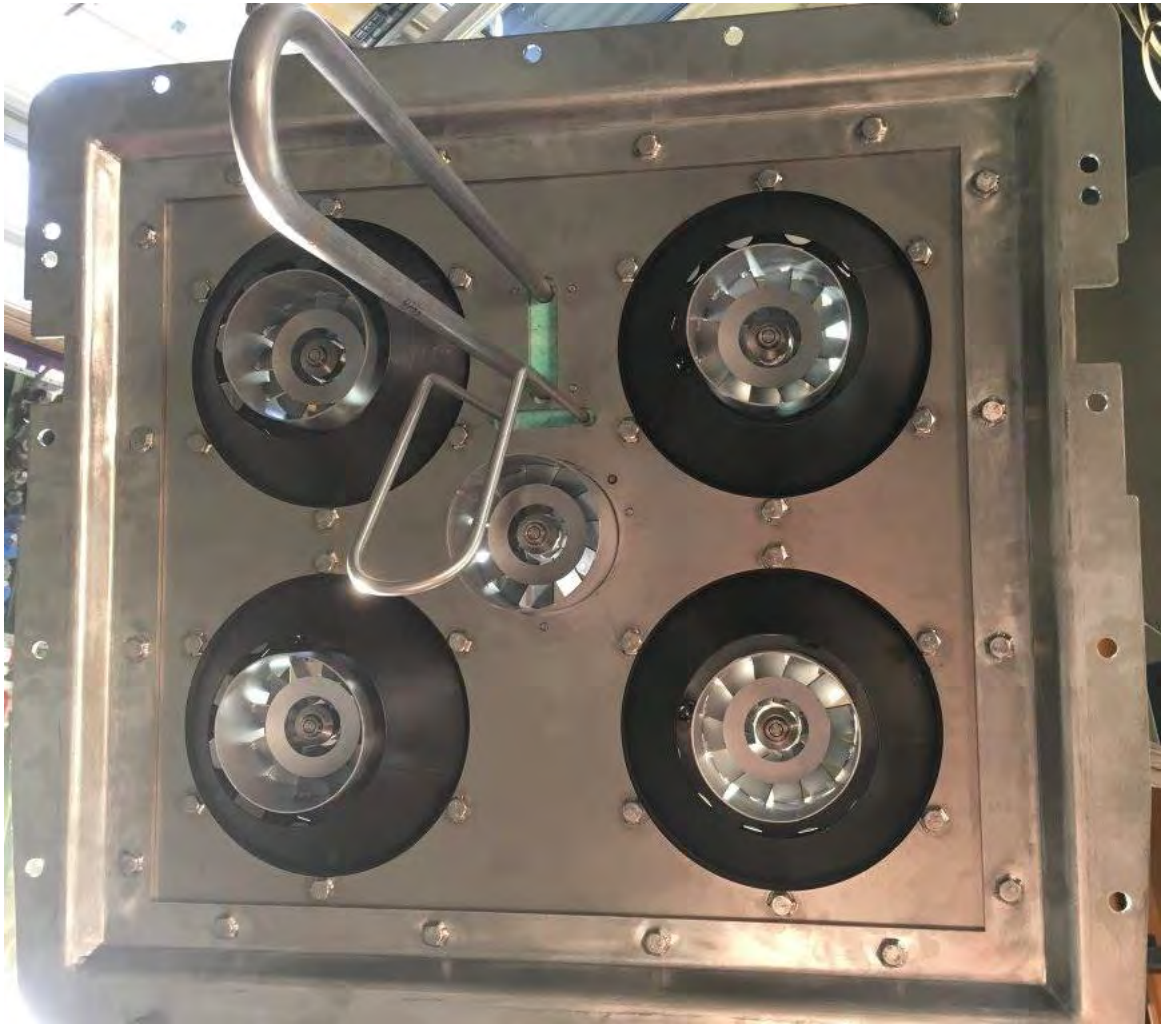
Filisur, ready for the Albula

Inauguration on 5.3.2016

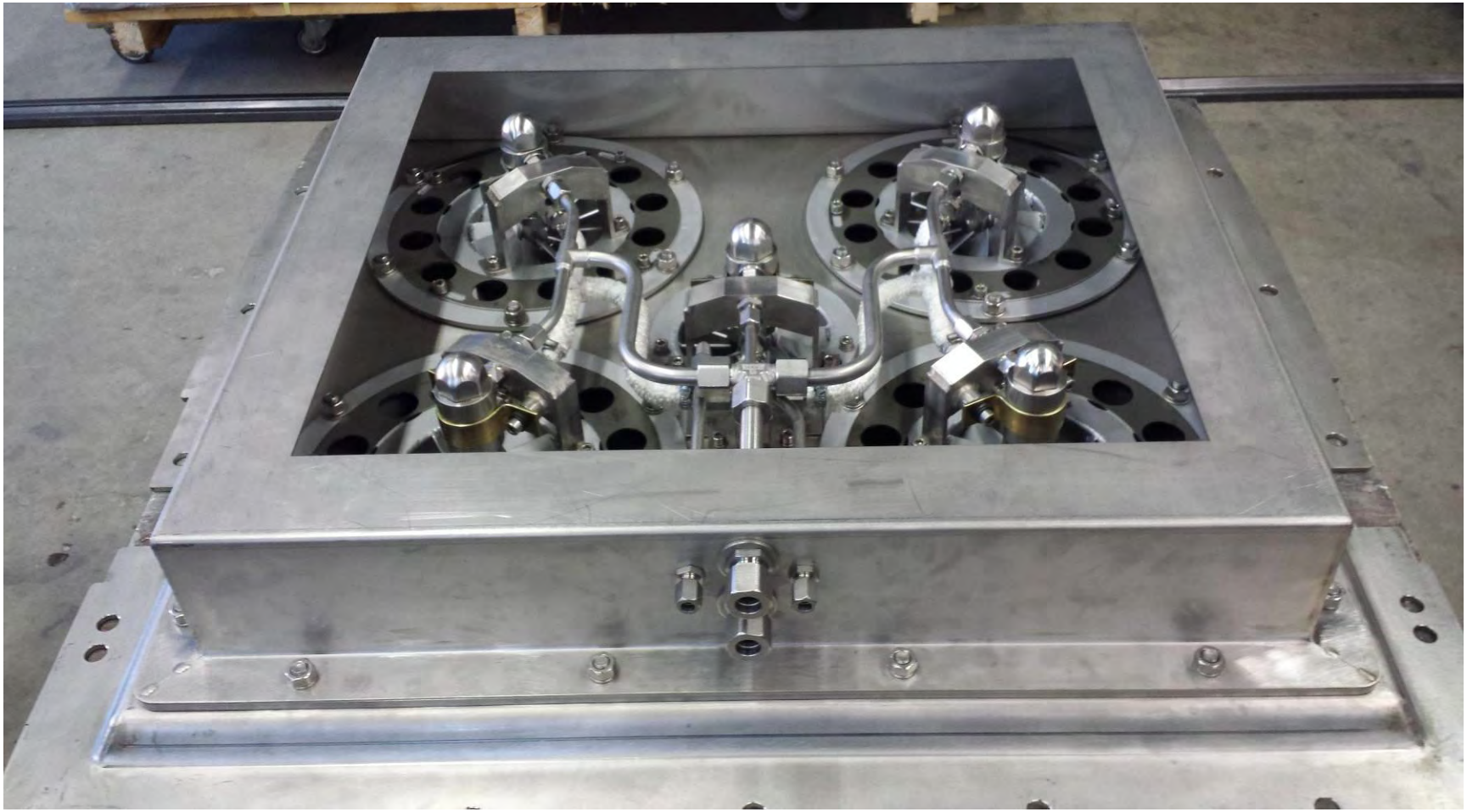
Engine driver with top-hat, tailcoat and white gloves

Puffing Billy Railway, Melbourne, Australien

DLM light-oil firing system



DLM light-oil firing system seen from below



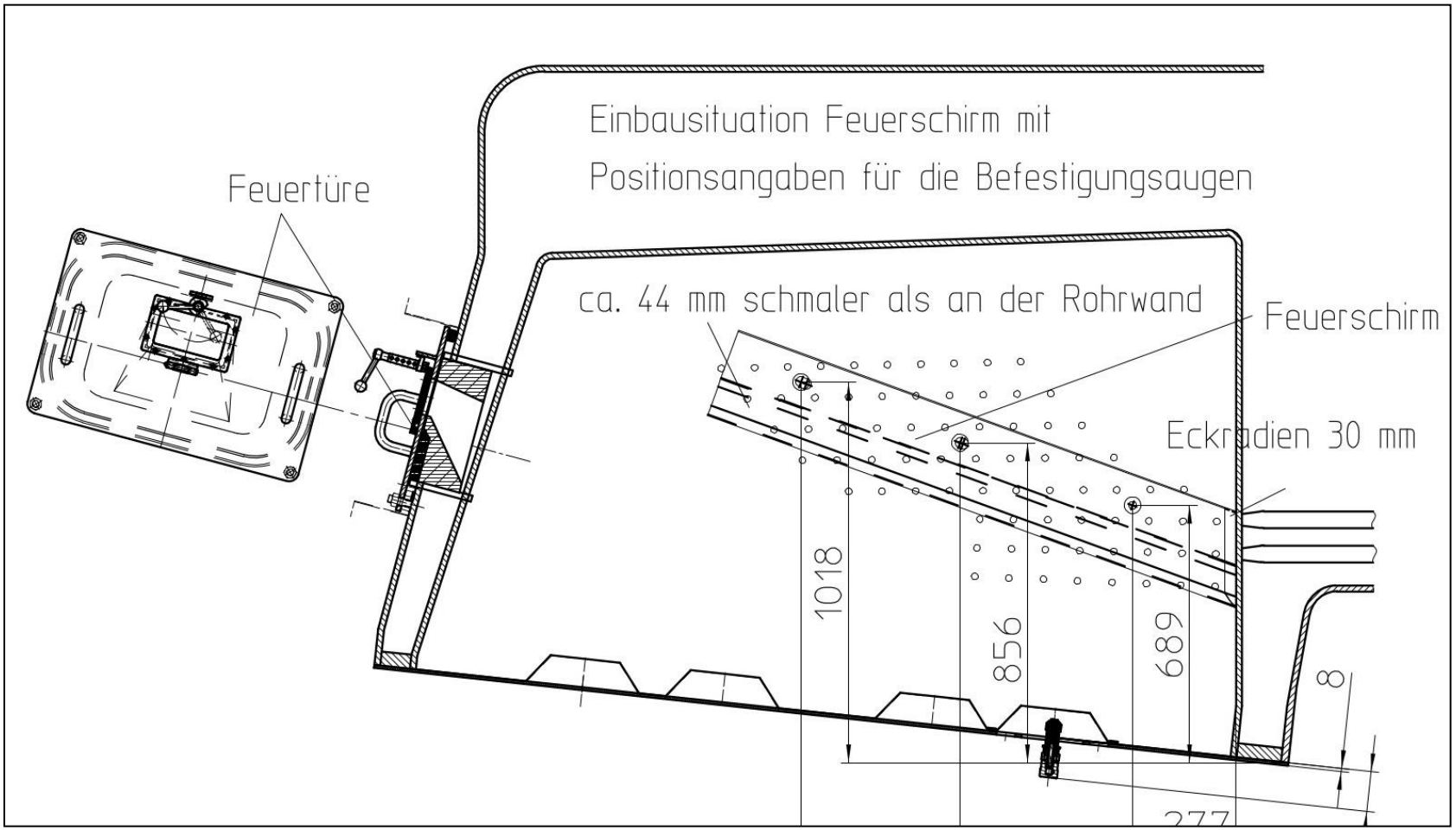
Modern DLM-type Burners


14A

NA class No.14A is now oil-fired

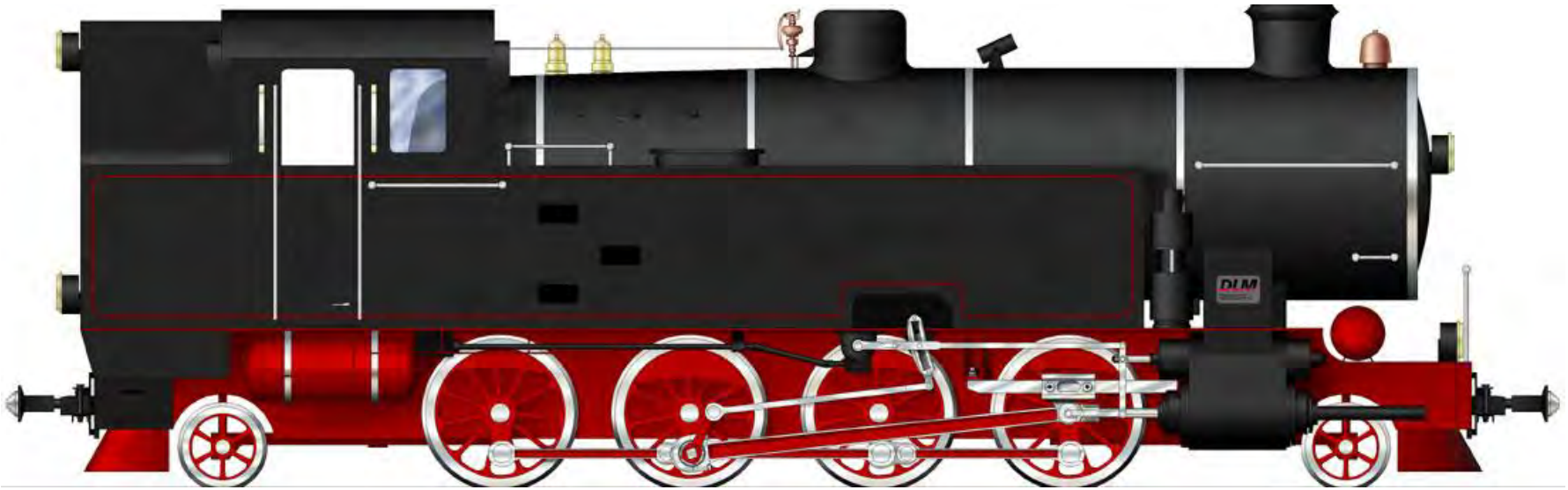
SOEG: Light-oil Firing of narrow gauge 99 787

Firebox of 2-10-2 No. 99 787




99 787

Project for new Steam Locomotives



Economic and environmentally friendly

- One man operation, much higher speed
- Maintenance free Roller Bearings
- Very clean Combustion, no smoke, no sparks

Grosskraftwerk Mannheim

Kohlekraftwerk Block 9 (2015). Dampfdaten: 290 bar, 600°C (20bar)
Leistung 900 MW, davon 350 MW für die DB (►ICE fährt mit Dampf)
Elektrischer Wirkungsgrad: 46.4%, mit Kraft-Wärme-Koppelung: 70%
KMK: 4 Speicherlokomotiven: Dfl ziehen 4'000t-Züge, Cfl ziehen 2'000t

Fireless Locomotives

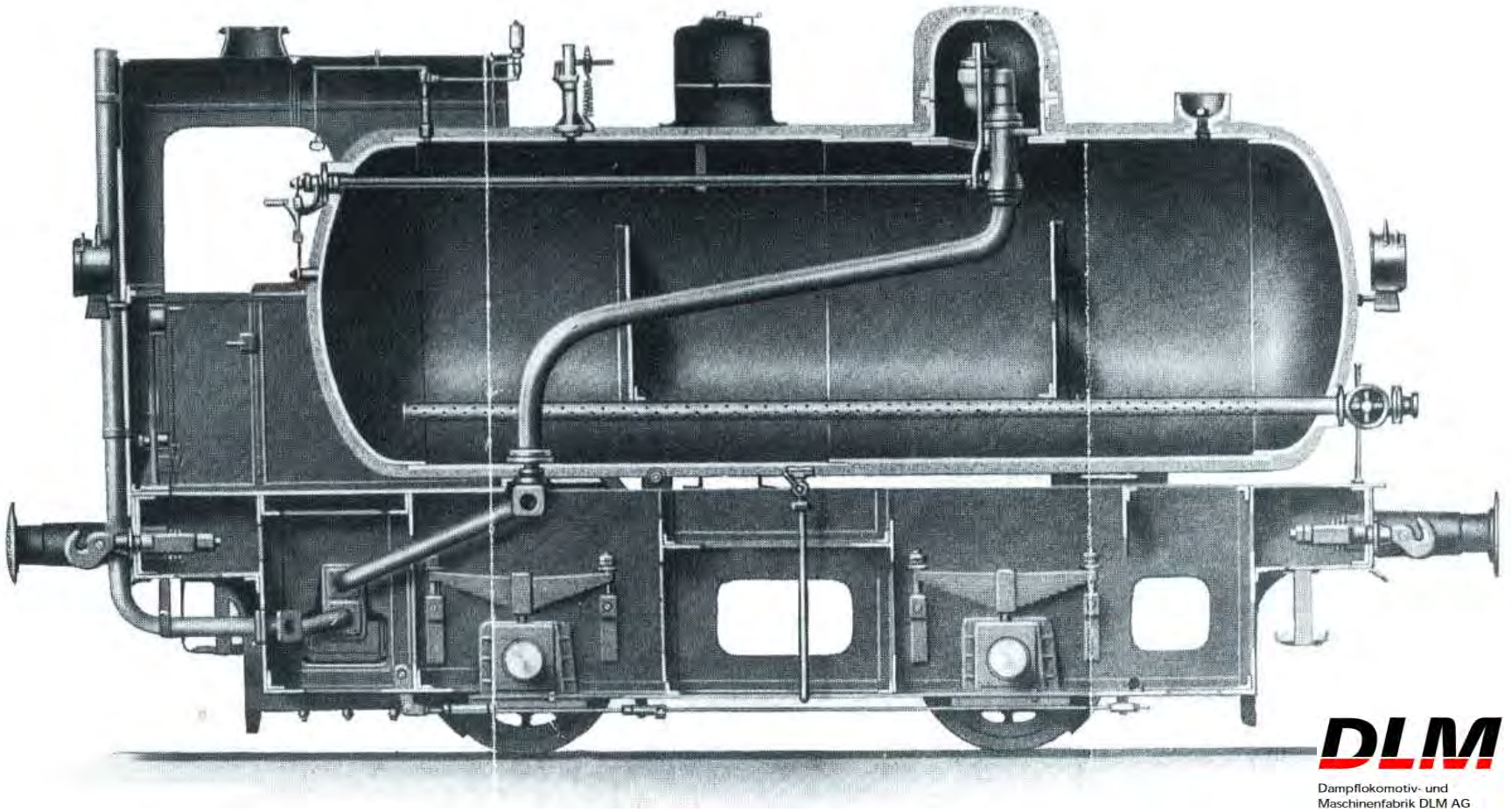
economic – clean – silent – environmentally friendly – CO_2-neutral

Steam Accumulators use the excellent capability of water to store high amounts of energy under pressure.

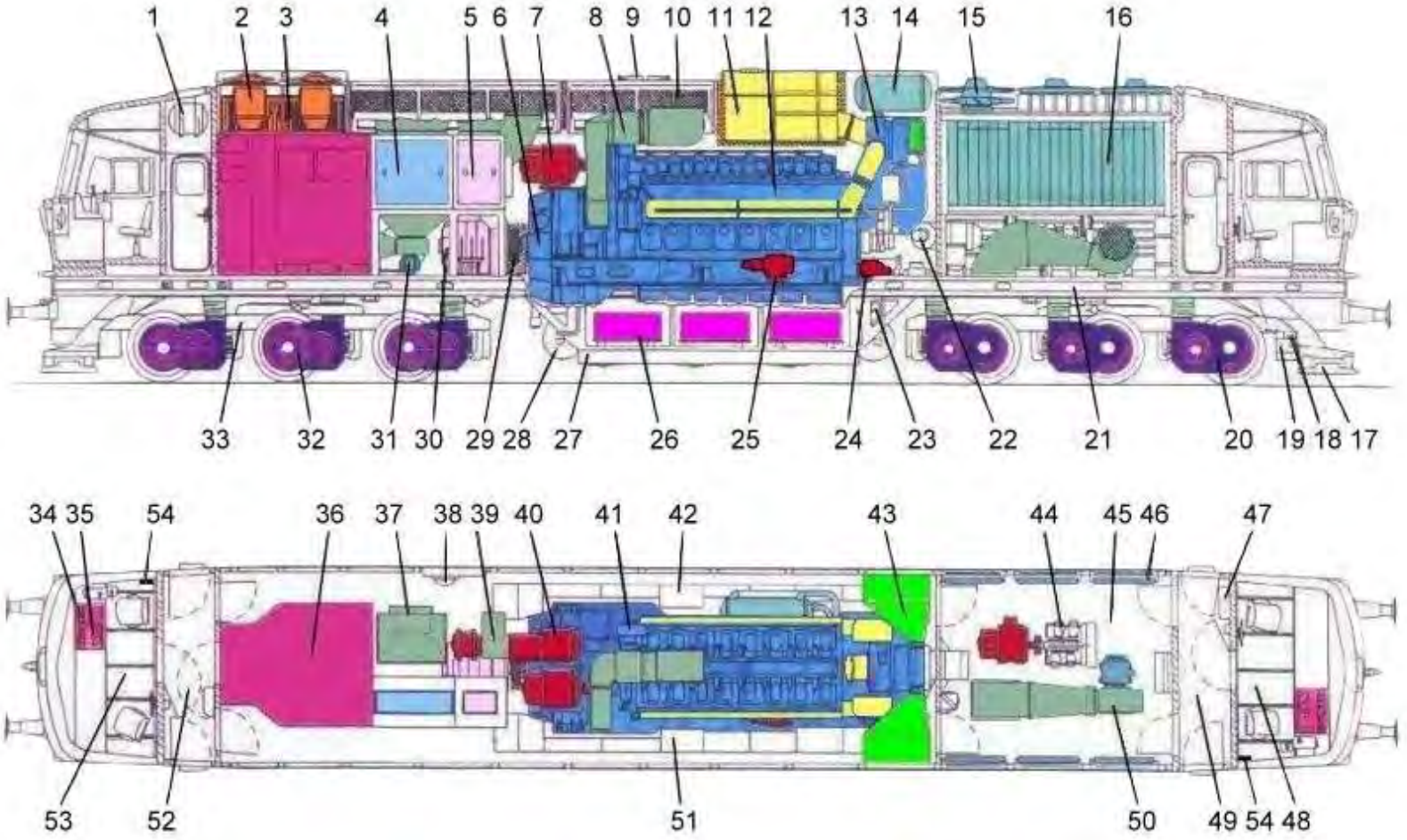
Fireless steam locomotives use this technology. Invented in 1882, they became very popular for shunting in industry. 3’500 fireless locomotives worked in Germany alone, some are active now. Fireless locomotives had been built up to 1986, but with the demise of the steam locomotives, this ingenious technology got forgotten as well.

Time for a Revival!

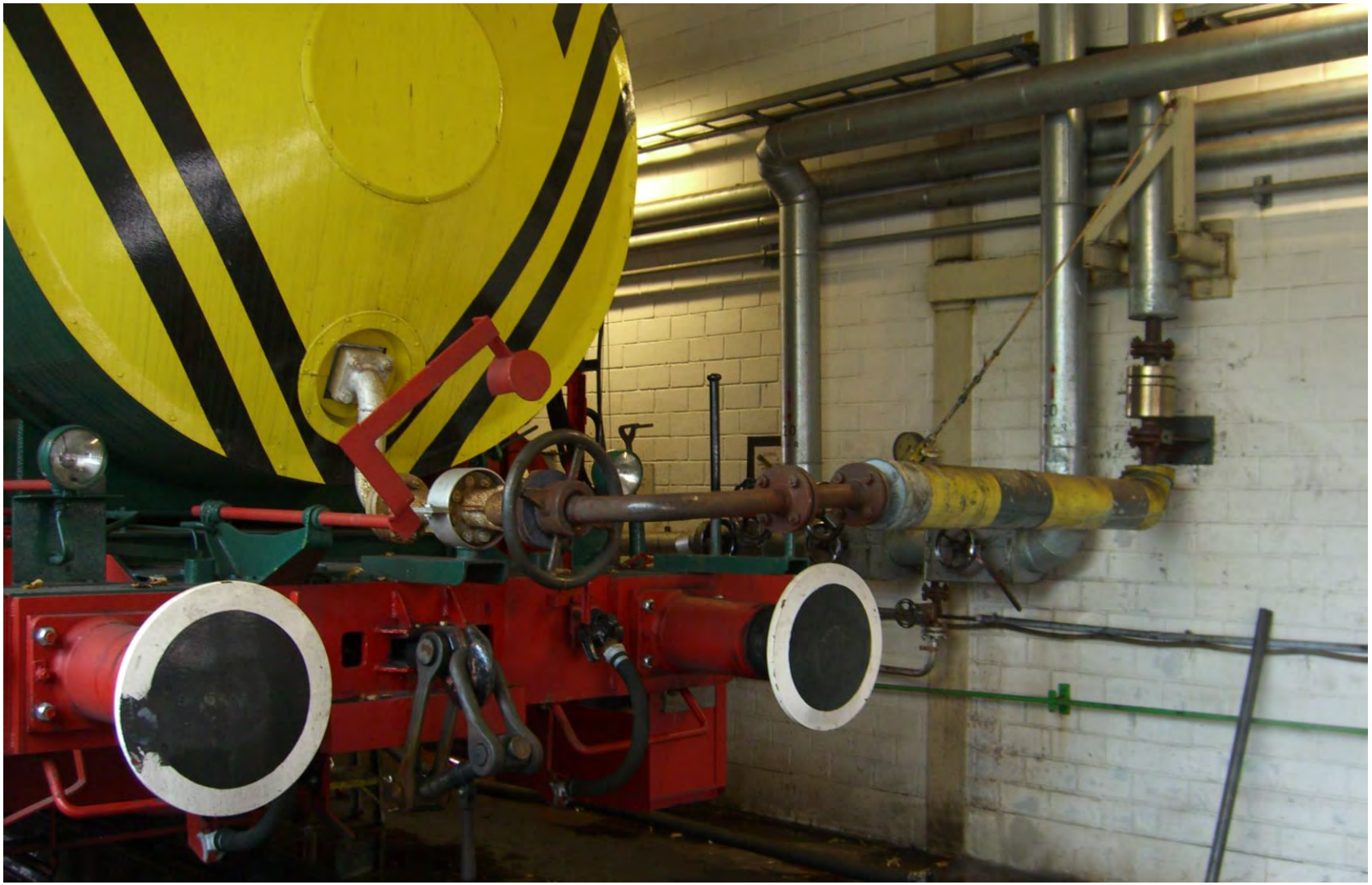
Schematic of a Fireless Locomotive



Schematic of a Diesel Locomotive



Loading station, GKM Mannheim



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Loading station, GKM Mannheim

Reloading a big fireless locomotive takes approx. 20 minutes, GKM, 23.01.2013

0-8-0 fireless locomotives pull trains of 4’000 tons

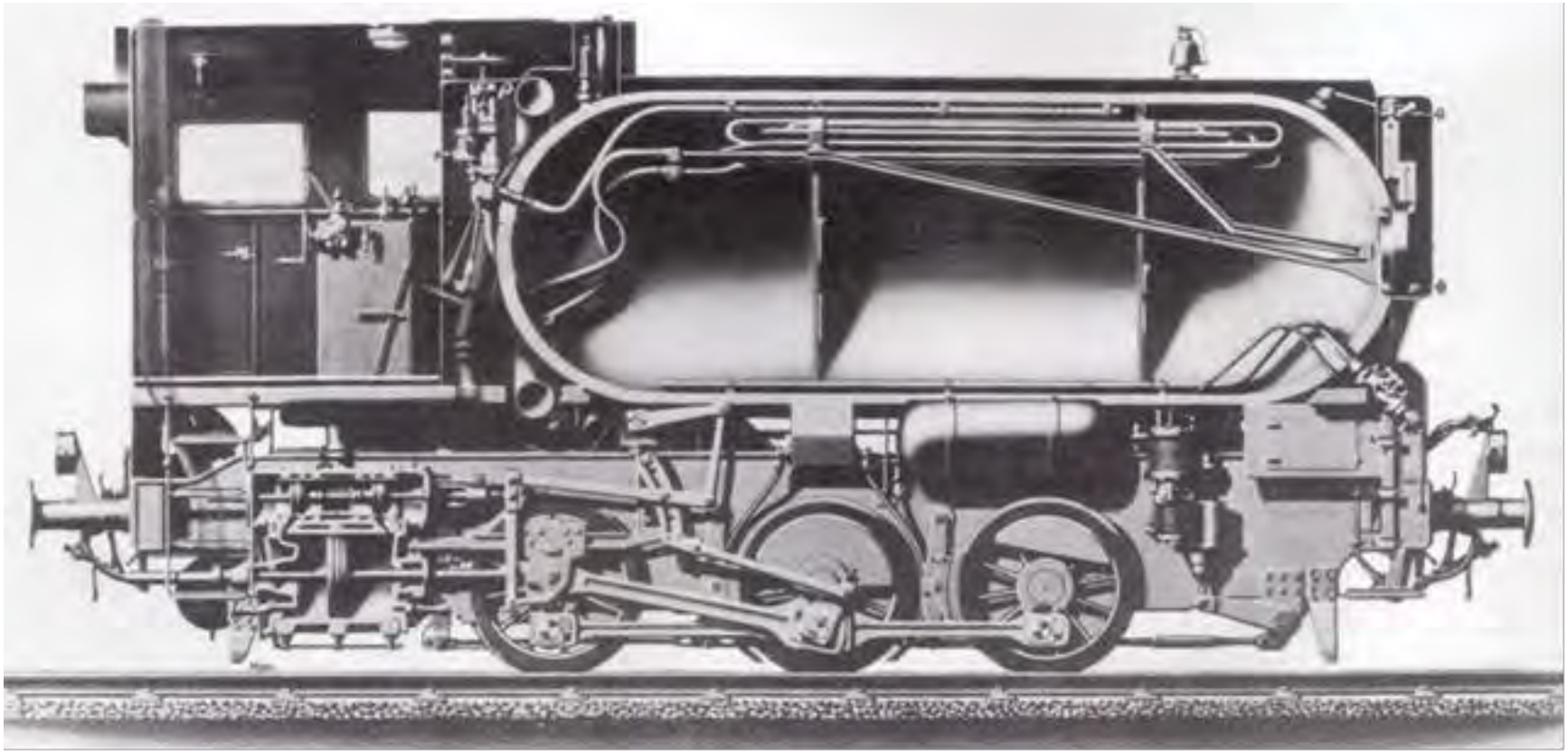
FLC 03 160: one of DLM‘s fireless locomotives

Presentation of the fireless locomotives FLC 03 147 and FLC 03 160 in Schaffhausen on 26. and 27.10.2010

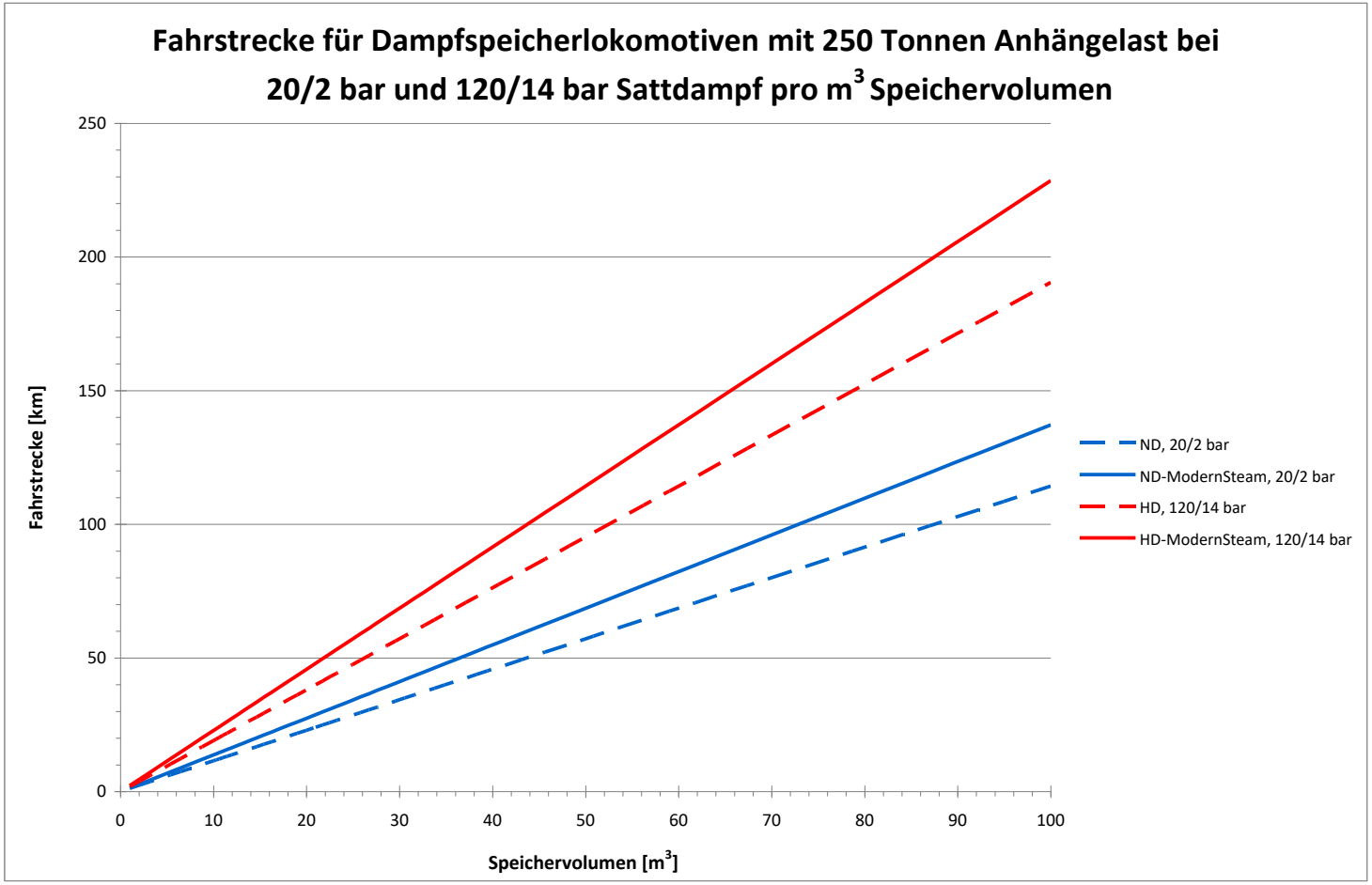
High pressure fireless locomotive, 85 bar

Baujahr: 1973

Schematic of a Gilli High-Pressure Fireless Locomotive



Great operating Ranges are possible with fireless Gilli-Locomotives



New Steam Locomotives are:

- *Economical: One man operation, remote control*
- *Ecological: Light oil firing, fireless operation*
- *Low on maintenance: Roller bearings, welded design*
- *Powerful, efficient and reliable*

Clean Steam Traction has a Future!

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