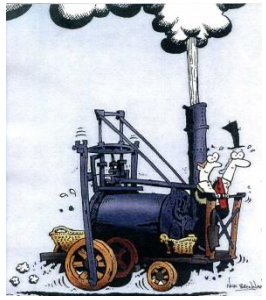


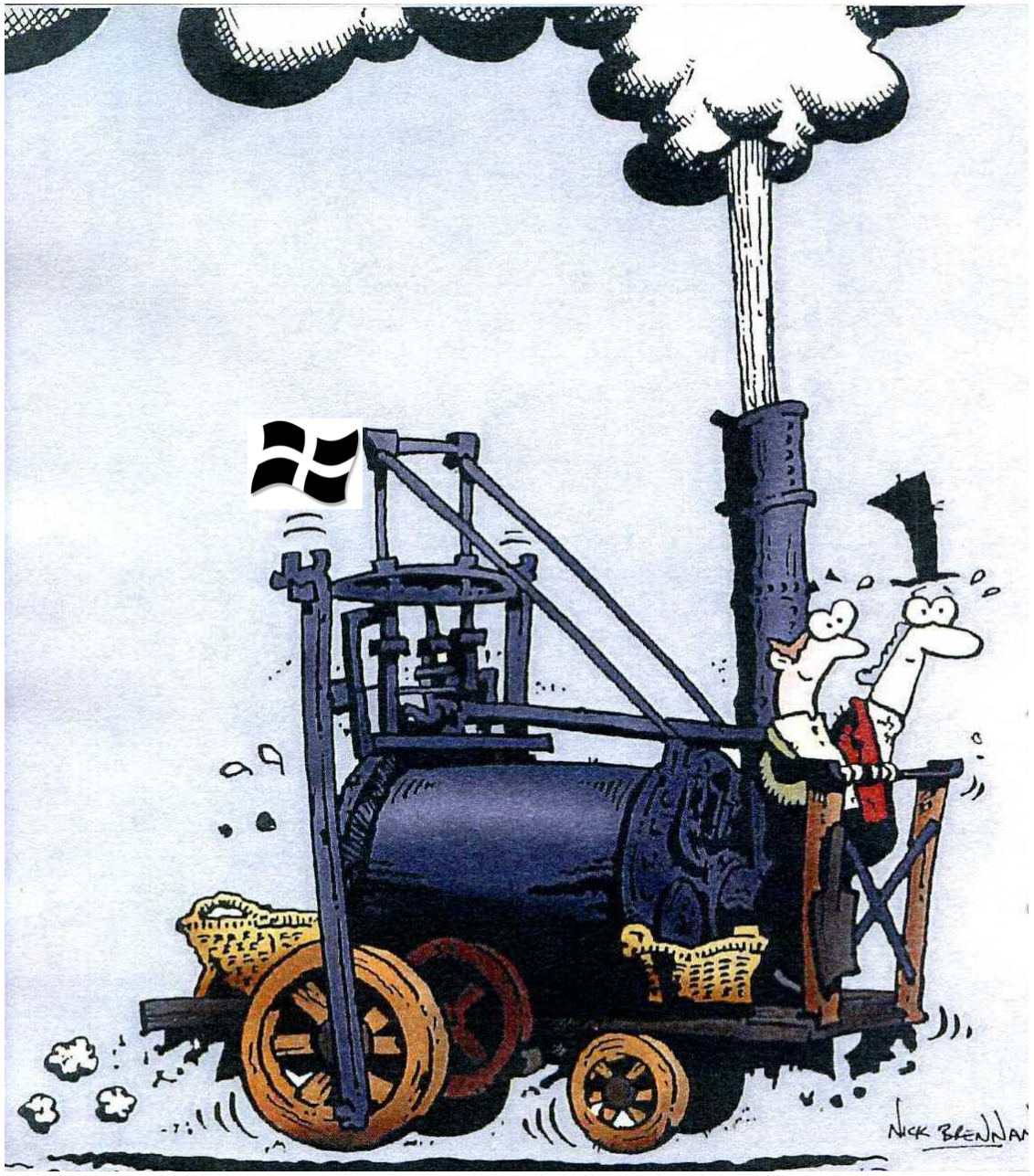


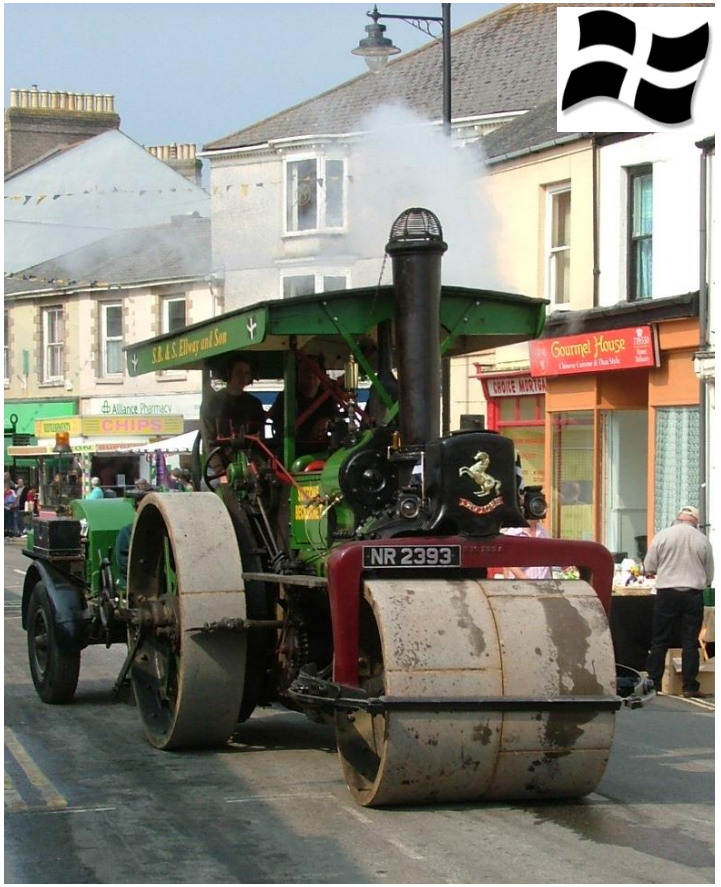



Cornwall and Scotland at the Interceltic Festival in Lorient, Brittany this year

Cornwall - Land of Steam!

Philip Hosken
The Trevithick Society





Today our vision of steam in Cornwall is something like this

Water, H_2O and fire produce steam

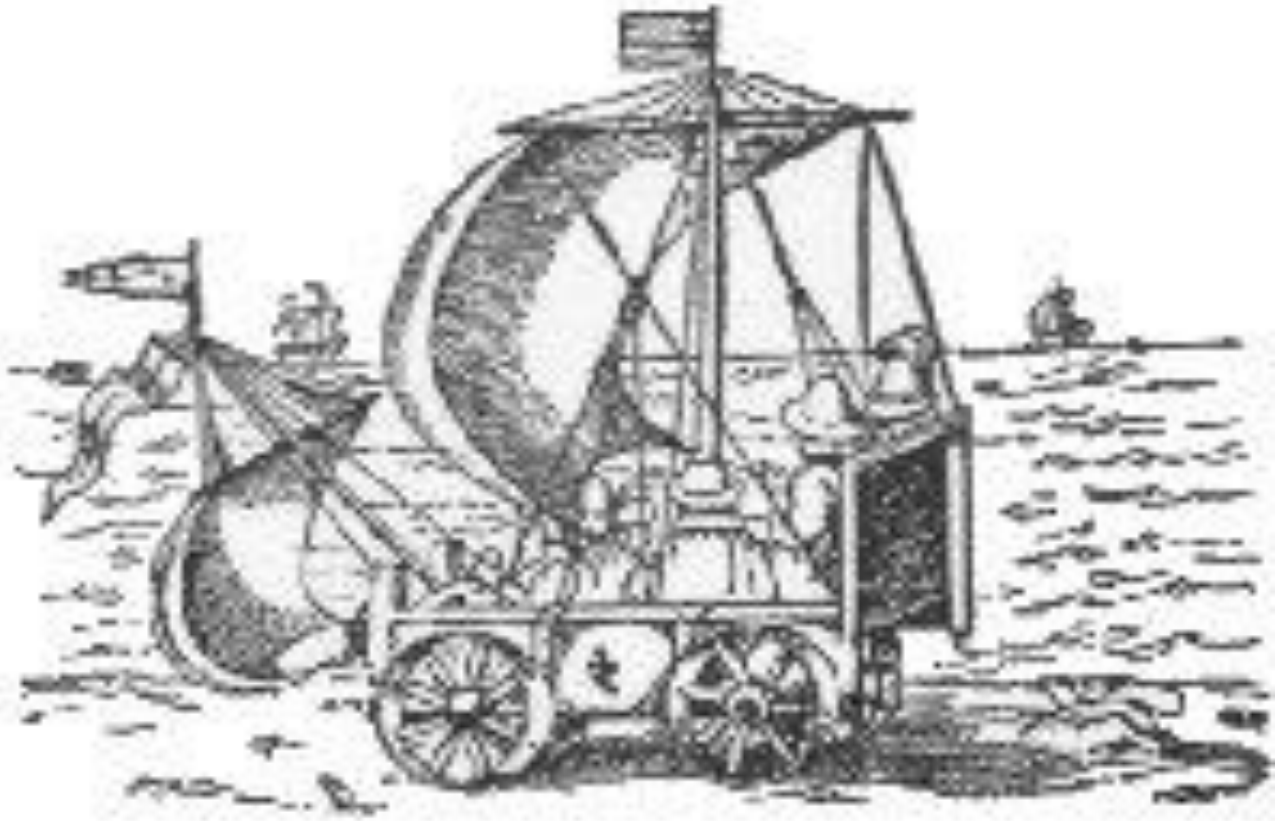
We know that strange things happen when you boil water

In olden times steam was looked upon as the work of the Devil and those connected to it were the Devil's disciples.

There are 'Steam Devil' and 'Dirt Devil' steam cleaners today

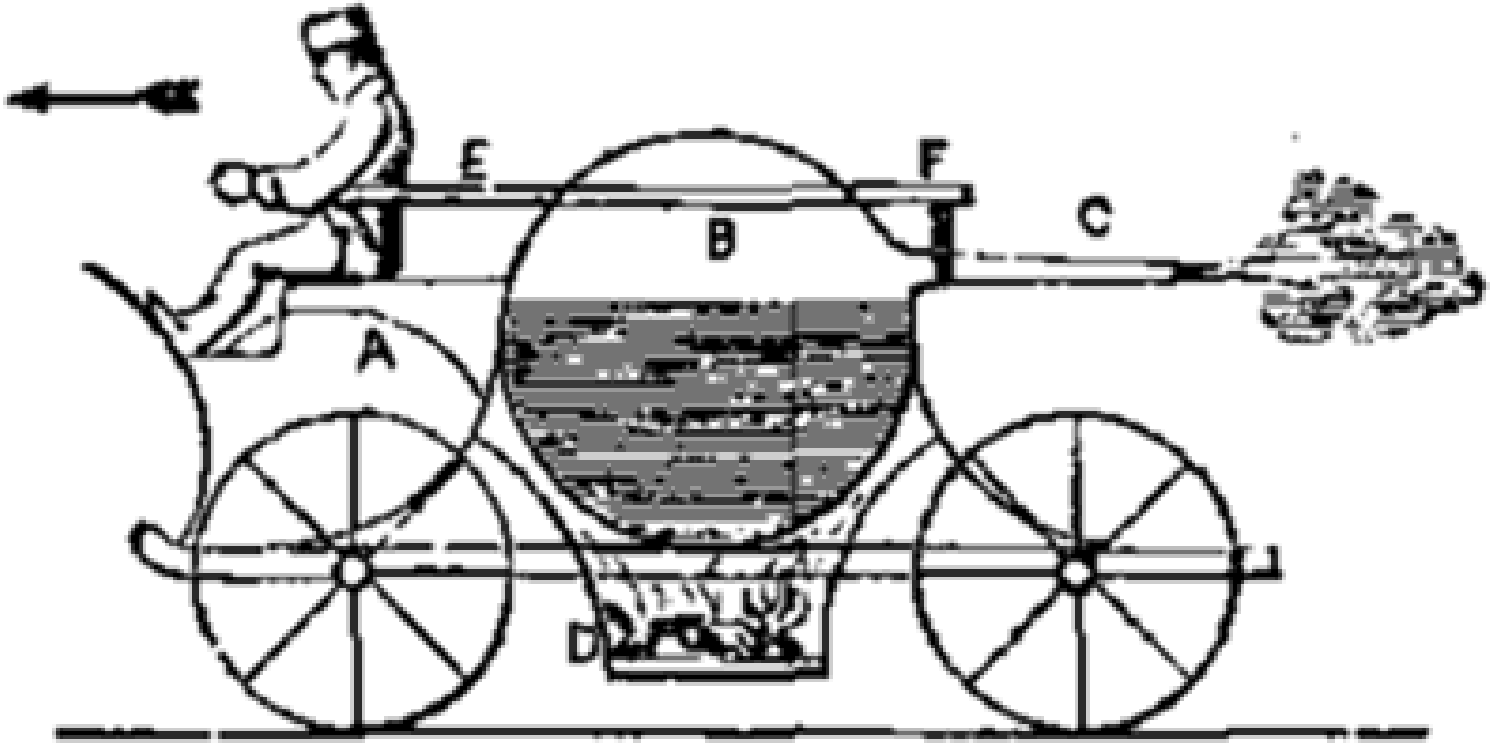
And there’s gravity!

Man's desire for horseless travel



Idea for a C16th wind operated carriage

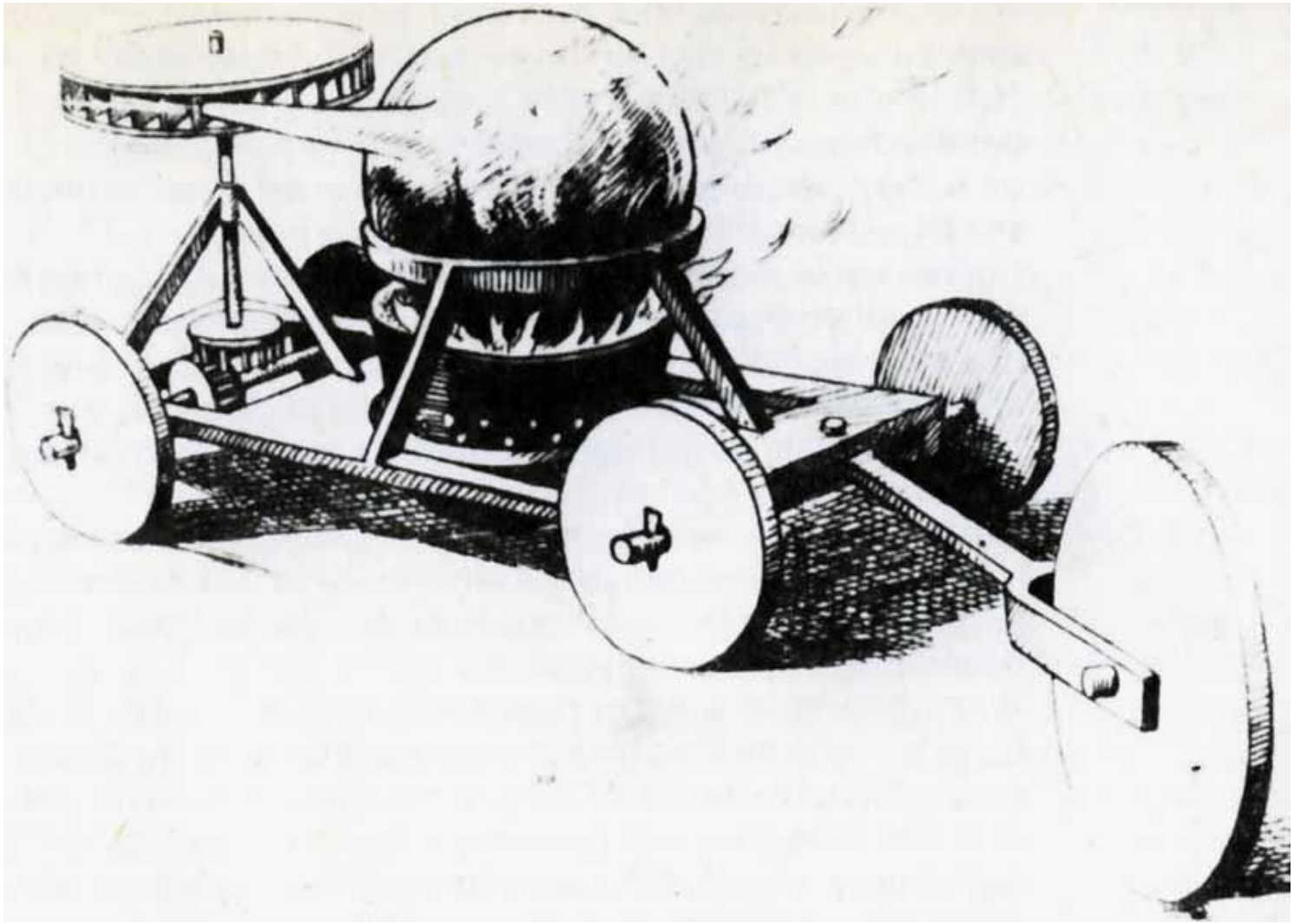
How we do
it nowadays



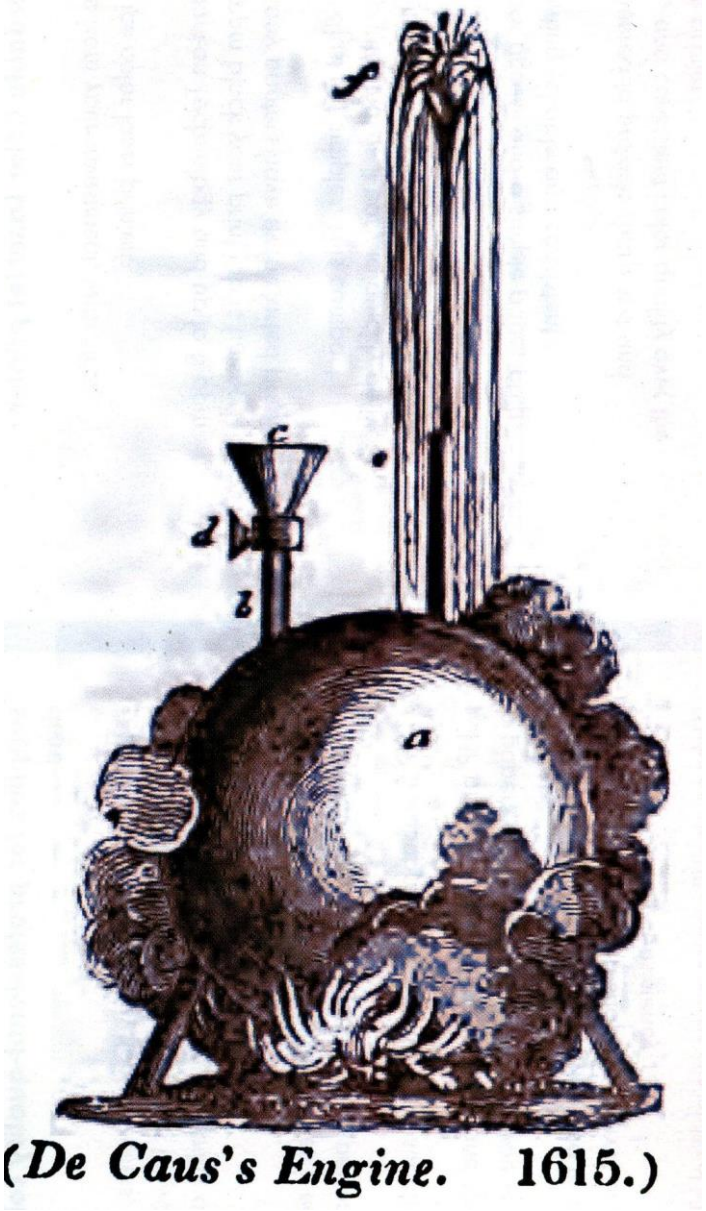
'For every action there is an equal and opposite reaction.'

Newton's 3rd Law of motion

Isaac Newton's proposed steam carriage of 1680

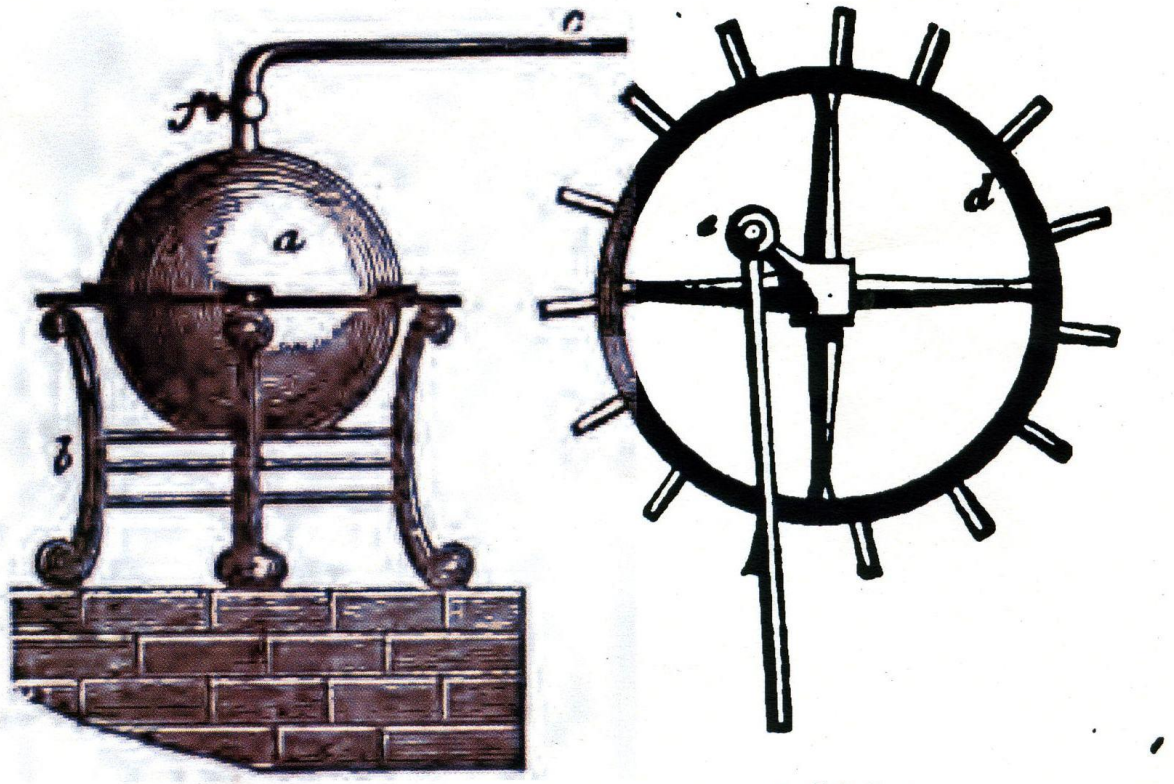


Ferdinand Verbiest, a French missionary in China invented the first turbine car in the year 1672.



(*De Caus's Engine.* 1615.)

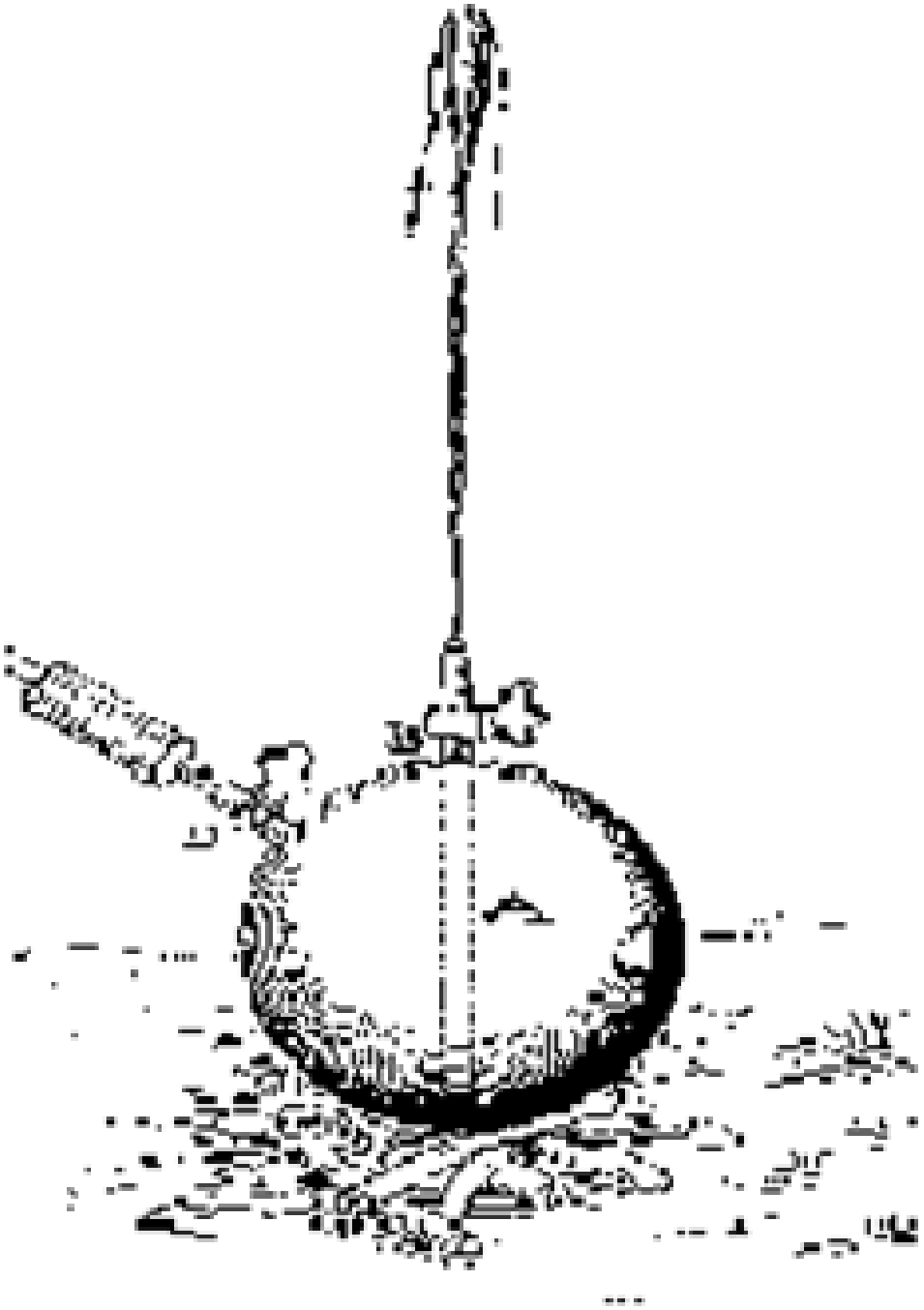
De Caus engine
1615



(*Branca's Engine.* 1628.)

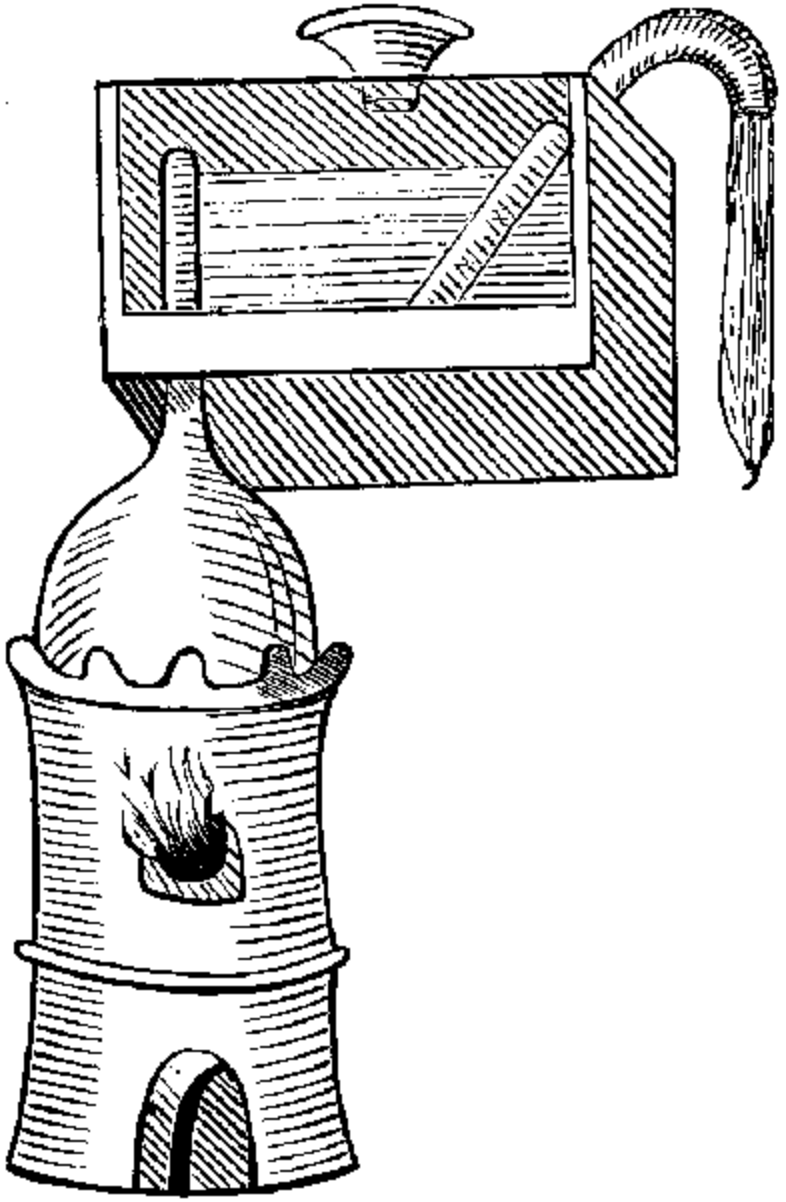
Branca's steam turbine 1628

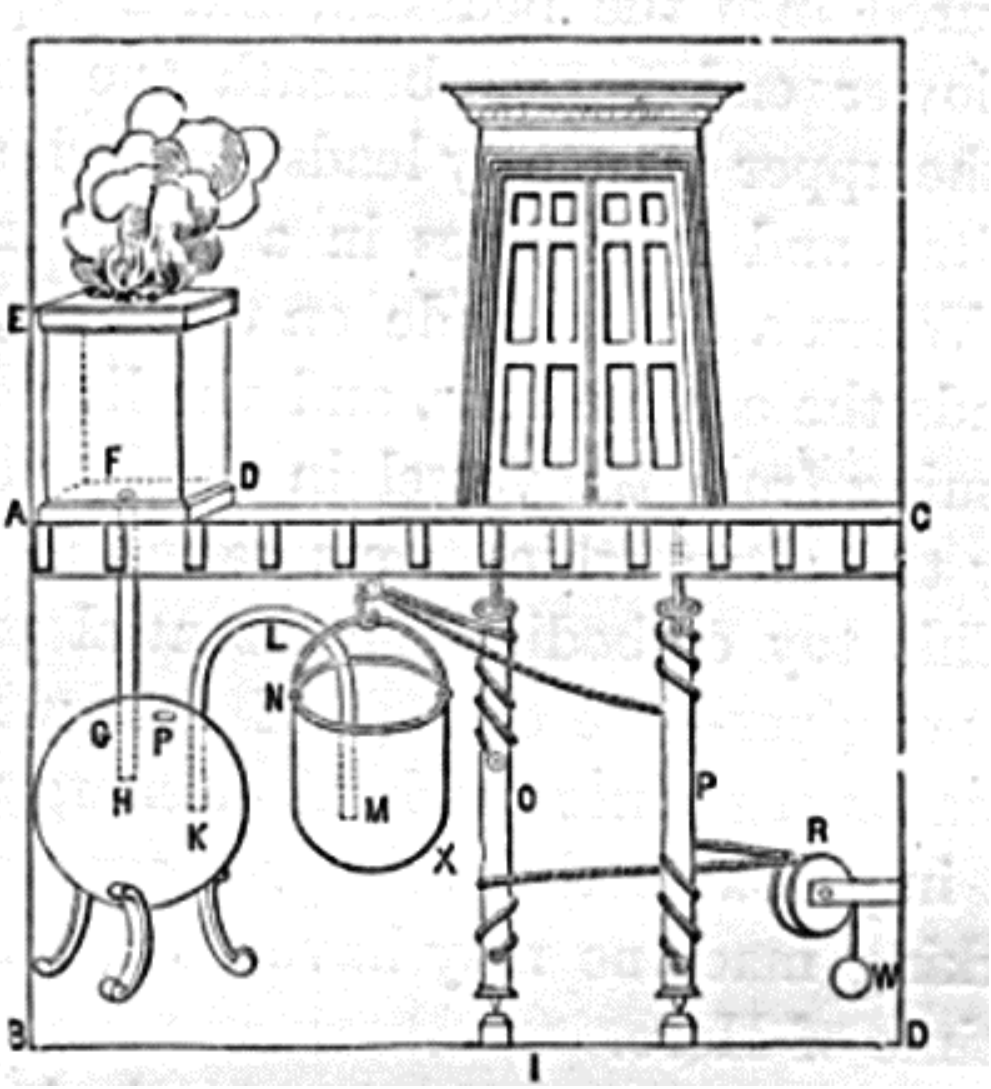
He planned to use a con rod and crank



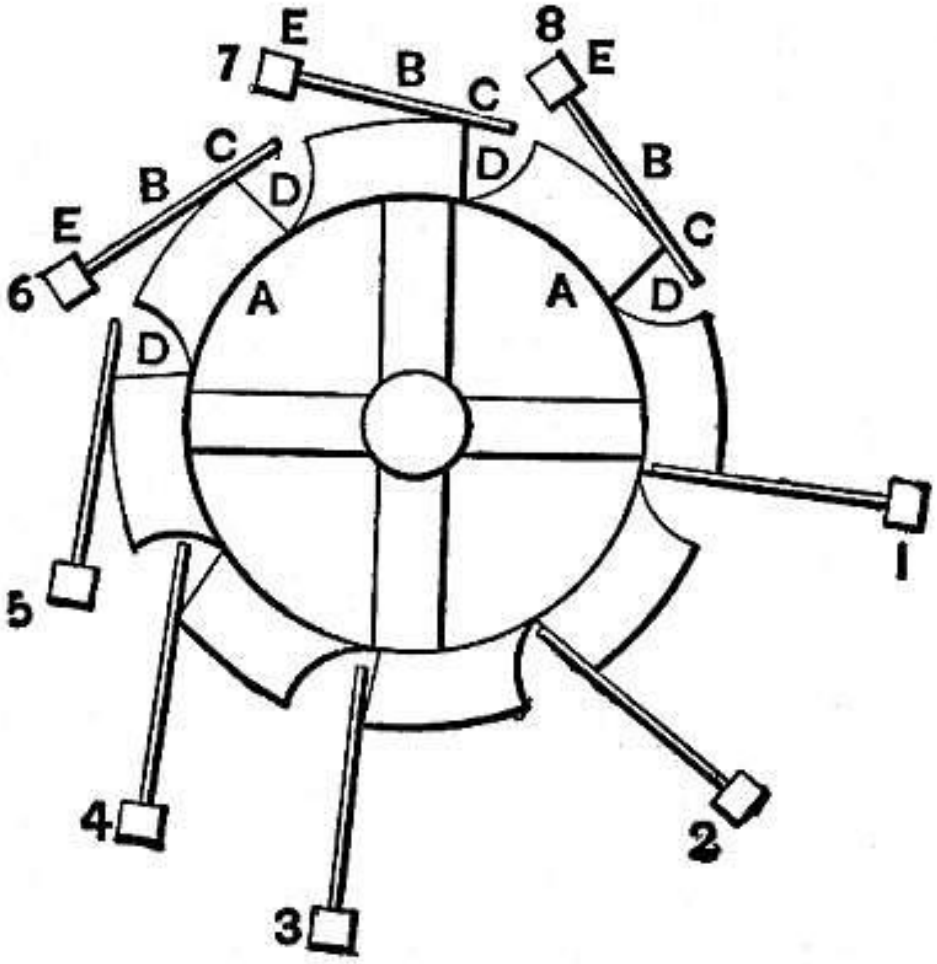
Marquis of Worcester's machine that was claimed to lift water 40 feet.

Marquis of Worcester and his engine in 1655

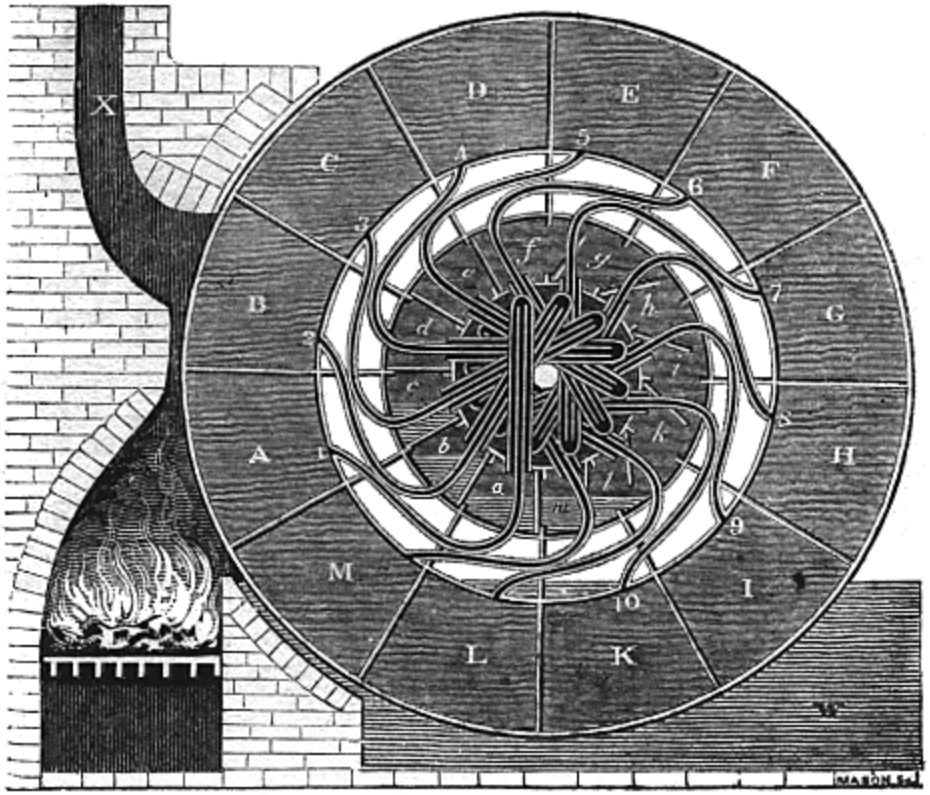




Marquis of Worcester, 1601 – 1667, rotary motion



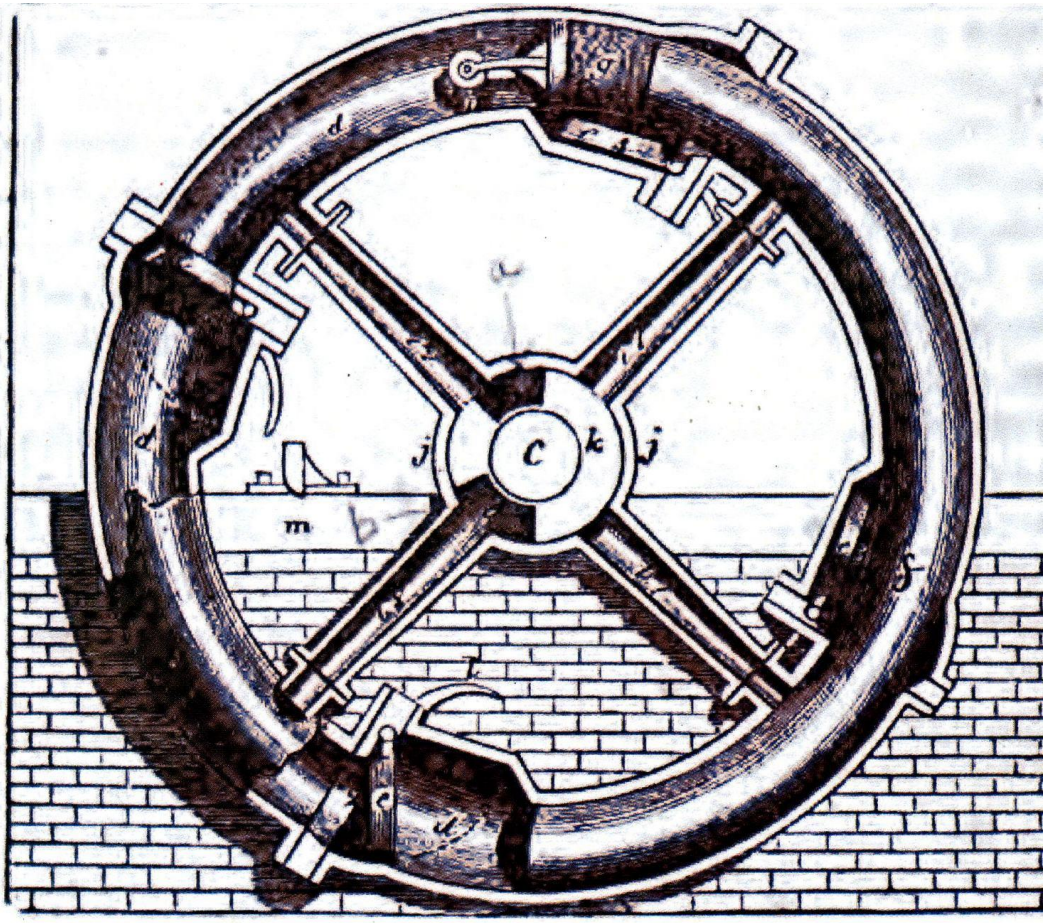
Marquis of Worcester perpetual motion machine, described by the French as one of the perpetual motion fallacies



Amonton's firewheel: 1699

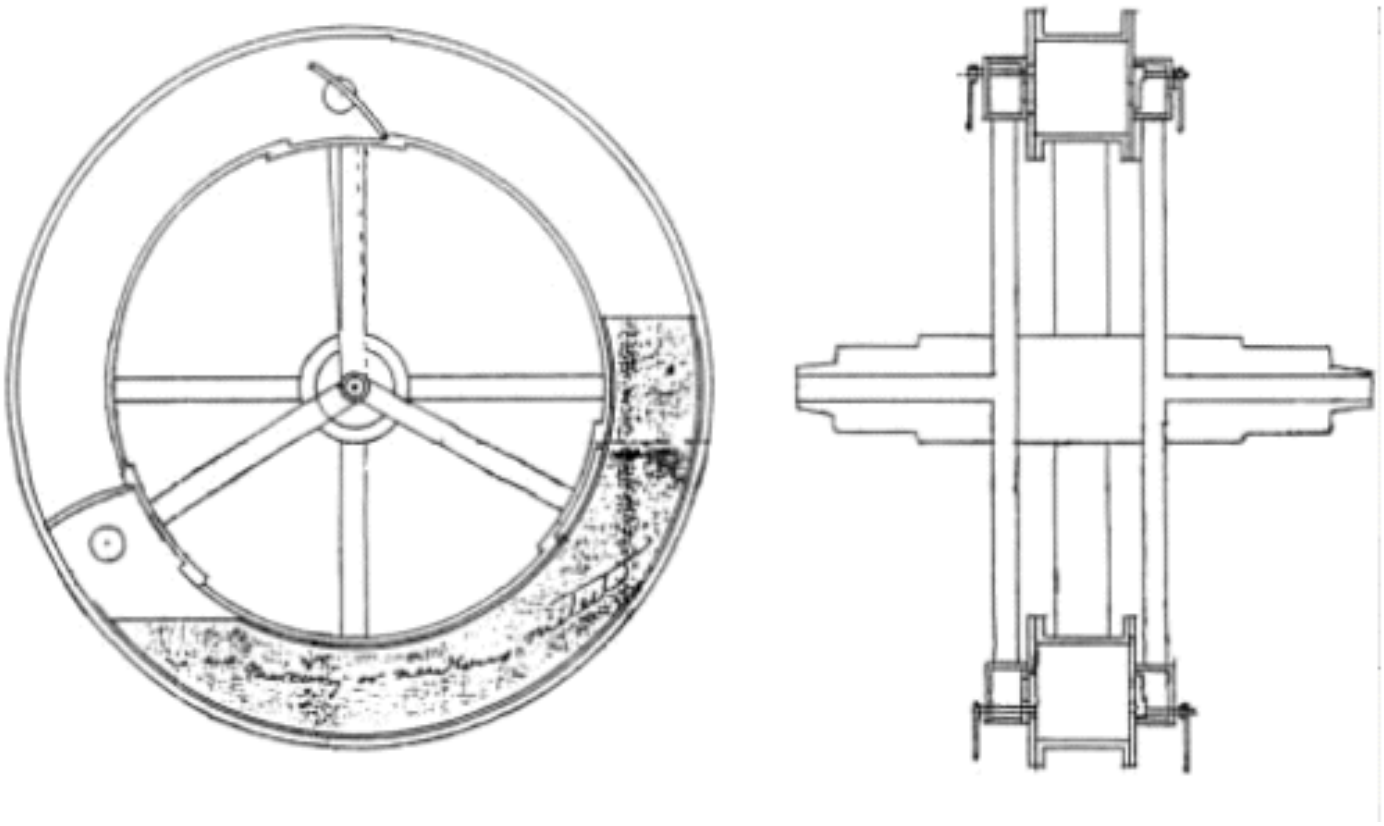
French Academy of Sciences

http://www.aqpl43.dsl.pipex.com/MUSEUM/POWER/steamwheel/steamwheel.htm

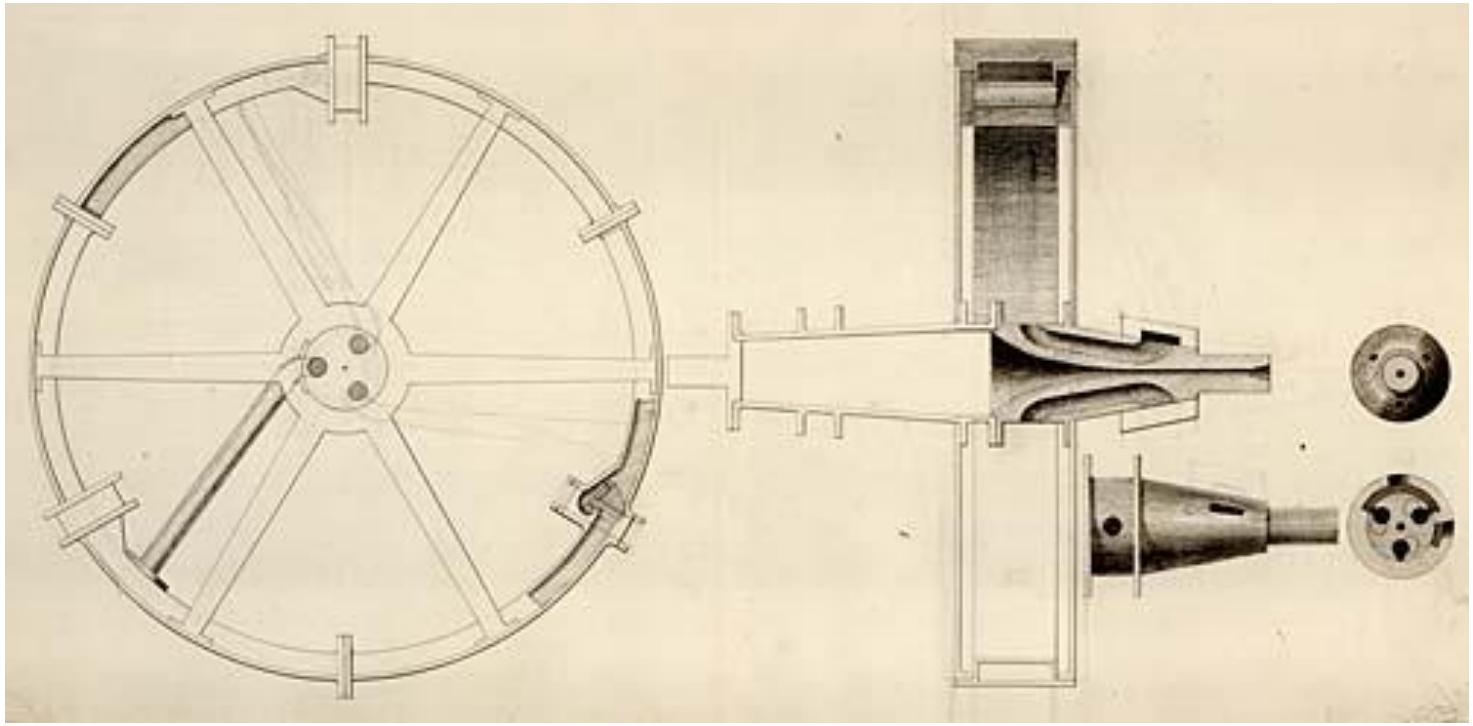


(Watt's First Rotary Engine. 1769.)

Watt's first rotative engine, 1769

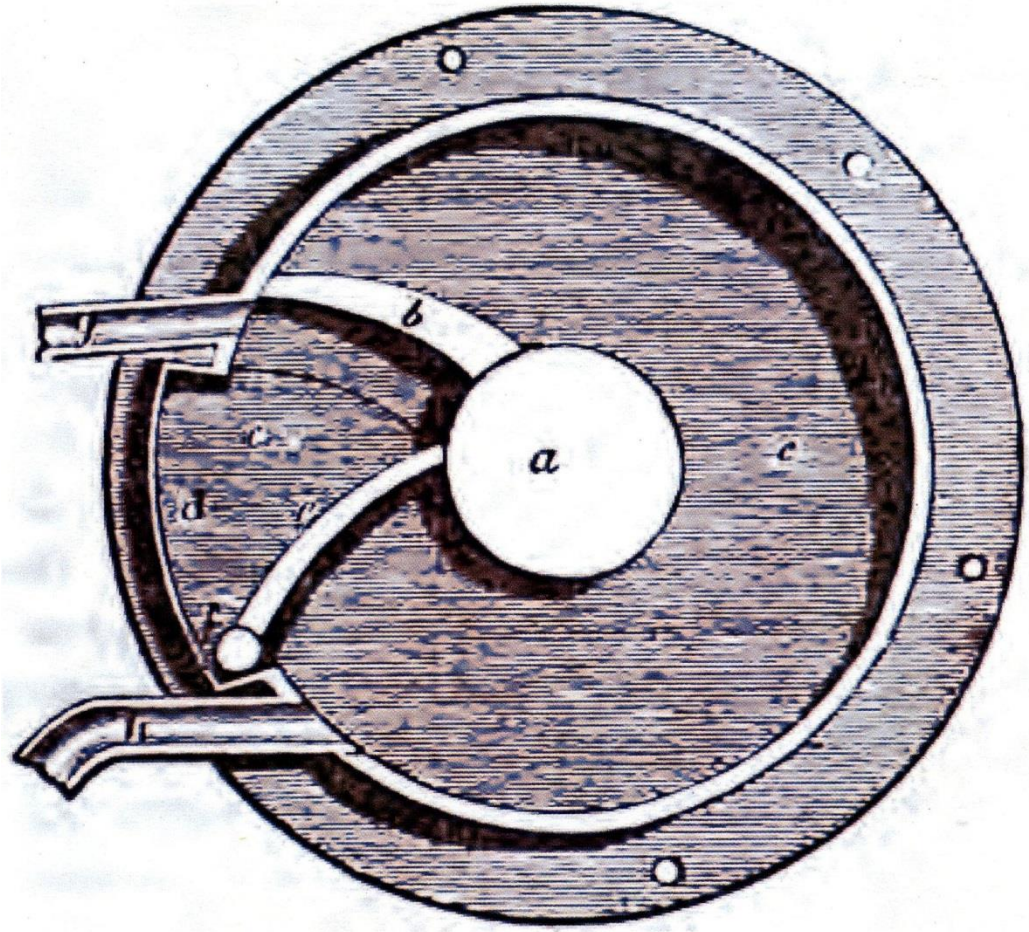


Watt’s mercury-steam wheel of 1769



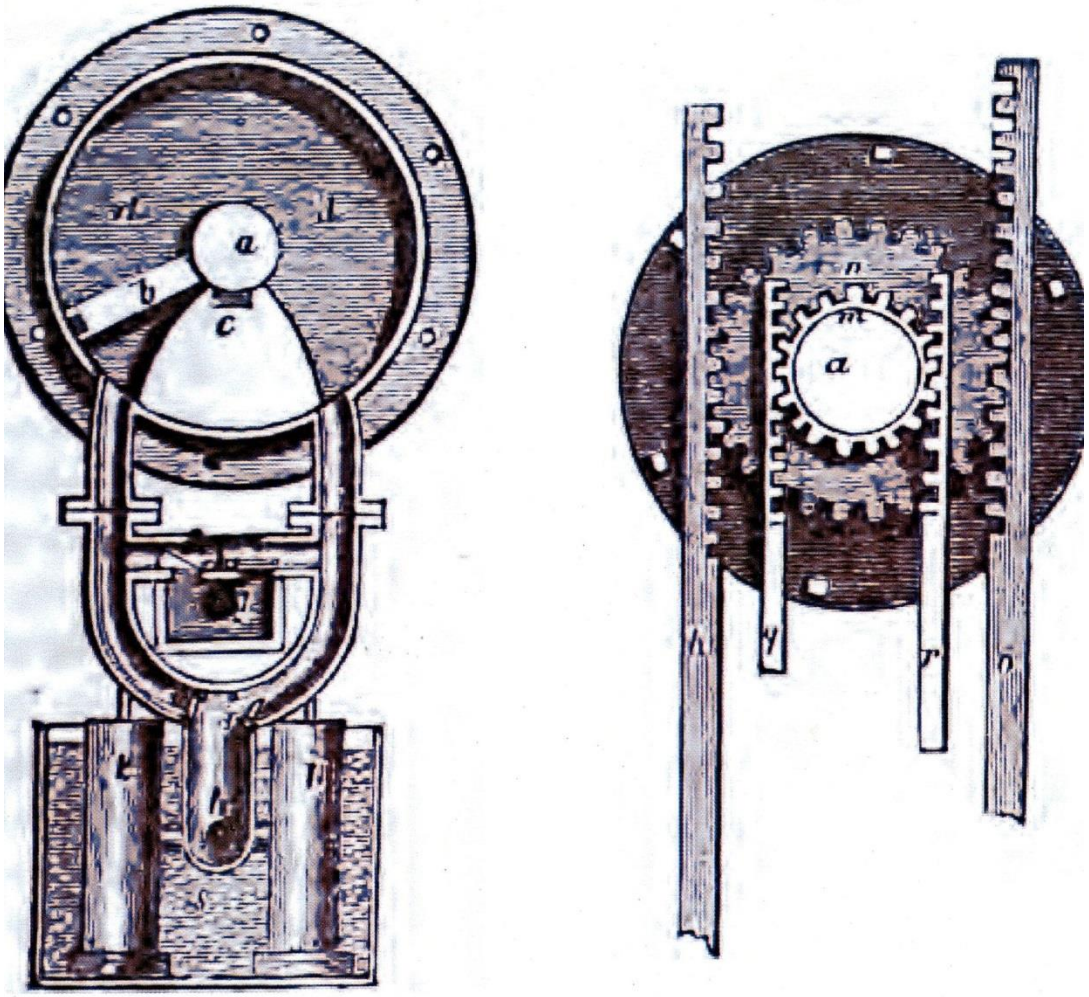
James Watt’s mercury-steam wheel, 1781

Watt lived in Cornwall from 1777 to 1800



(*Watt's Second Rotary Engine.* 1782).

Watt's second rotative engine, 1782

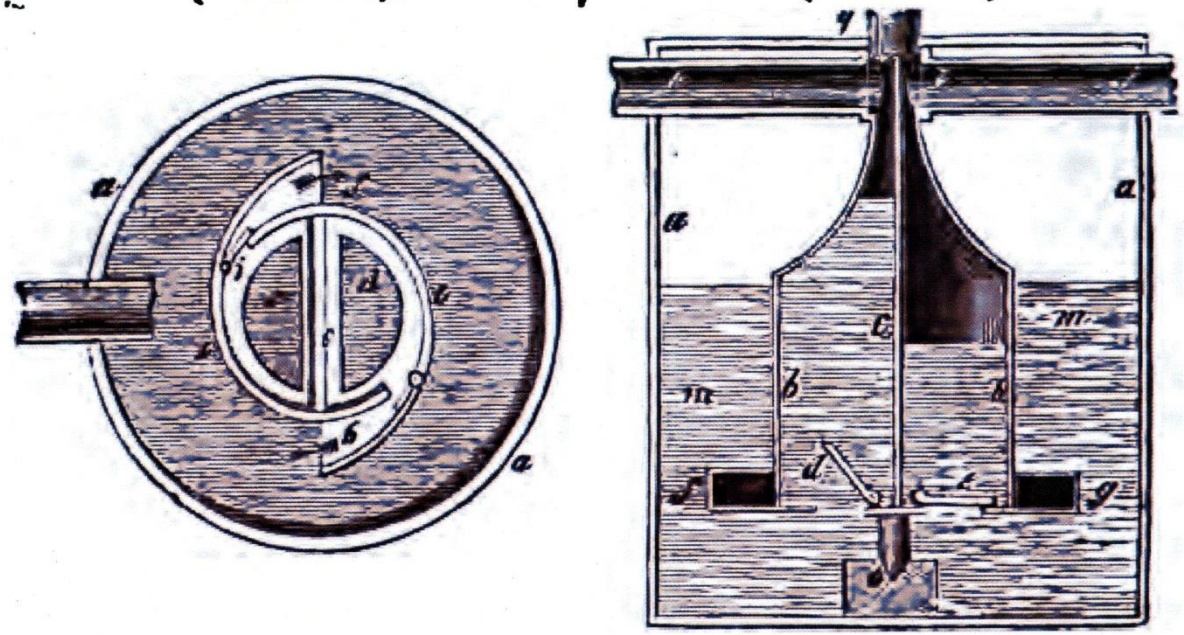


(Watt's Semi-rotative Engine. 1782.)

Watt's semi-rotative engine, 1782

(FIG. 1.)

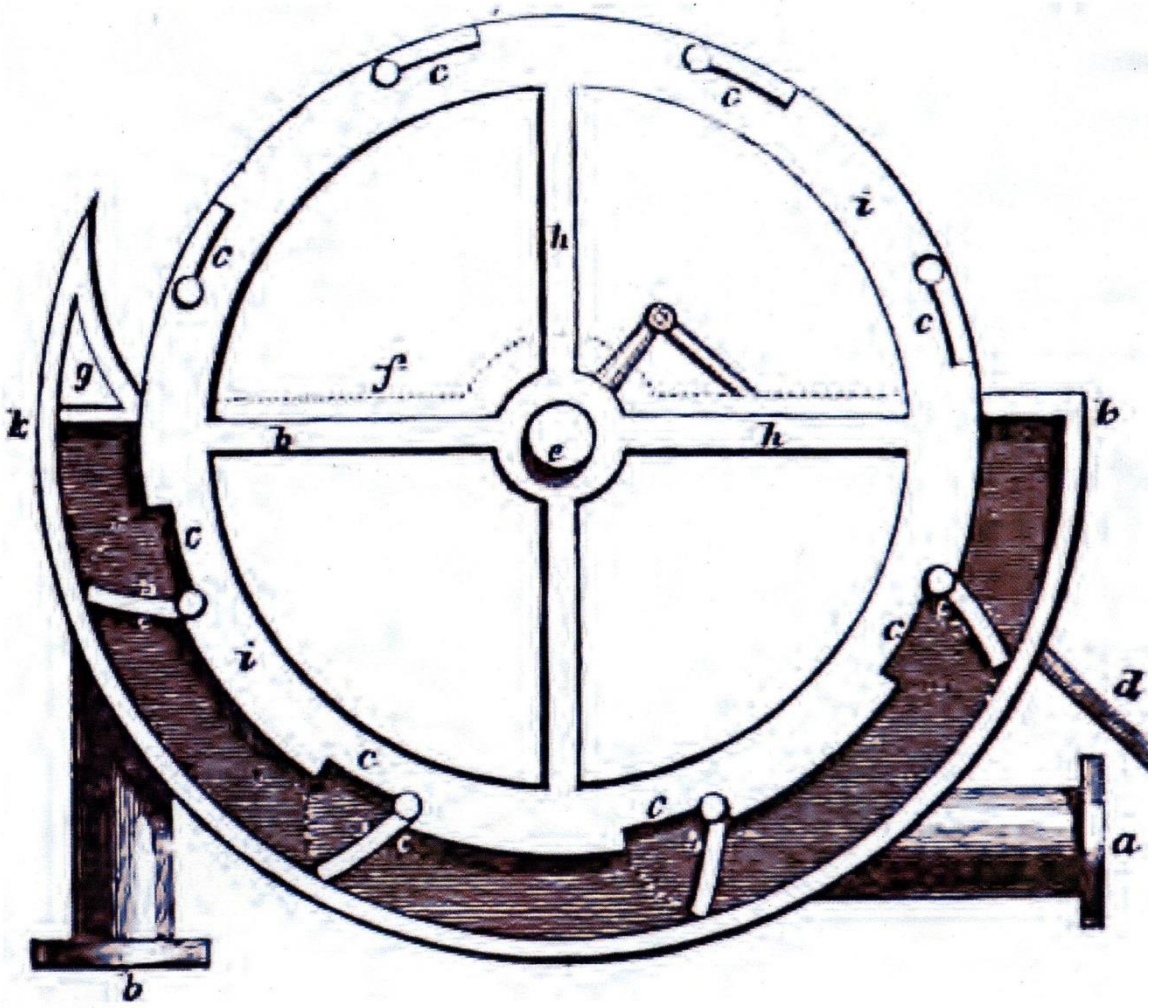
(FIG. 2.)



(FIG. 3.)

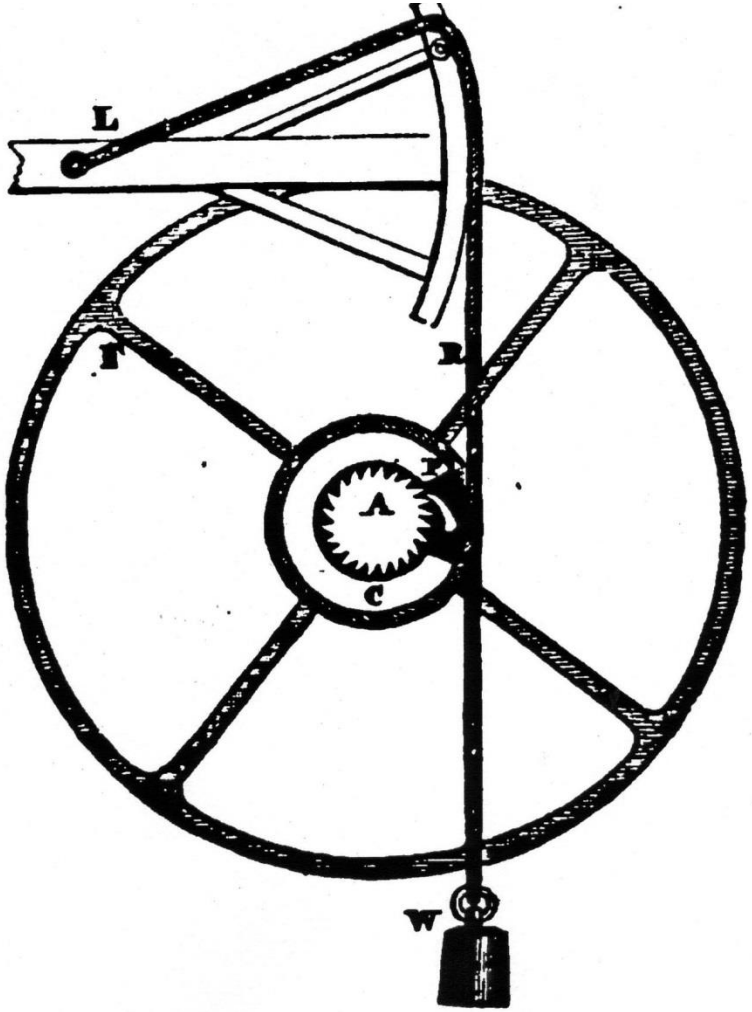
(*Watt's Rotatory Engine.* 1784.)

Watt rotative engine 1784



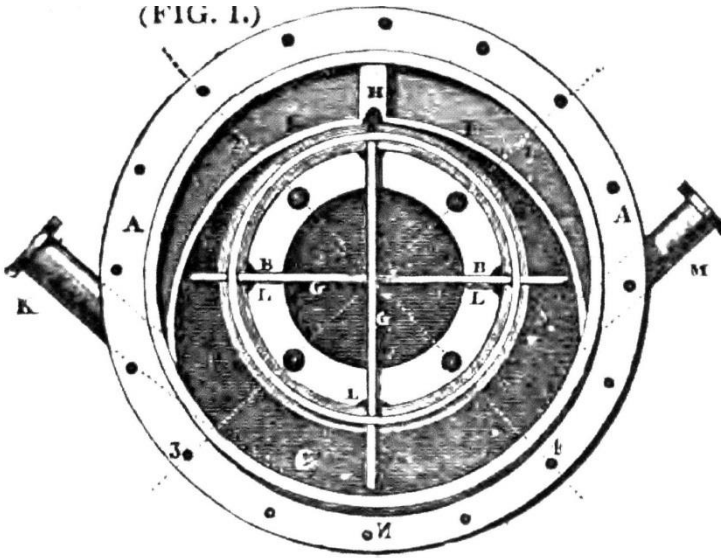
(Cooke's Rotative Engine. 1787.)

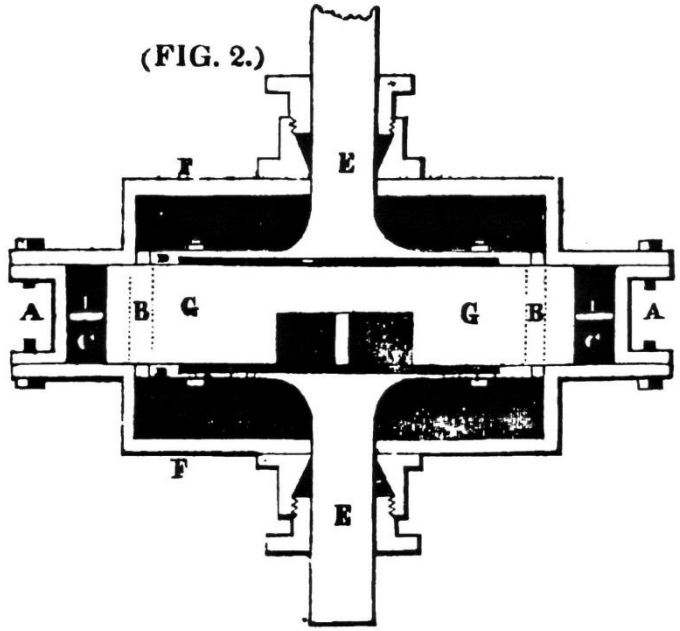
Cooke's Rotative Engine 1787



(*Burgess's Rotary Motion.* 1789.)

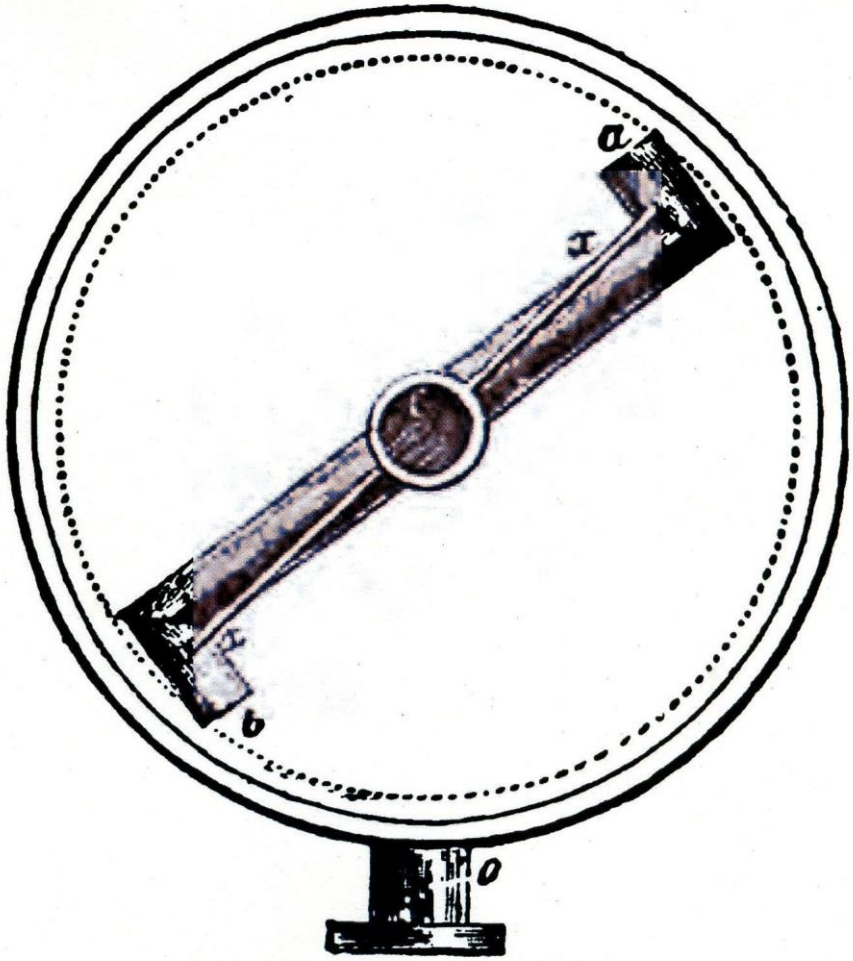
Burgess's Rotary Motion, 1789





(Bramah and Dickinson's Rotative Engine. 1790.)

Bramah & Dickinson's rotative engine 1790

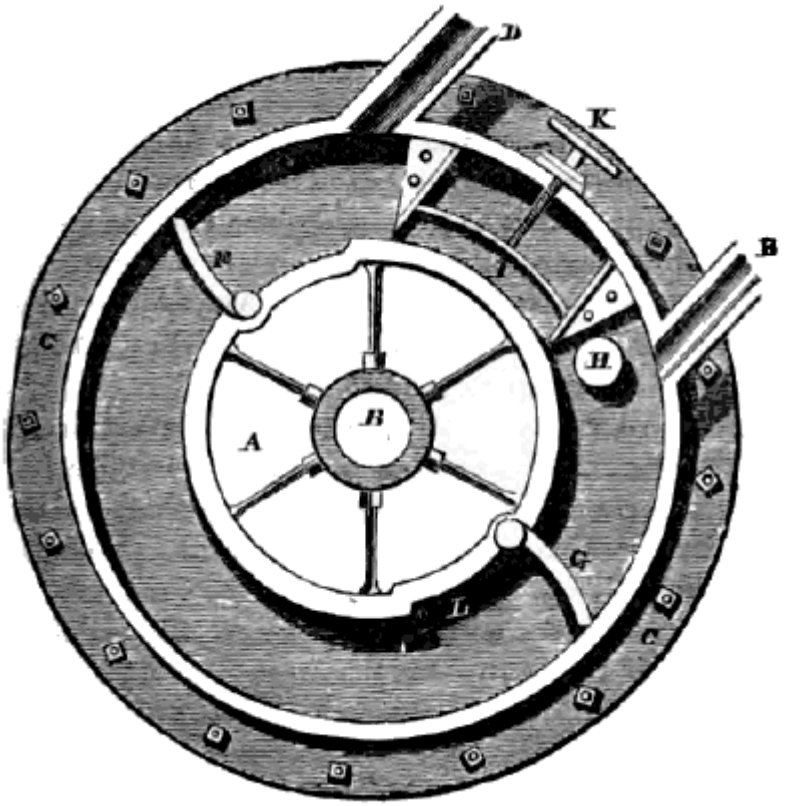


(*Sadler's Engine.* 1791.)

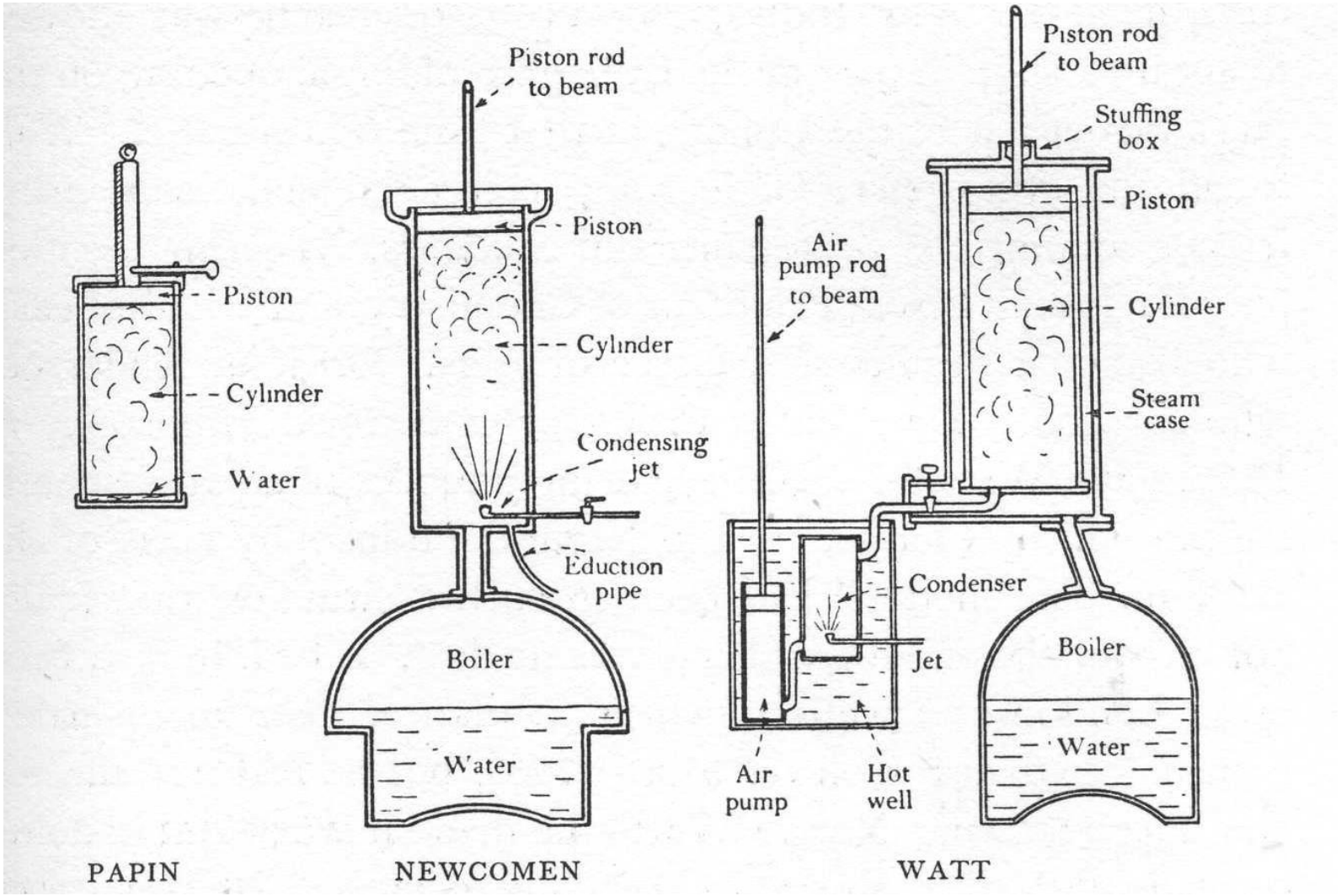
This engine is Hero's in another form, and, like it, ar ineffective toy.

Sadler's engine, 1791.

'An ineffective toy'



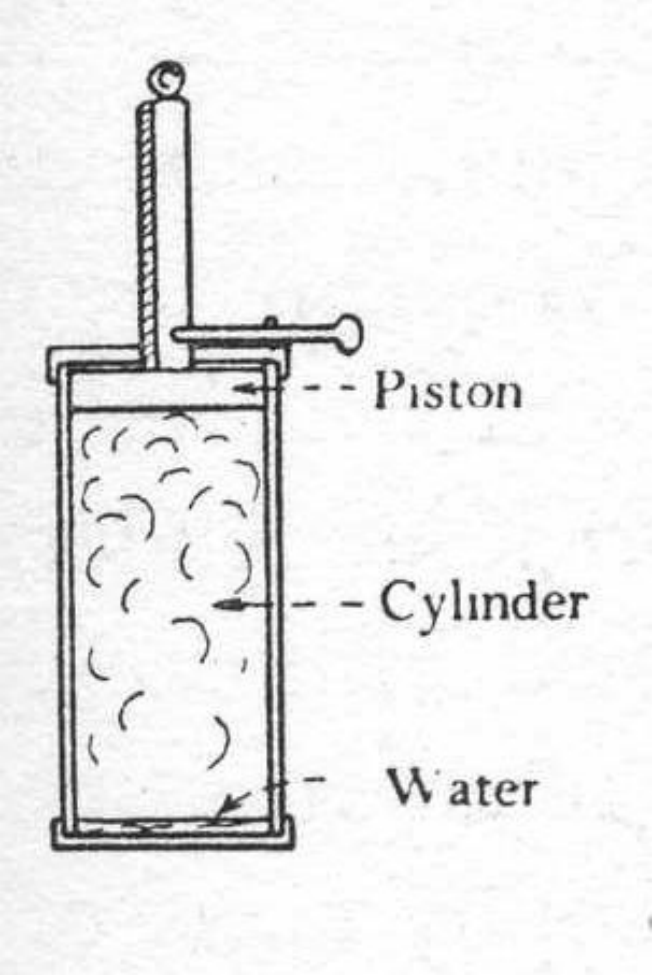
William Chapman, 1802



The first major steps in the creation of mechanical power

All the boilers at this time were either ‘haystack’ or ‘kettle’ designs

Science Museum exhibit



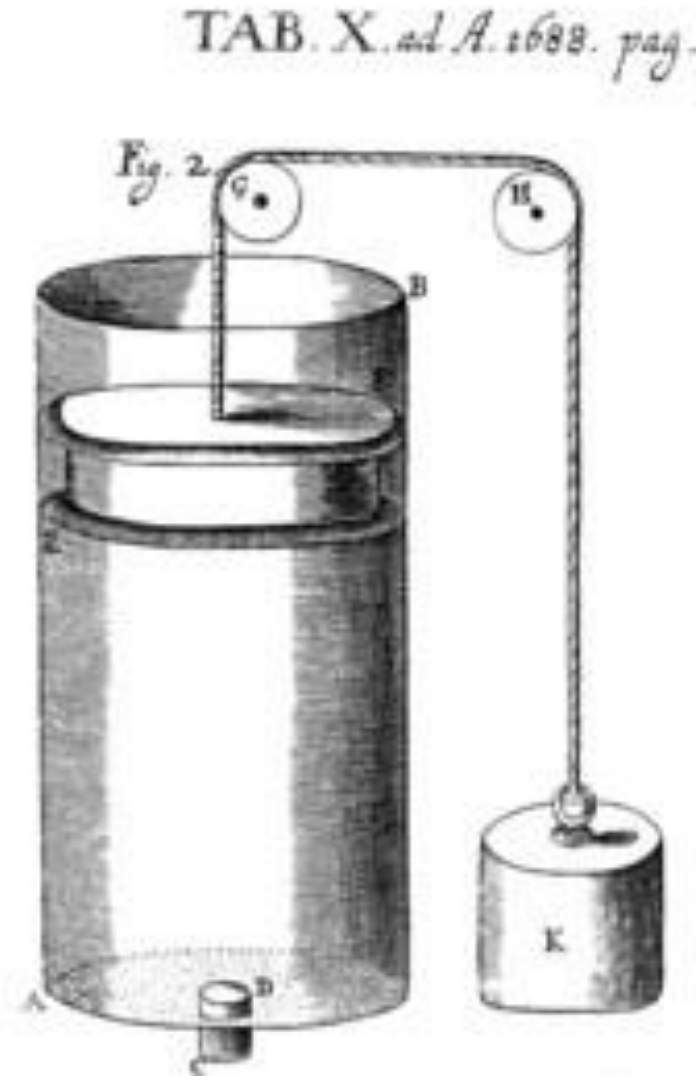
Let's look at the significant steps forward

Denis Papin

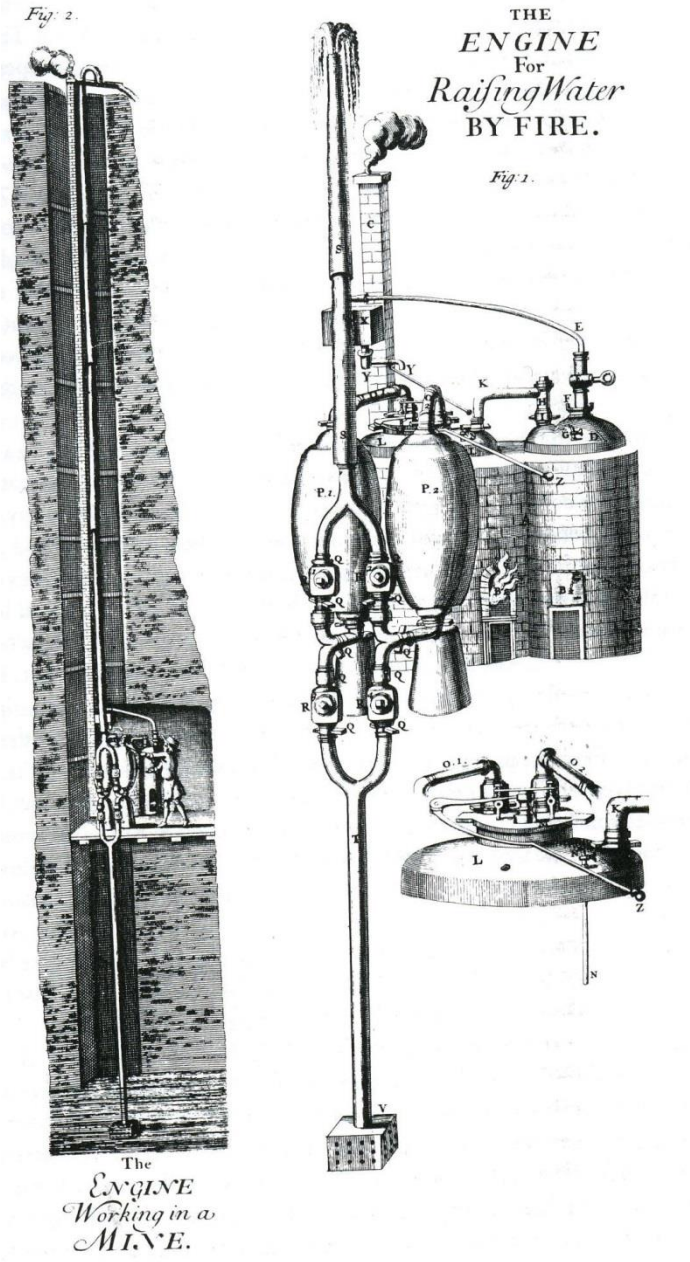
1647-1712

Chitenay, France

Also invented the safety valve and the pressure cooker

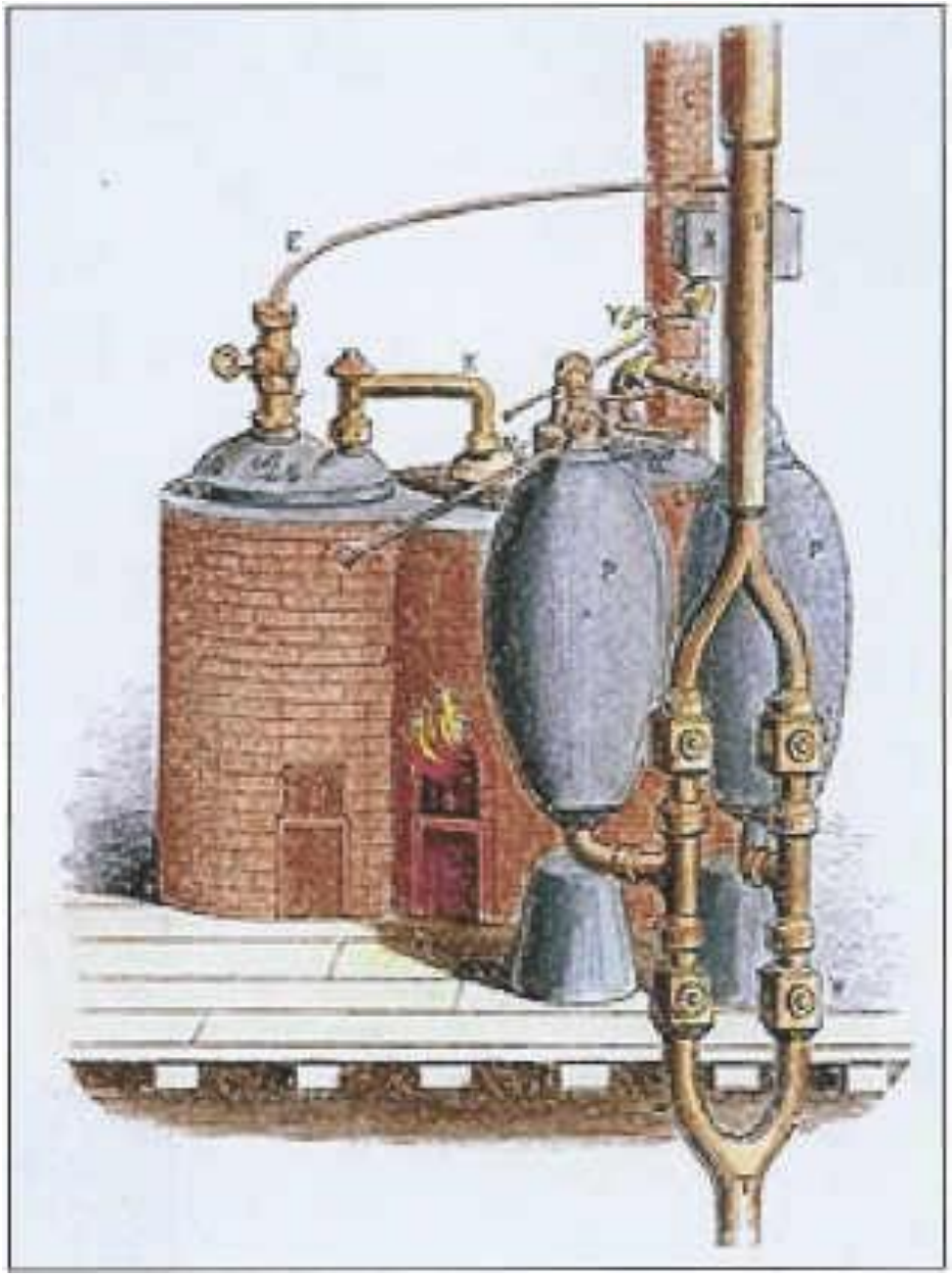


Papin's steam engine developed 1683



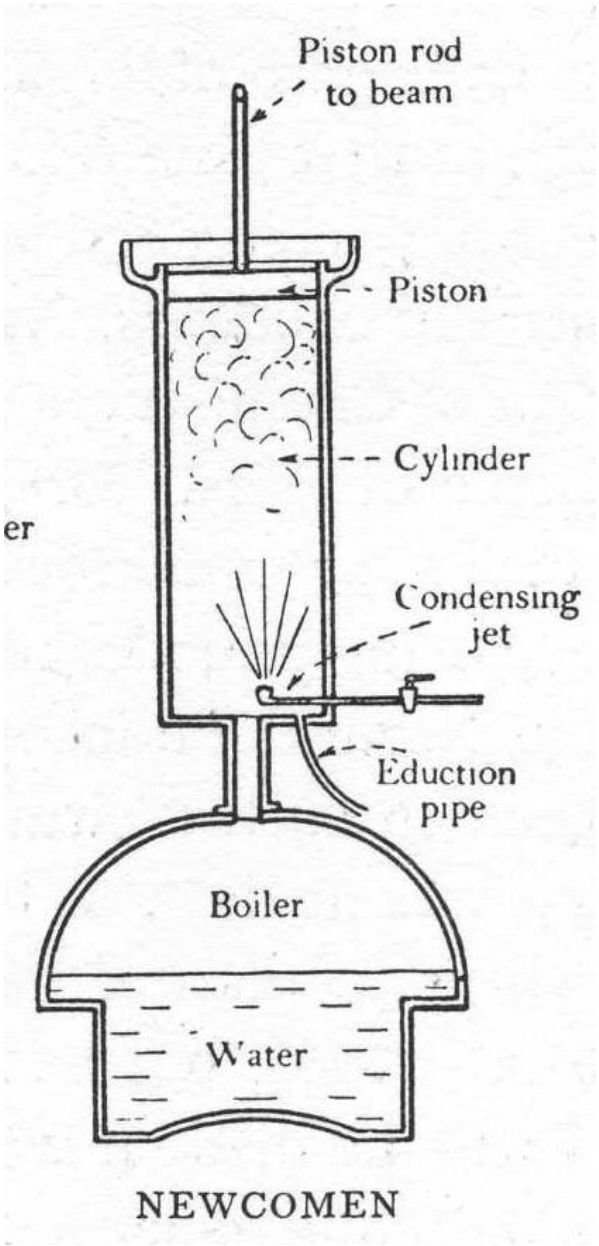
Thomas Savery's 'Miners' Friend' depended upon high pressure steam that he was unable to produce.

With a perfect vacuum he could raise water just 34 feet



Thomas Savery, 1650 – 1715. ‘Miners’ Friend’

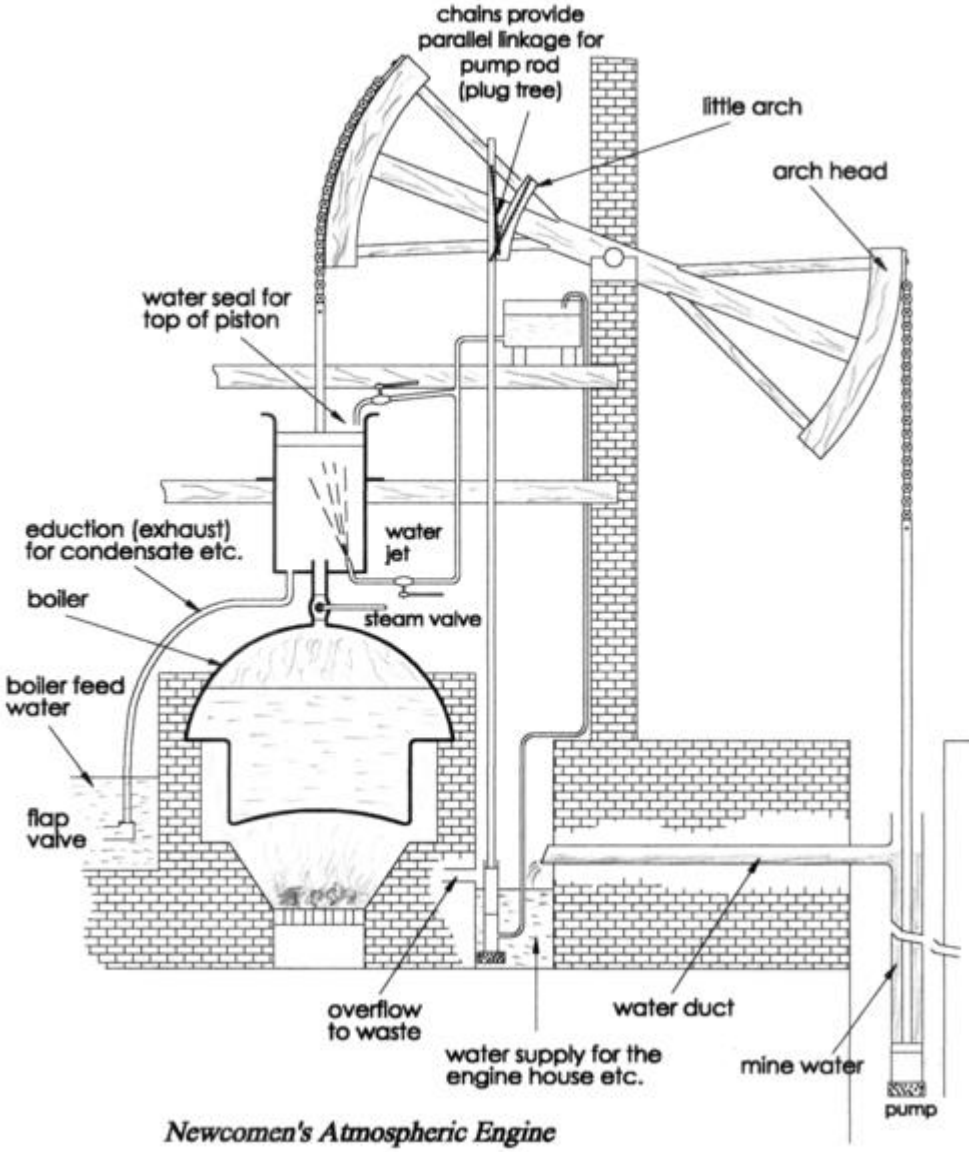
Claimed it was an ‘engine to raise water by fire’, 1702.



Thomas Newcomen

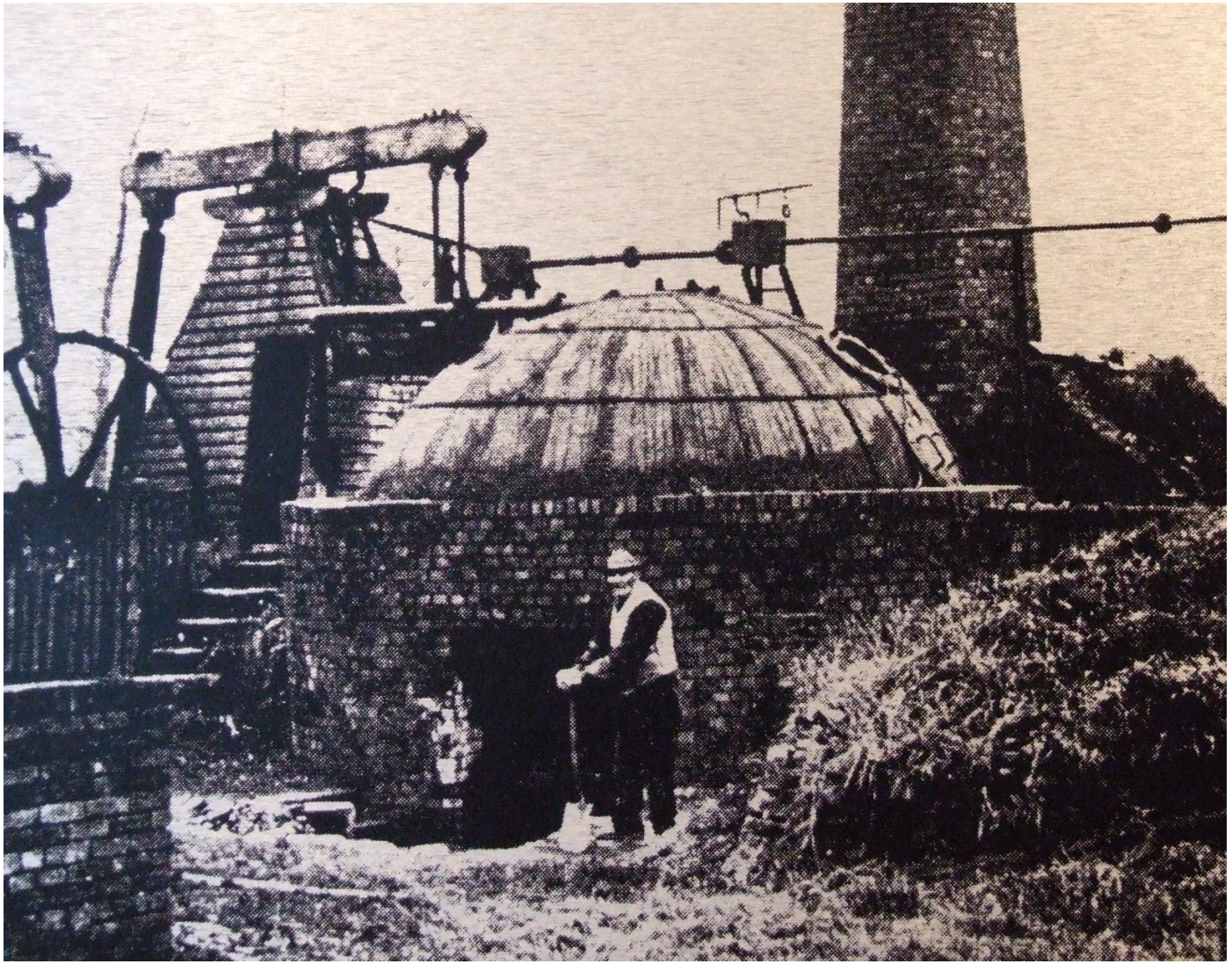
1664-1729
Dartmouth, Devon

Blacksmith and Baptist minister



The Newcomen engine

Newcomen had to pay Savery royalties on every engine he built until the patent expired



In practice it looked more like this

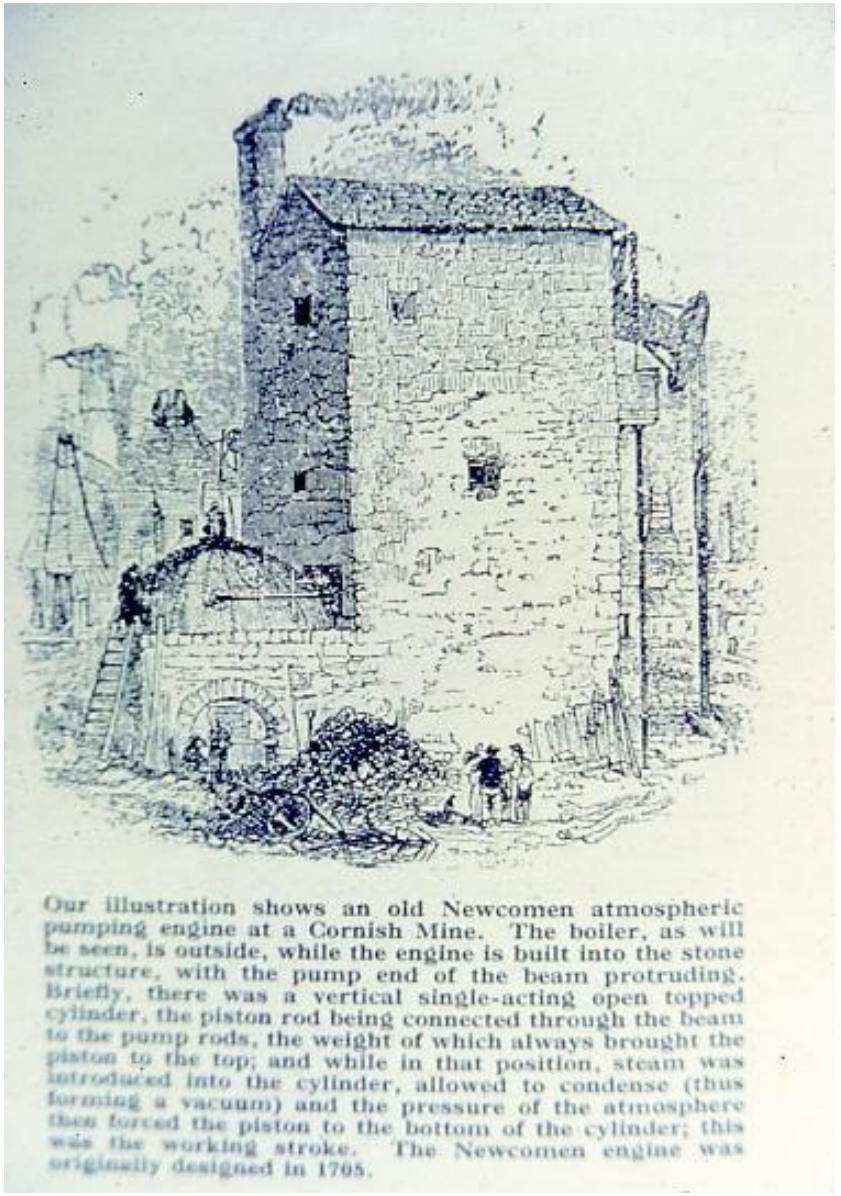
1760 Newcomen engine, 1880 photograph

Thomas Newcomen, 1663 – 1729

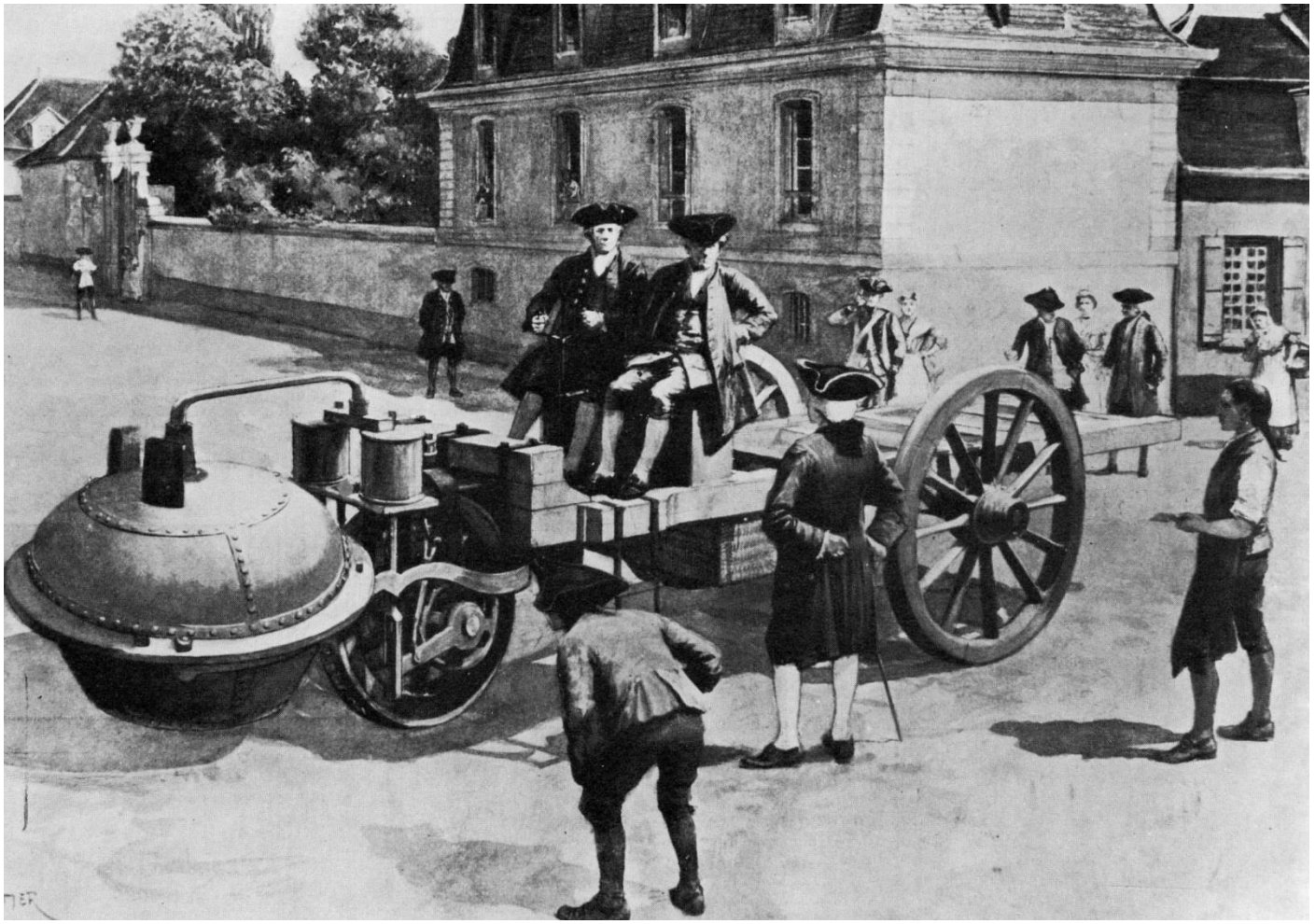
Built first atmospheric engine in 1712

First engine introduced to Cornwall in 1720

Josiah Wedgwood records that he counted 13 Newcomen engines in the one parish of Gwennap.



Our illustration shows an old Newcomen atmospheric pumping engine at a Cornish Mine. The boiler, as will be seen, is outside, while the engine is built into the stone structure, with the pump end of the beam protruding. Briefly, there was a vertical single-acting open topped cylinder, the piston rod being connected through the beam to the pump rods, the weight of which always brought the piston to the top; and while in that position, steam was introduced into the cylinder, allowed to condense (thus forming a vacuum) and the pressure of the atmosphere then forced the piston to the bottom of the cylinder; this was the working stroke. The Newcomen engine was originally designed in 1705.



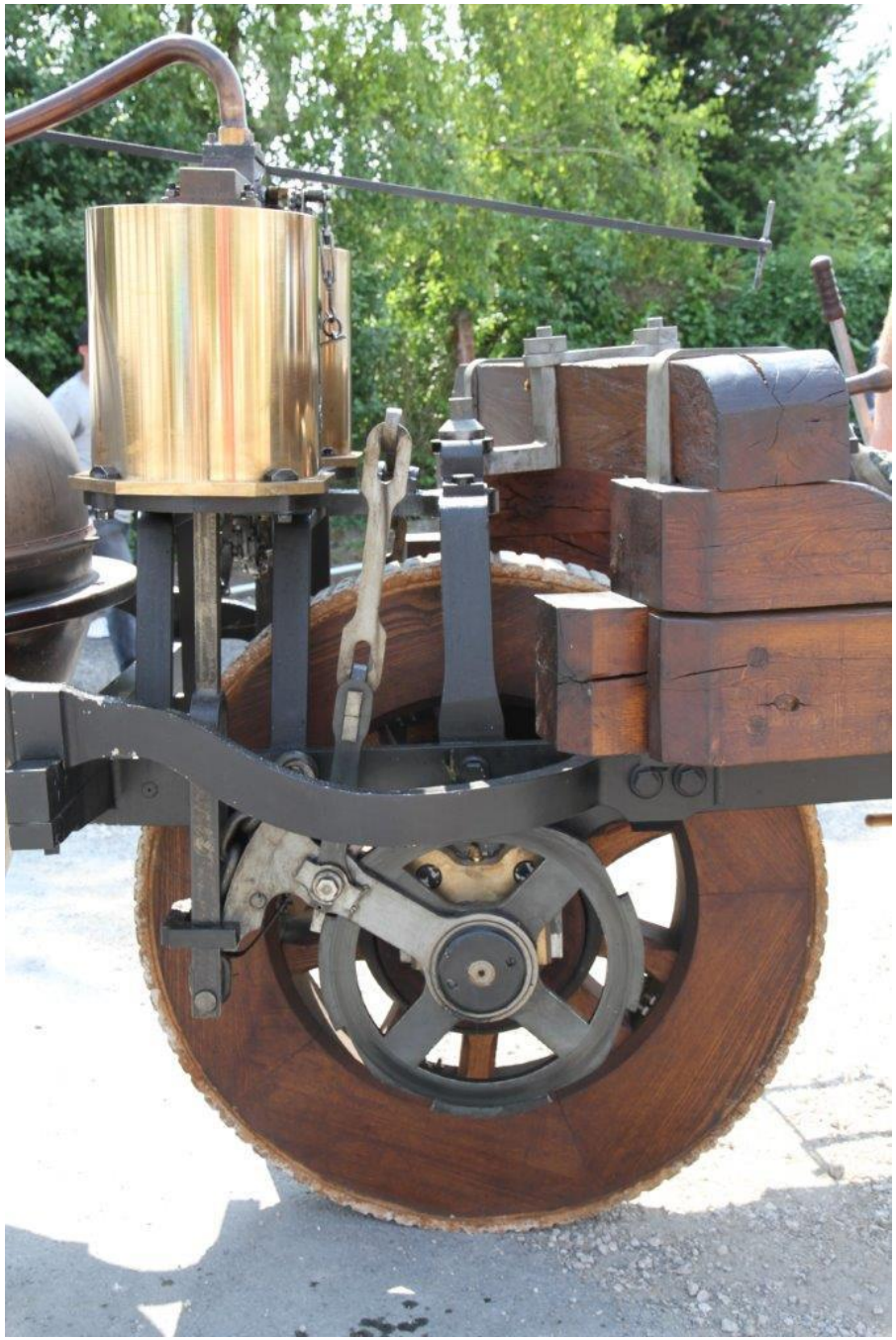
Nicholas Cugnot

1725 - 1804

Three-wheeled high-pressure locomotive

1769

Cugnot replica



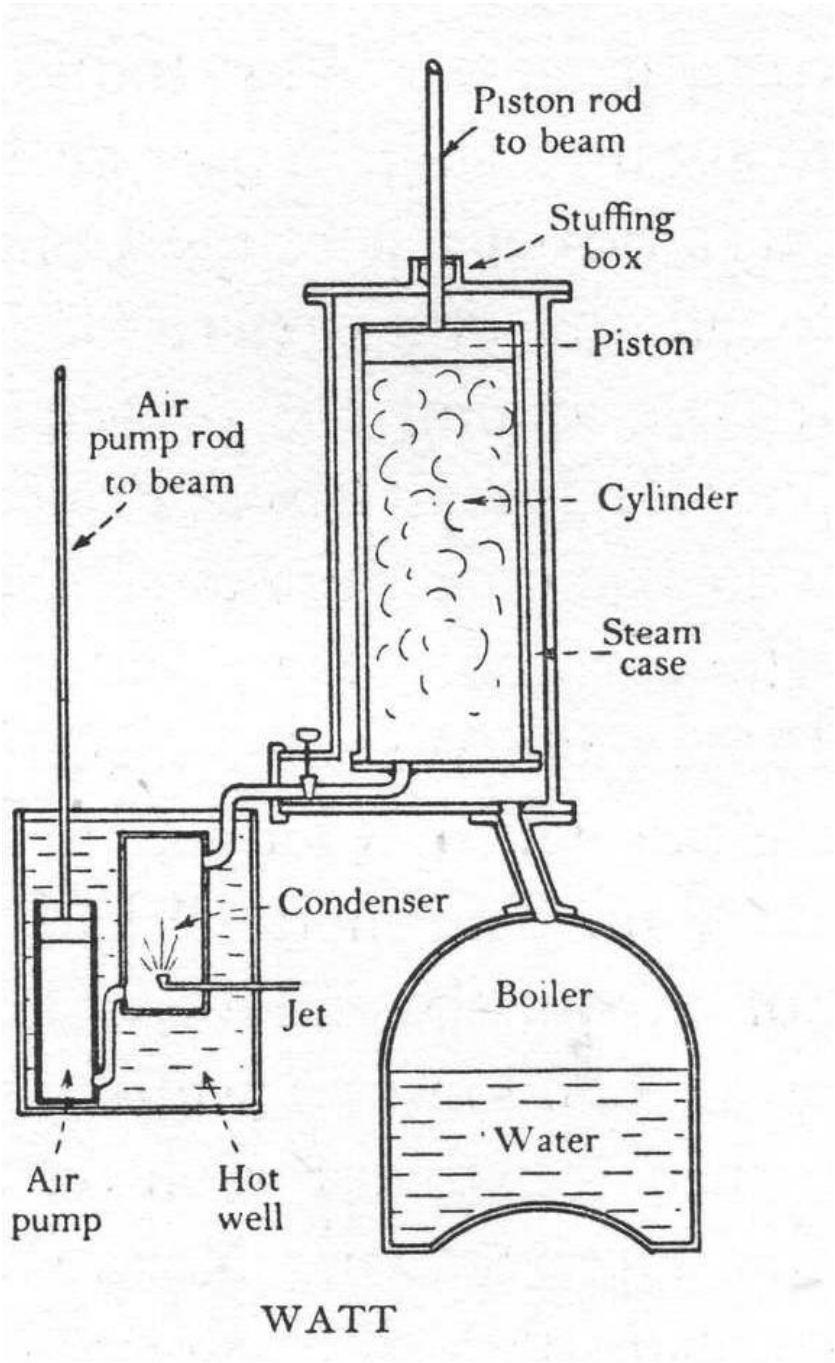
The ‘works’ of Cugnot’s engine

The Cugnot replica passes the Trevithick Society tent at Chitenay, July 2014

‘Historic’ meeting of the two replicas

The name of James Watt will always be associated with the steam engine.

But not the steam engine as we know it.



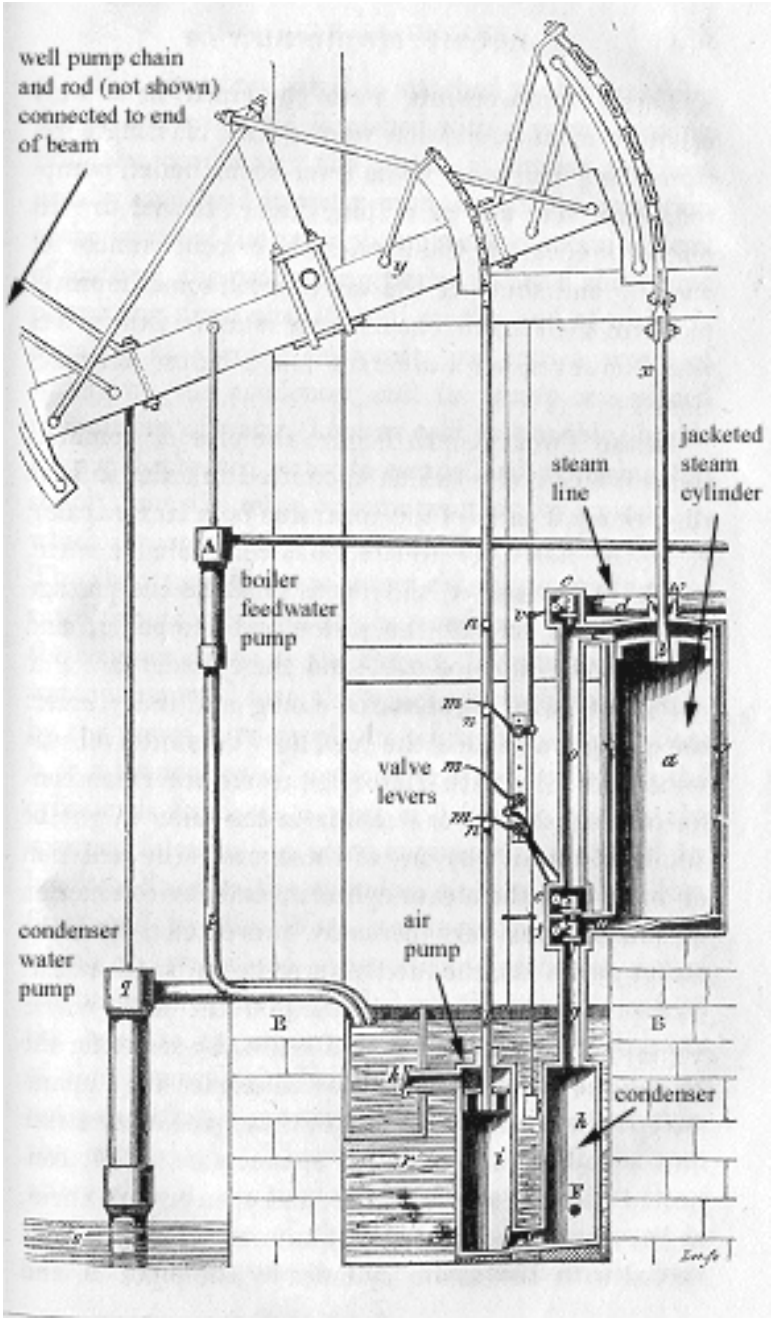
James Watt

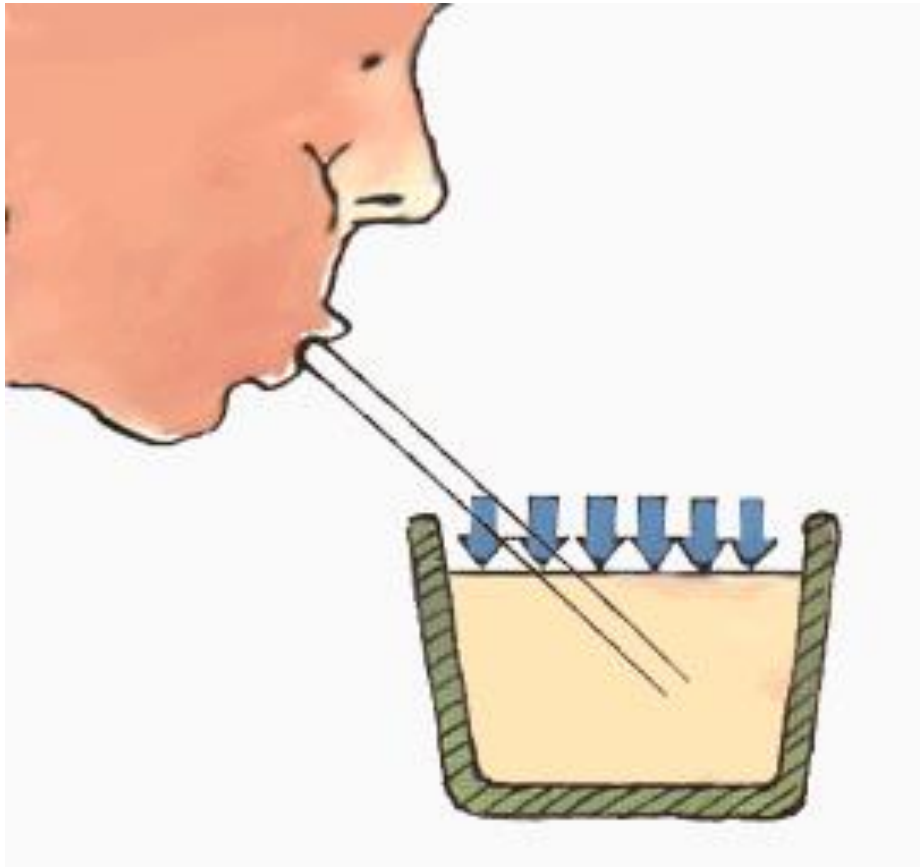
1736-1819

Greenock,
Renfrewshire

- **James Watt's engine used a separate condenser to reduce the steam to water.**

- **This reduced the considerable heat loss from the piston and cylinder.**





The power of a Newcomen or Watt engine is limited to atmospheric pressure,
1 bar or 14.7 lbs/sq”
at sea level

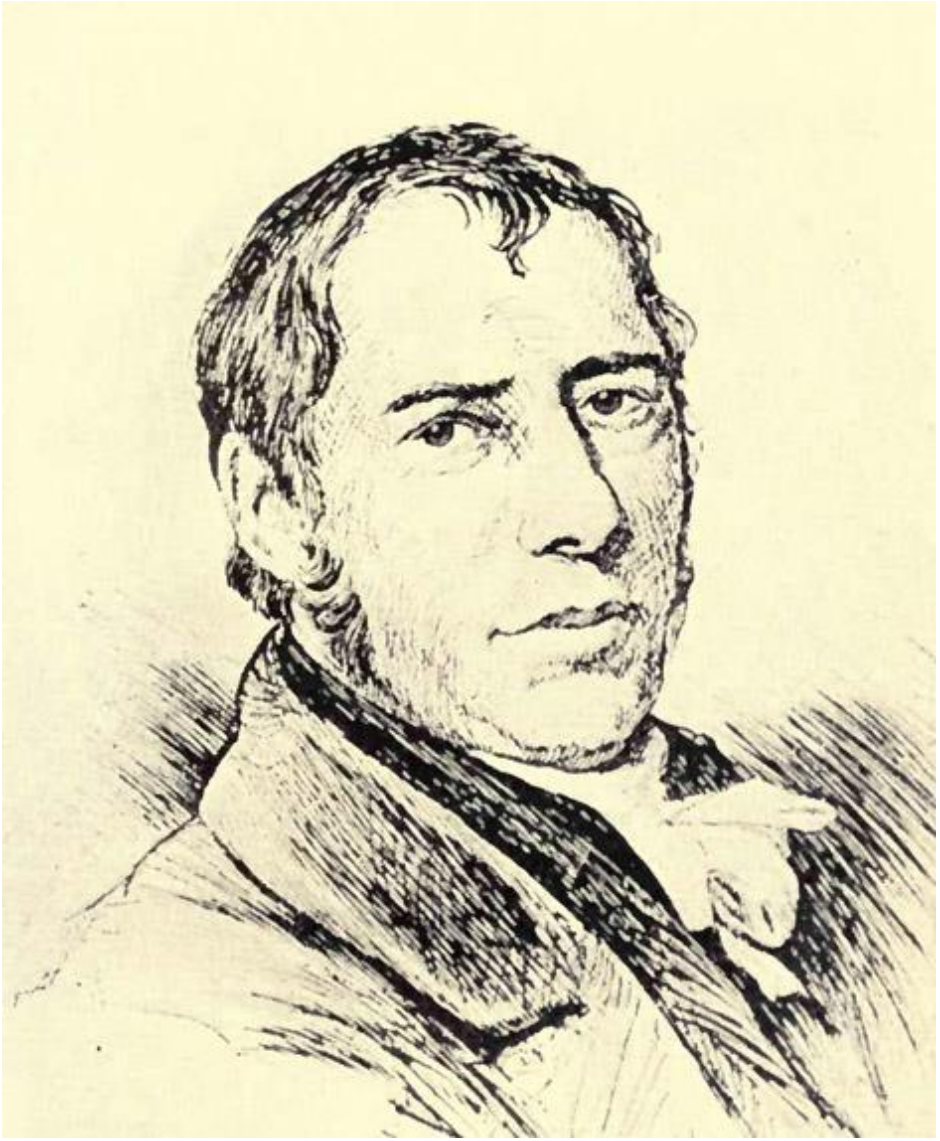
It was terminal technology

Matthew Boulton

1728 - 1809

‘selling what all the world desires’

And then, along came young Richard Trevithick, 1771 - 1833



Richard Trevithick

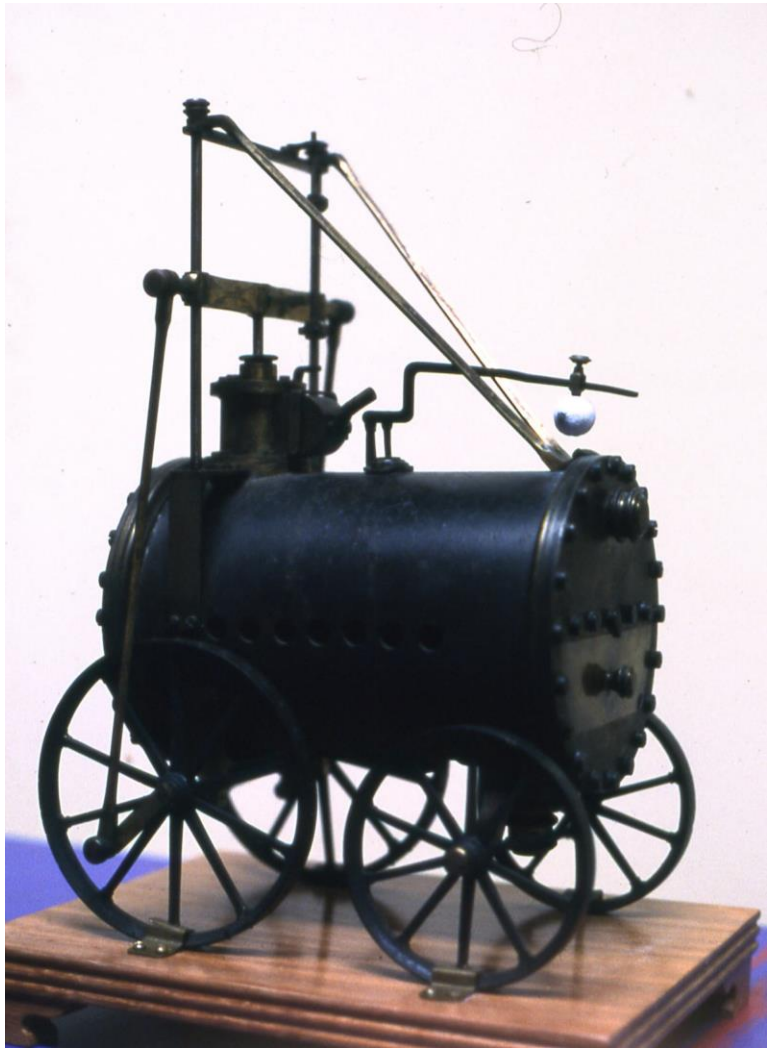
Man & machine

(1771-1833)

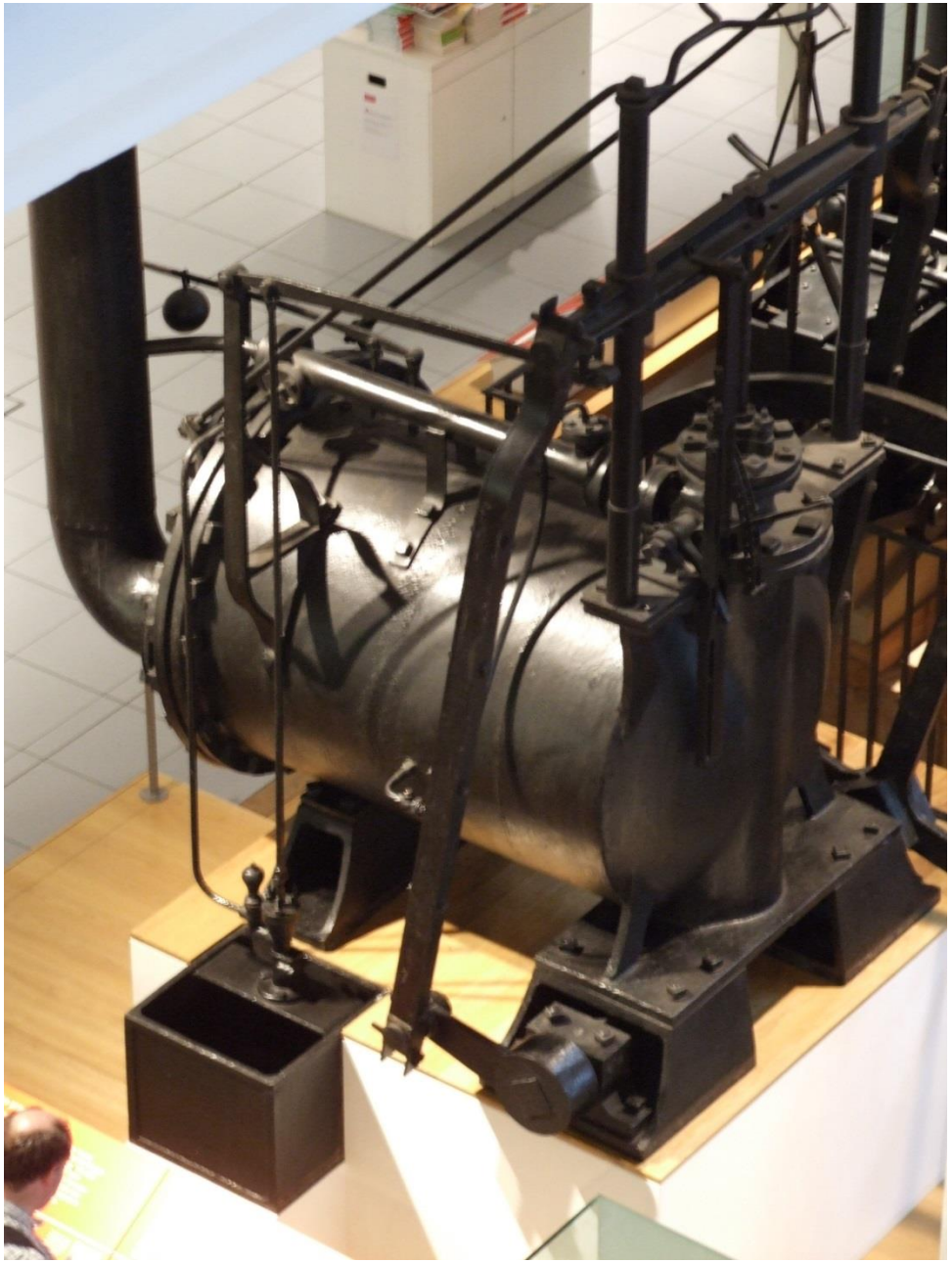
He harnessed the power of high pressure steam for transport and industry.

Who was he?

This model was made by William West, brother–in-law to Trevithick's wife Jane, in about 1797. It proved Trevithick's ideas of high pressure steam and self-propelled locomotion.



Trevithick model of 1790s, now in the Guinness Collection, Dublin



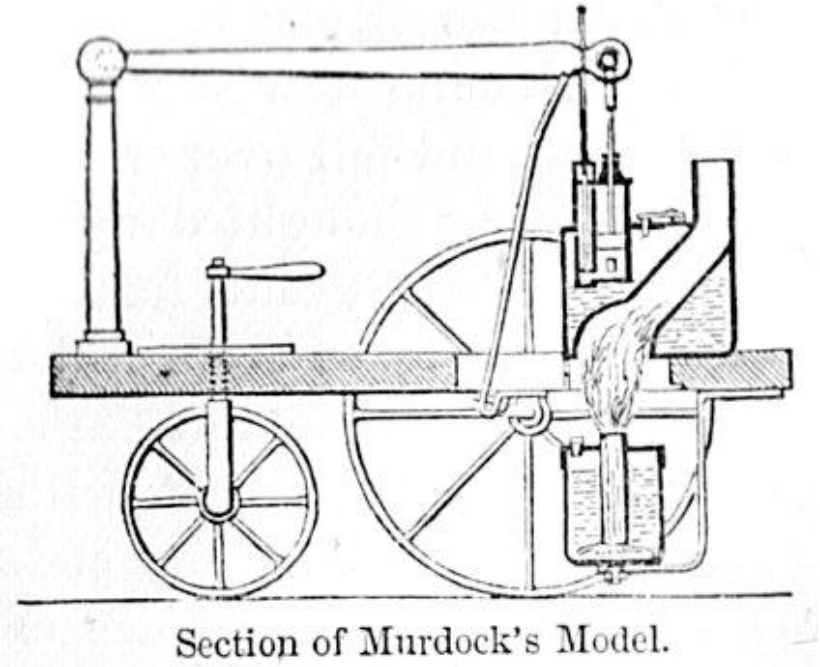
Hazeldine's 1806 Trevithick 'puffer' industrial engine

The Science Museum, Kensington

"Of course, the steam engine were invented by a Cornishman called Richard Tre-viv-ick"

Fred Dibnah, MBE

Nobody came to show him how to do it!



Section of Murdock's Model.

Did William Murdoch tell Trevithick his secrets?

NO!

We known from James Boswell's journal that Murdoch did not tell him about his locomotive or gas lighting, both of which existed when he called on him in 1792.

Let's look at pressure

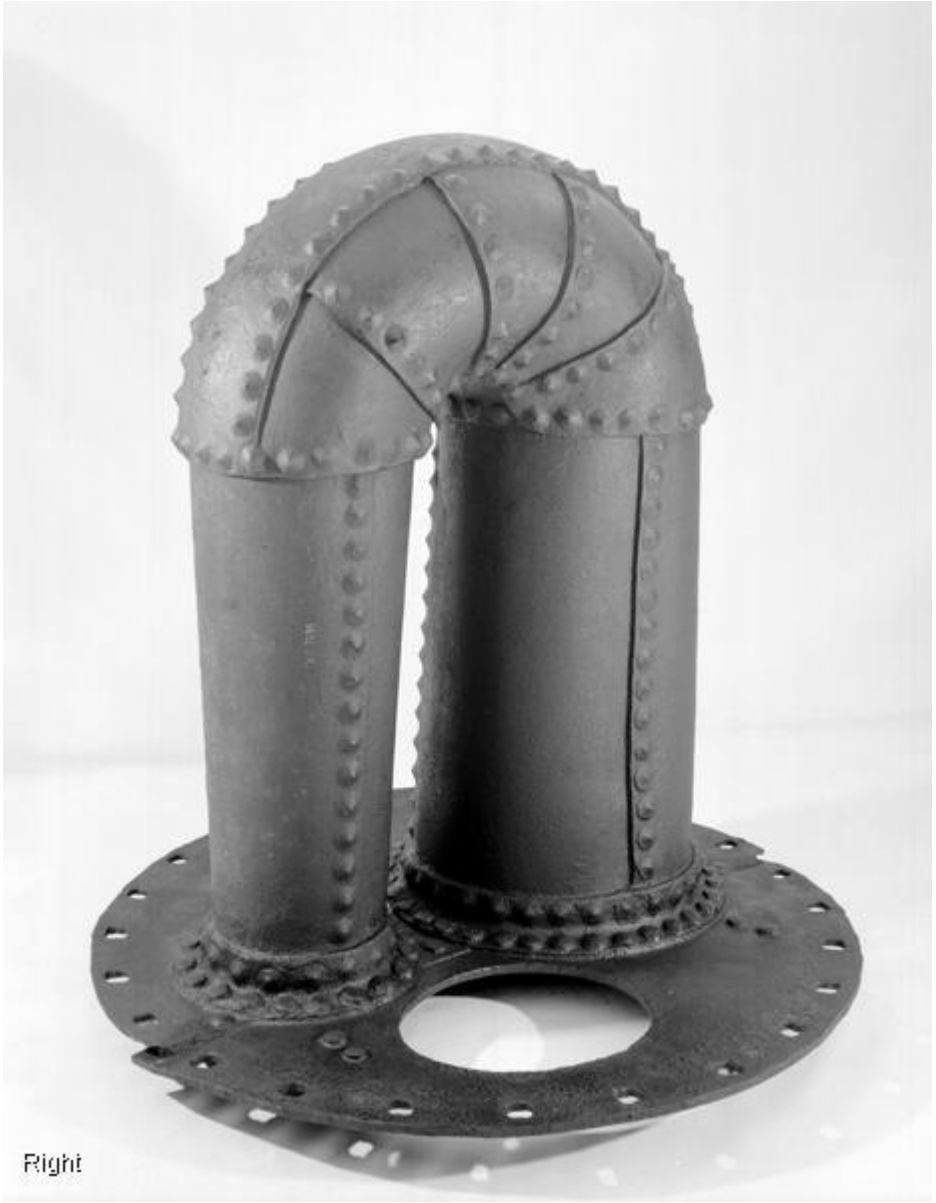
Watt's atmospheric engine, 3 lbs/sq"

Trevithick's 1801 locomotive 47 lbs/sq" (3.2 bar)

My household water system, including plastic pipes, 72.5 lbs/sq" (5 bar)

Domestic espresso machine, 217.5 lbs/sq" (15 bar)

'Flying Scotsman' 180 lbs/sq" (12 bar)



Engine made at Oak Farm Iron Works, Kingswinford

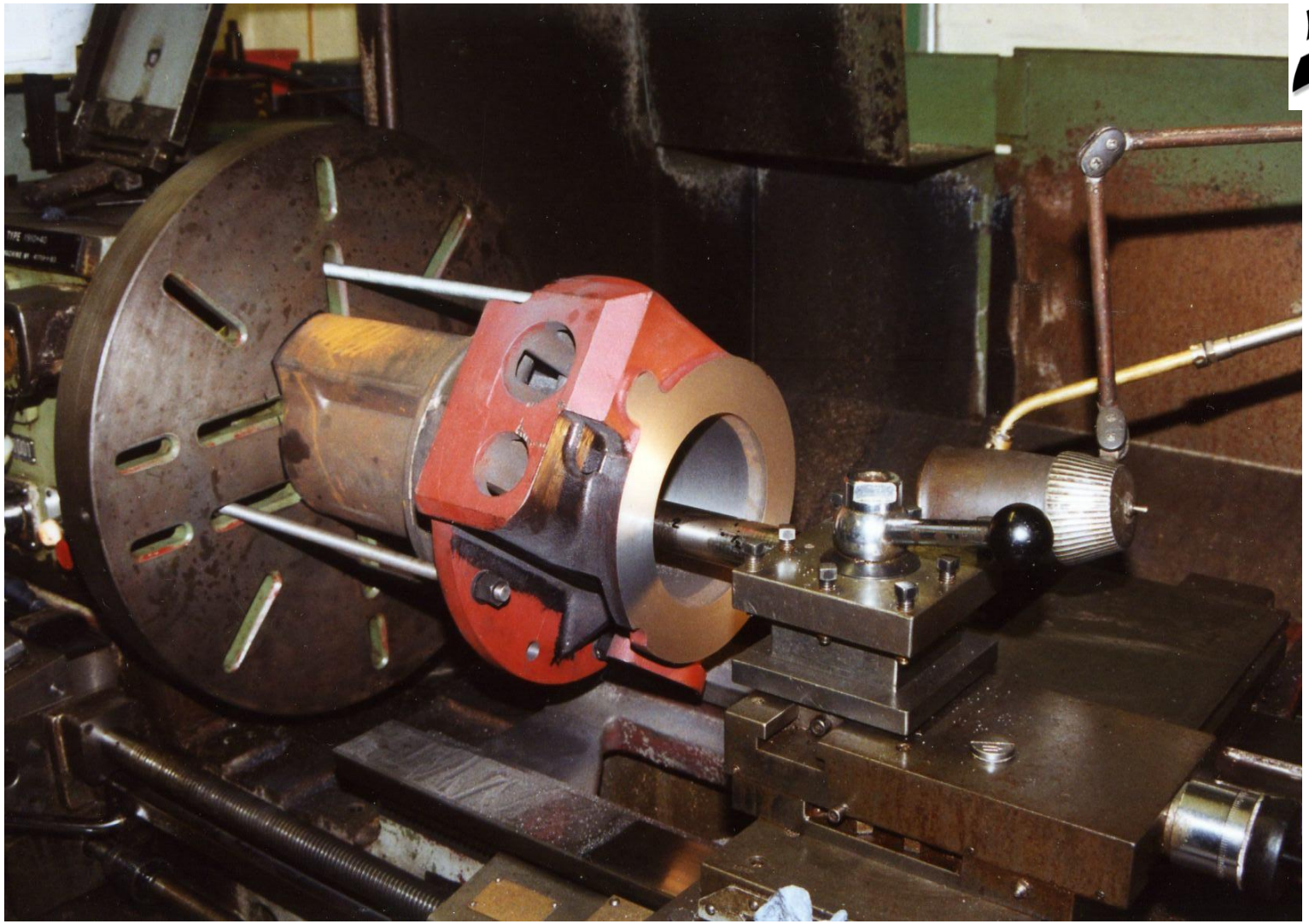
ScM Inv 1881-57
in store at Wroughton

E B Marten
Civil Engineer
Stourbridge
April 13 1881

Furnace tube at Deepdale Engineering Ltd

Completed boiler at
Deepdale Engineering Ltd

They are all real rivets

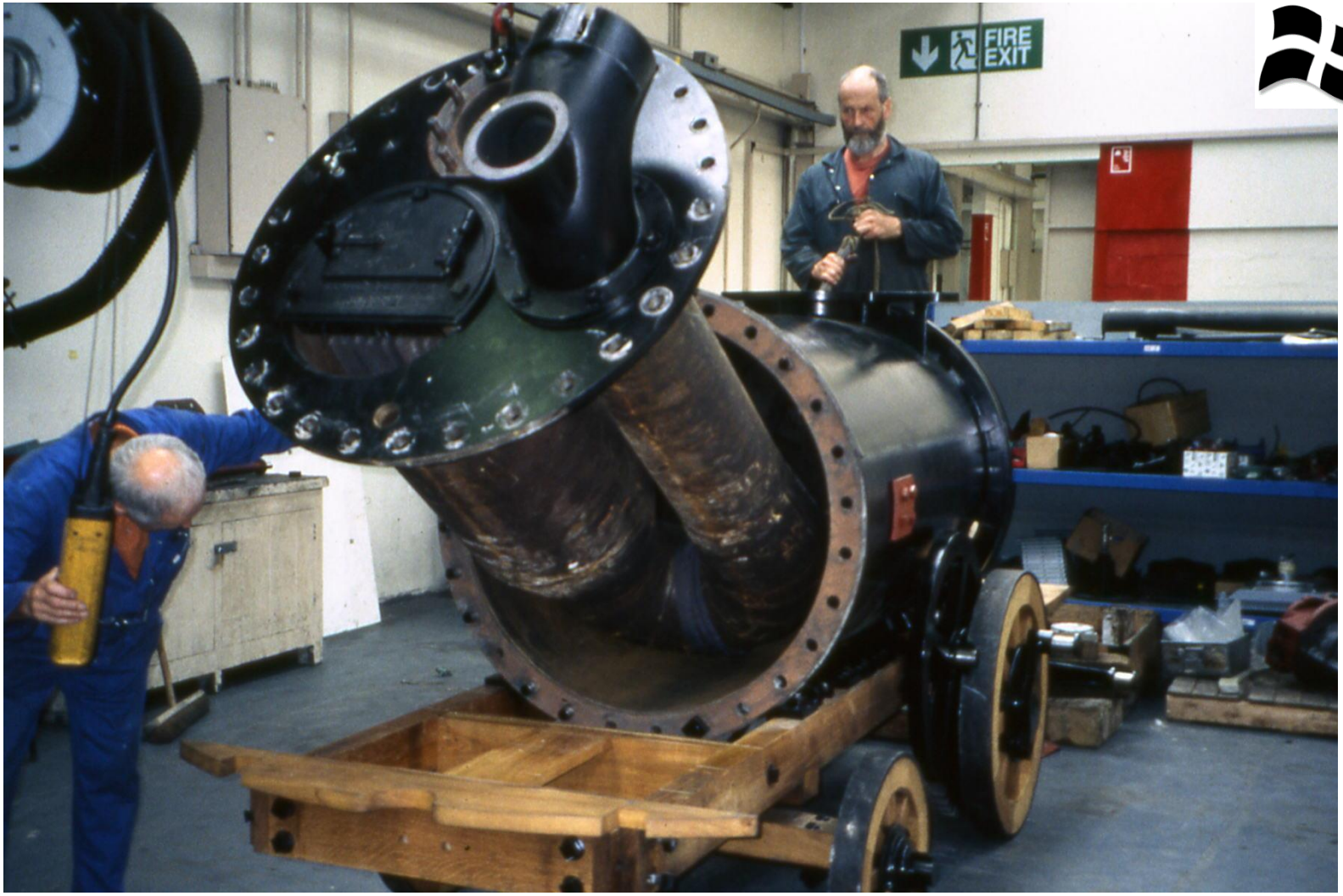


Machining the cylinder head

Four-way and inlet valve locations

John Sawle assembling the cylinder head And the wax piston lubricator

Arthur inserting the four-way valve



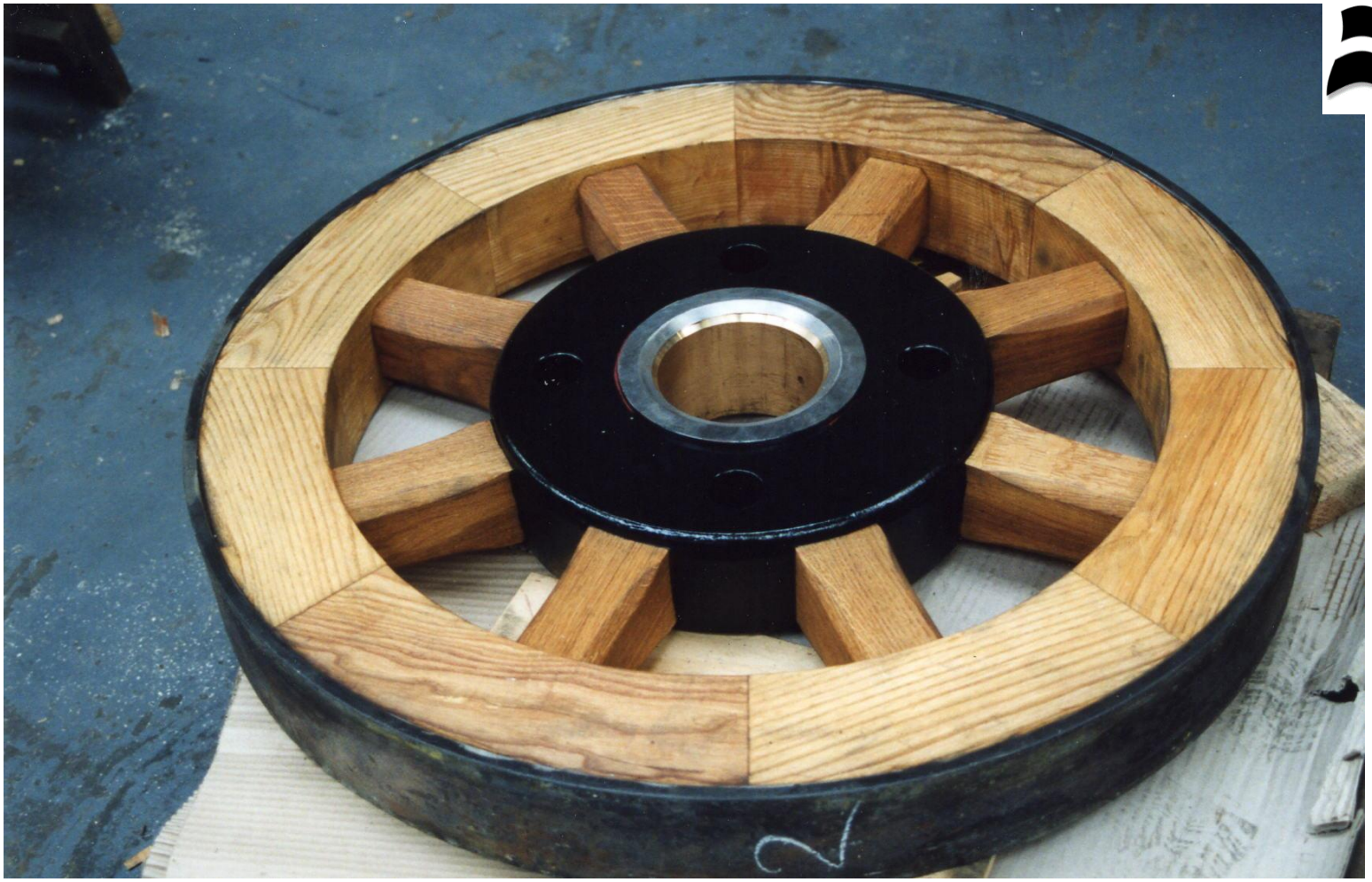
Lowering the fire tube into the boiler shell

"Don't worry, I'm enjoying it. It makes such a change from making b***** railings and gates all day!"

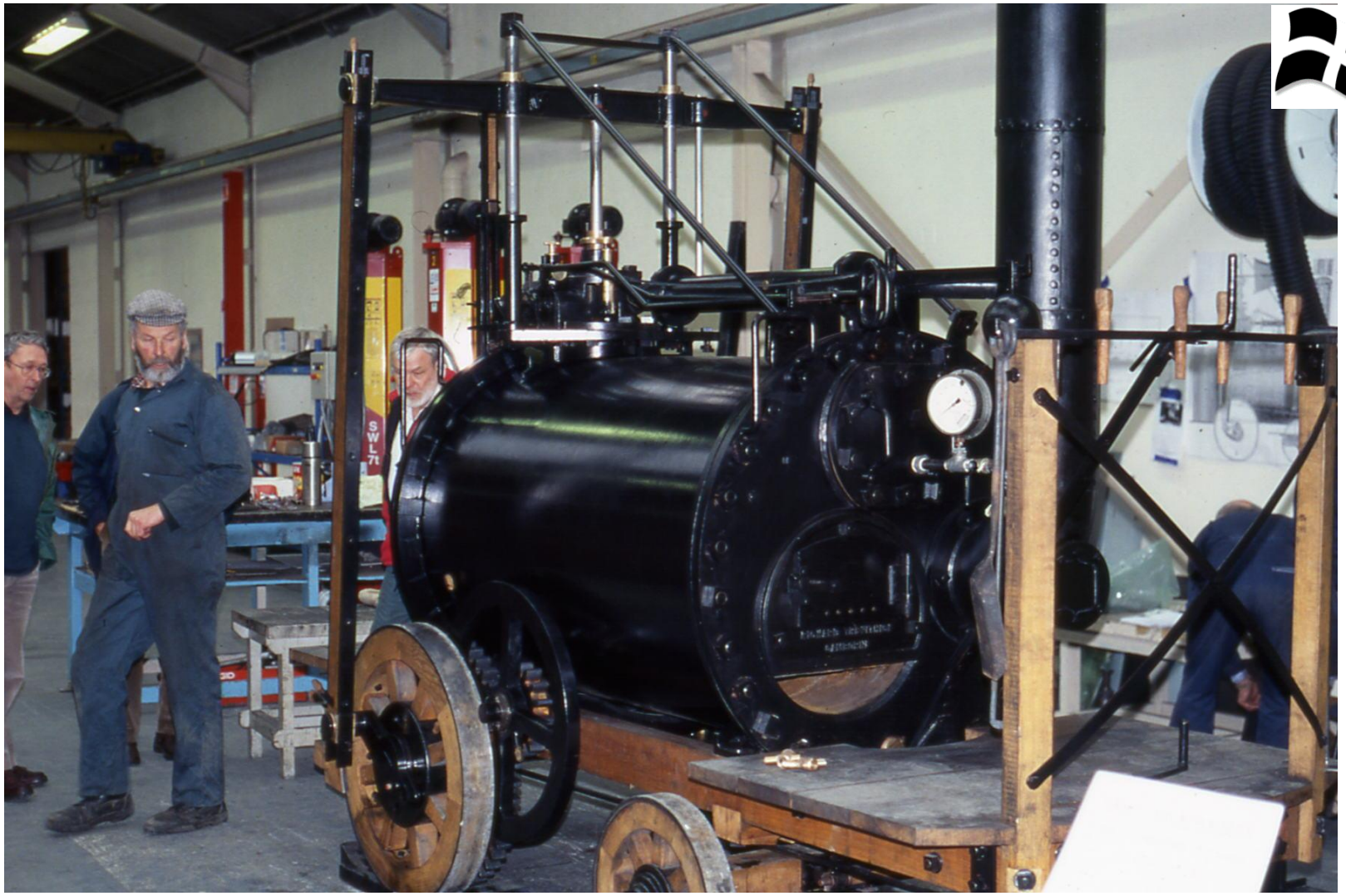
Placing the hot tyre on
the wooden wheel

Beating it down into place

Annealing the tyre



A completed wheel.
Oak spokes and ash fellies. Weight 2 cwt



First run-up of engine using compressed air

Ted Pritchard
from
Melbourne,
Australia

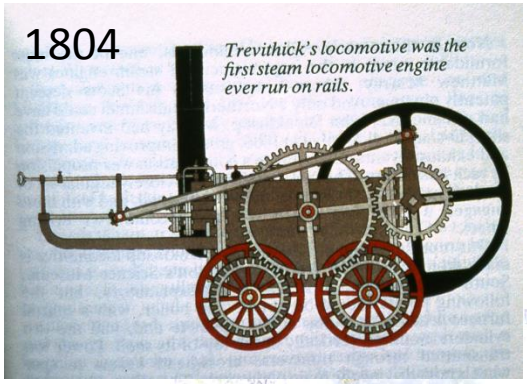
First outing

A 200 year long trip to Tehidy Mansion

It’s very popular in Camborne

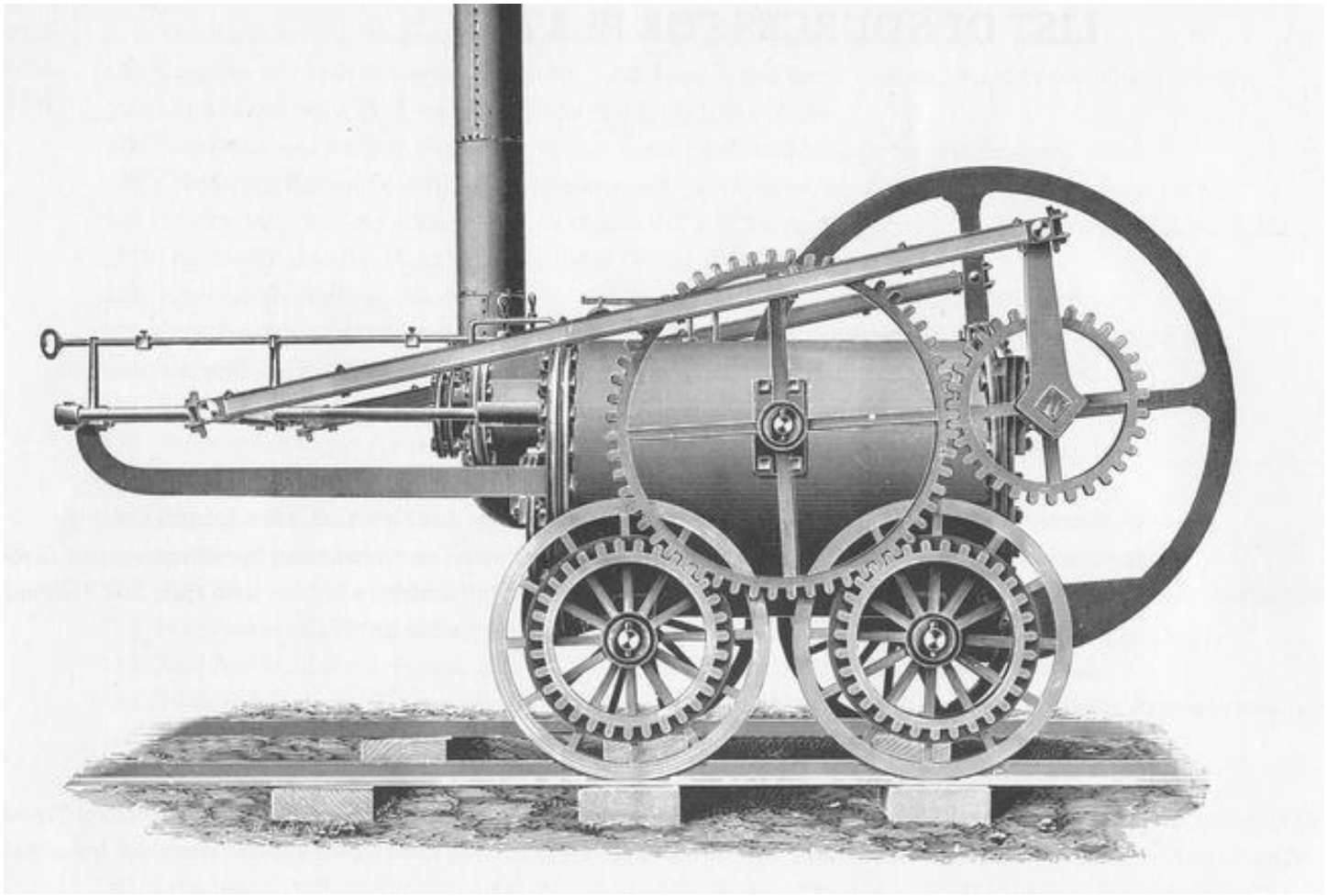
‘Going up Camborne Hill’ 2001

We entertain and that’s a lot of fun!



Trevithick encountered opposition wherever he sought support from authority or the public. Fortunately, he had a sympathetic father-in-law and engineering compatriots who saw the advantages in his ideas.

Trevithick’s 1803 London Carriage,
the first self-propelled London bus



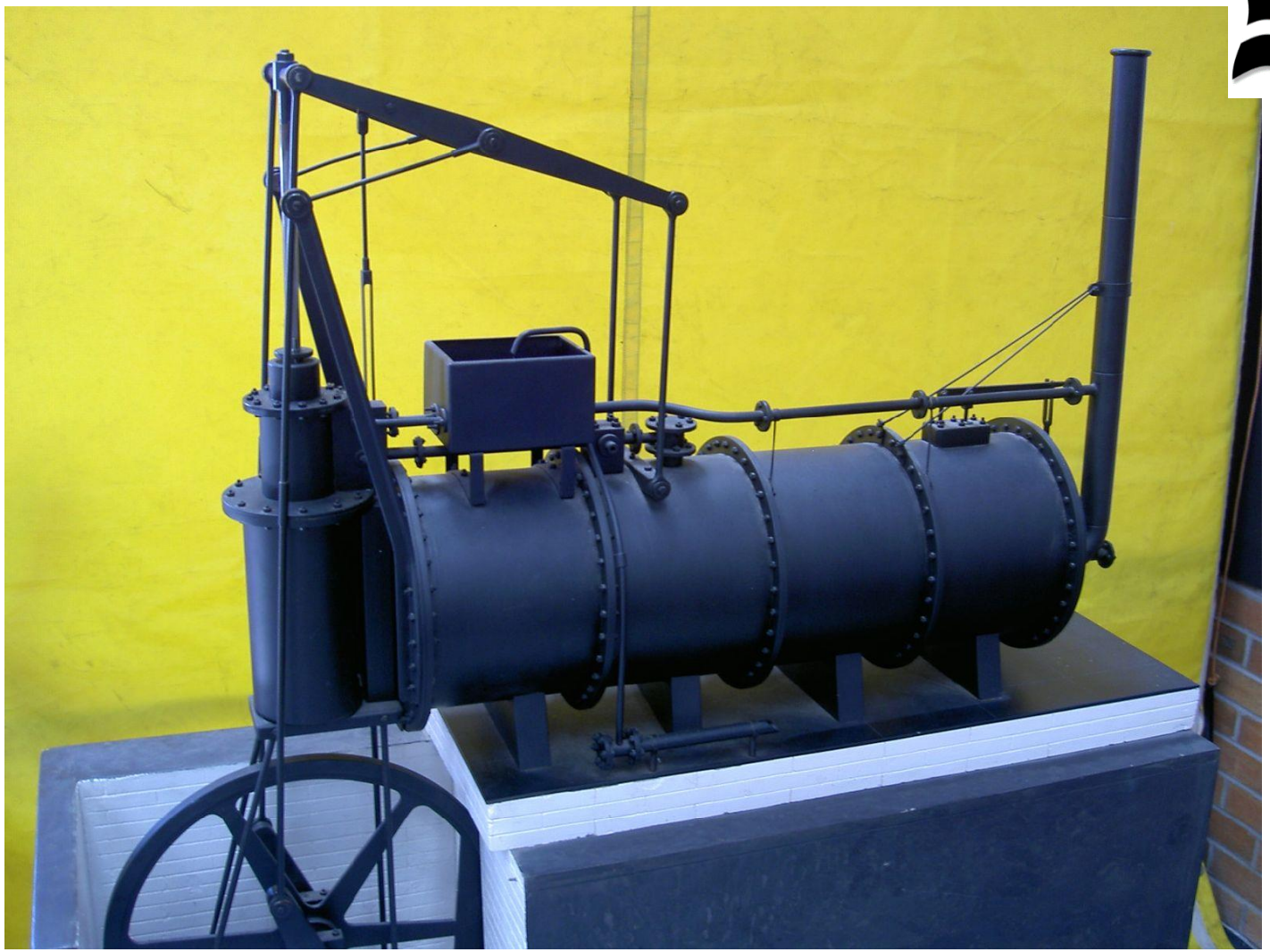
1804. 9½ miles from Penydarren to Abercynon, the world's first steam railway journey

T. Cuneo

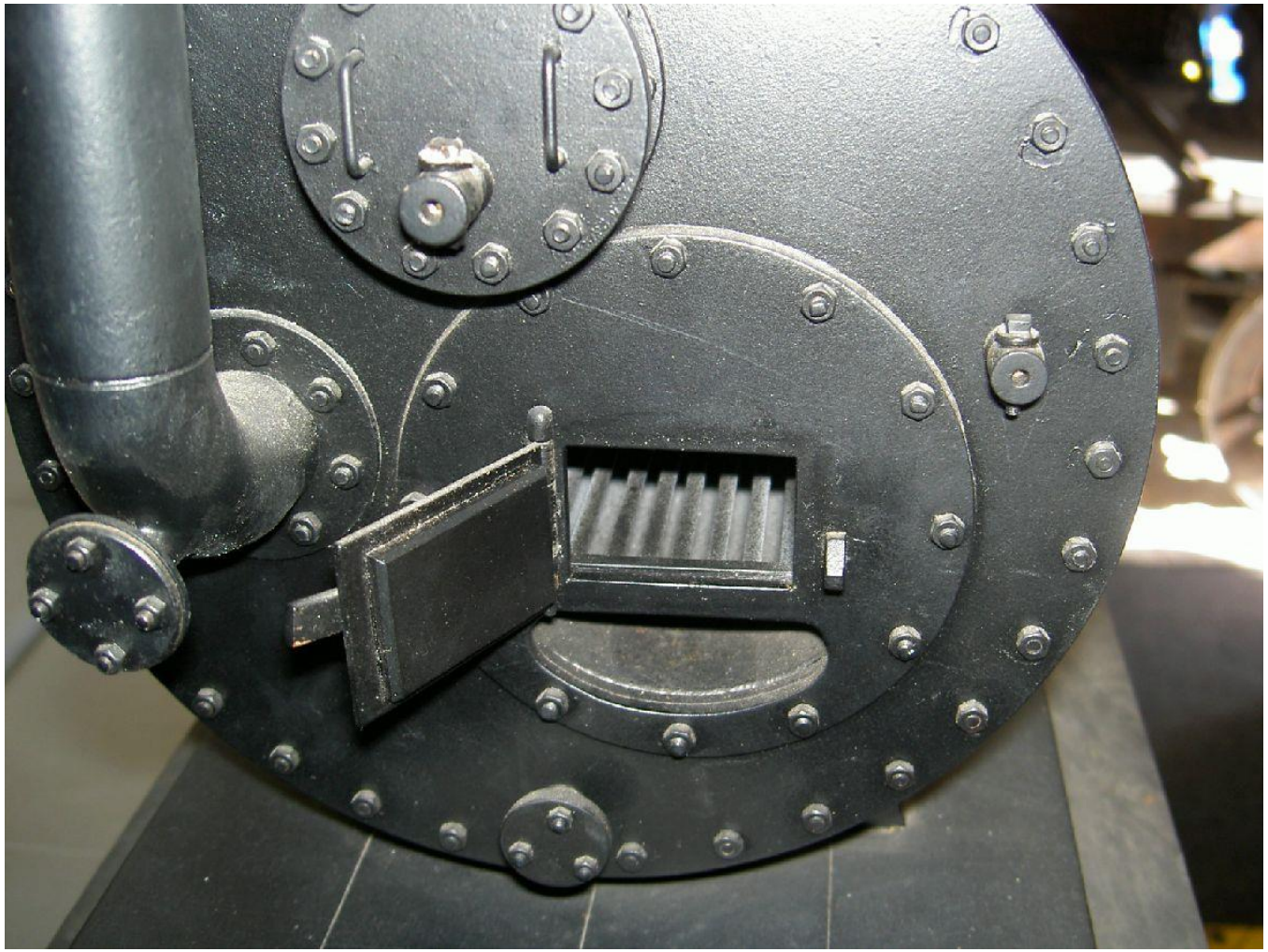
We don’t know what happened to the wager but are certain that Trevithick saw very little of it.

Two pound coin struck by the Royal Mint in 2004 to commemorate the world's first railway journey

Discovering a model of the Trevithick Tredegar engine at Penydarren, 2004



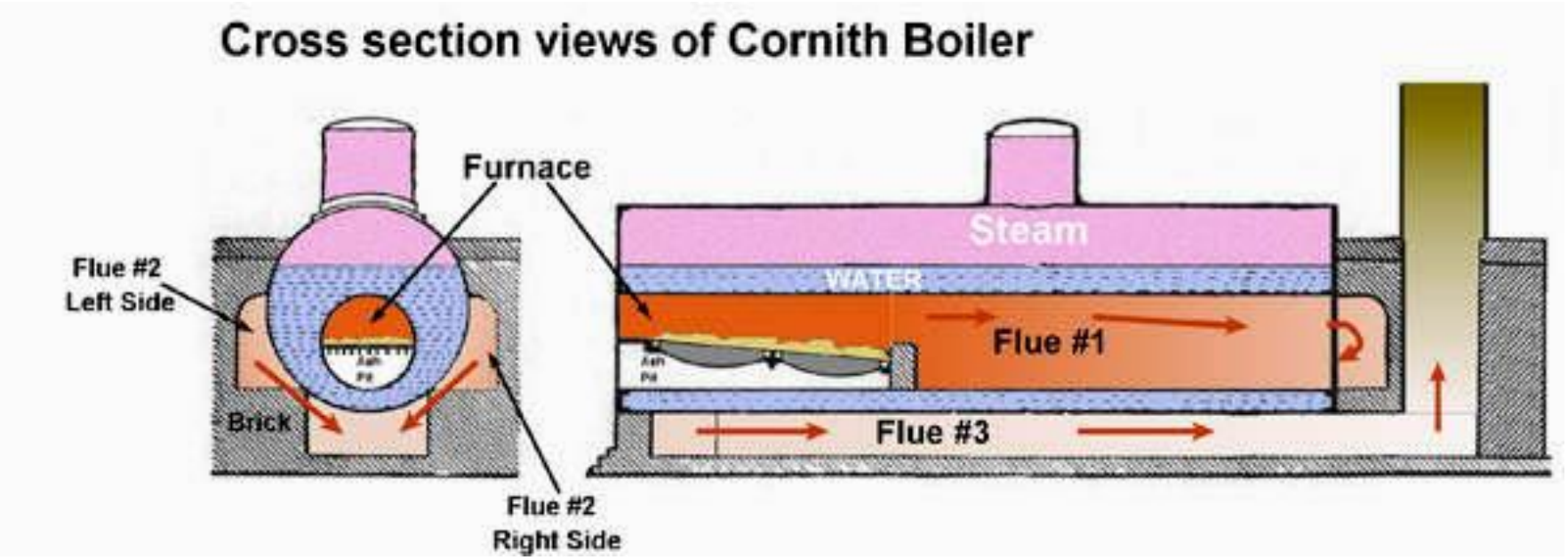
Typical early 1800s Trevithick engine with Cornish boiler



Typical Trevithick furnace arrangement

An imaginary drawing of the 1808 railway after the style of Thomas Rowlandson.

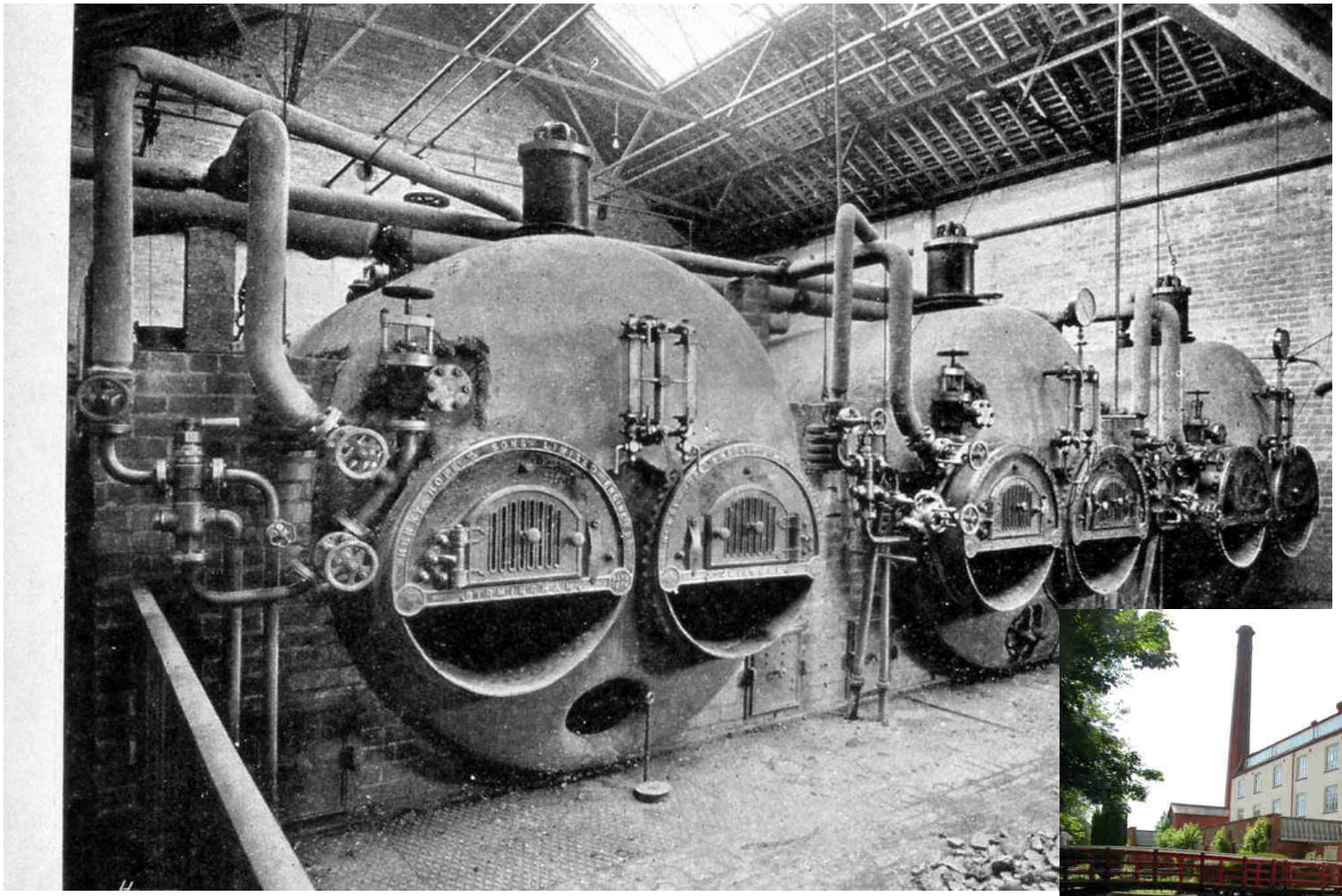
Replica of
‘Catch-me-who-can’
built at the Severn
Railway workshops
Bridgnorth



Note the spelling!

The Cornish boiler looks a simple thing nowadays but it made a significant contribution to C19th industry

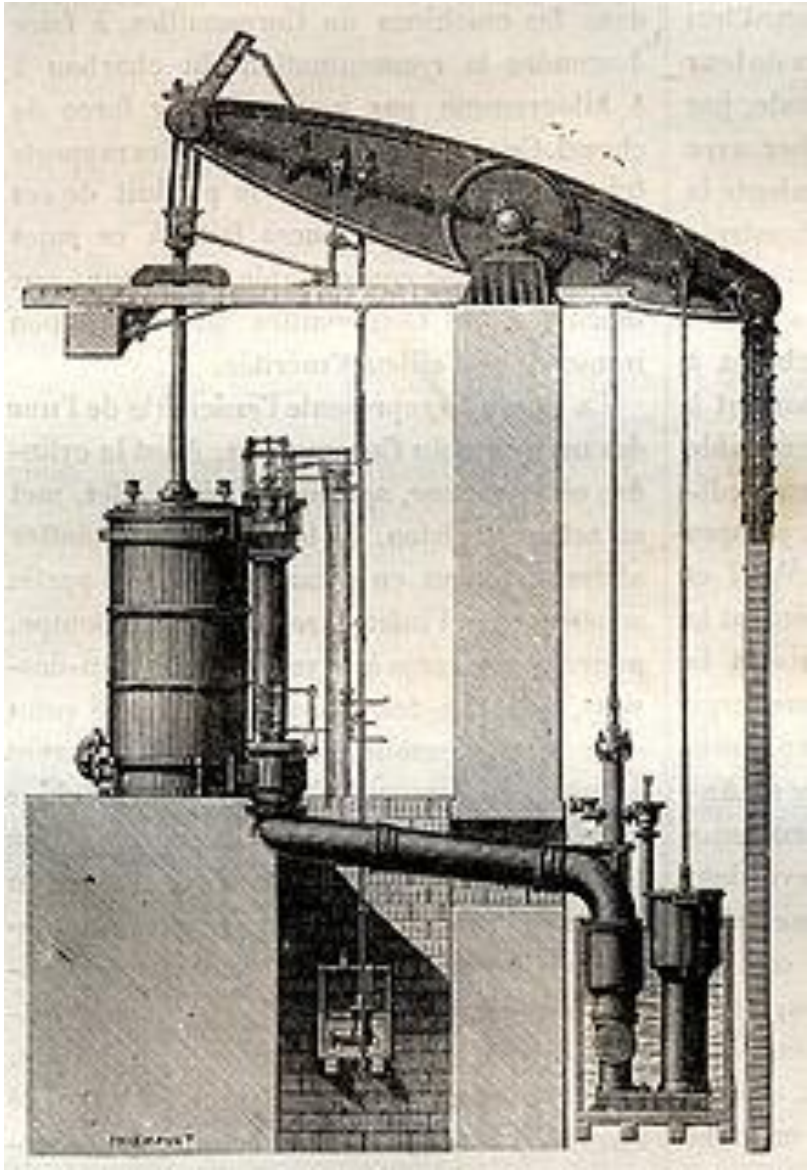
Many still exist



Double Cornish boilers

Coldharbour woollen mills Uffculme, Devon

We sent Cornish boilers all over the world



Cornish pumping engine

Cornish engine houses in Moonta, Australia, Okiep, South Africa and Kawau, NZ

Arltunga

110 kms east of Alice Springs

How did they get the boiler there?

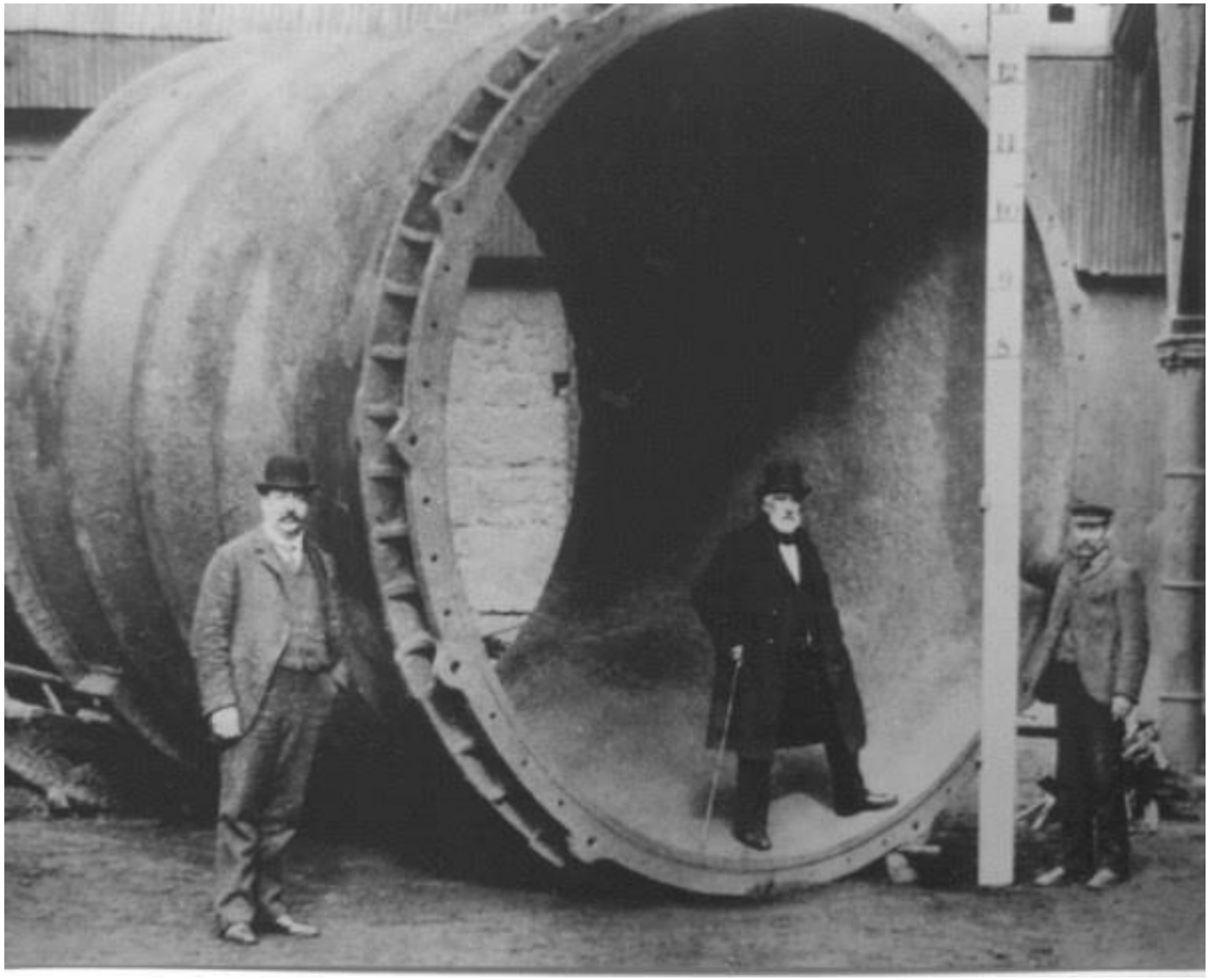
Arltunga was officially central Australia's first town, born out of a gold rush after alluvial gold was discovered in a dry creekbed in 1887.
Fortune seekers had to travel 600km from the Oodnadatta railhead, often on foot.

100”
Cornish pumping engine built by Harveys of Hayle at Kew Steam Museum
1871

Pumped 10,000,000 gallons a day ‘til
1956

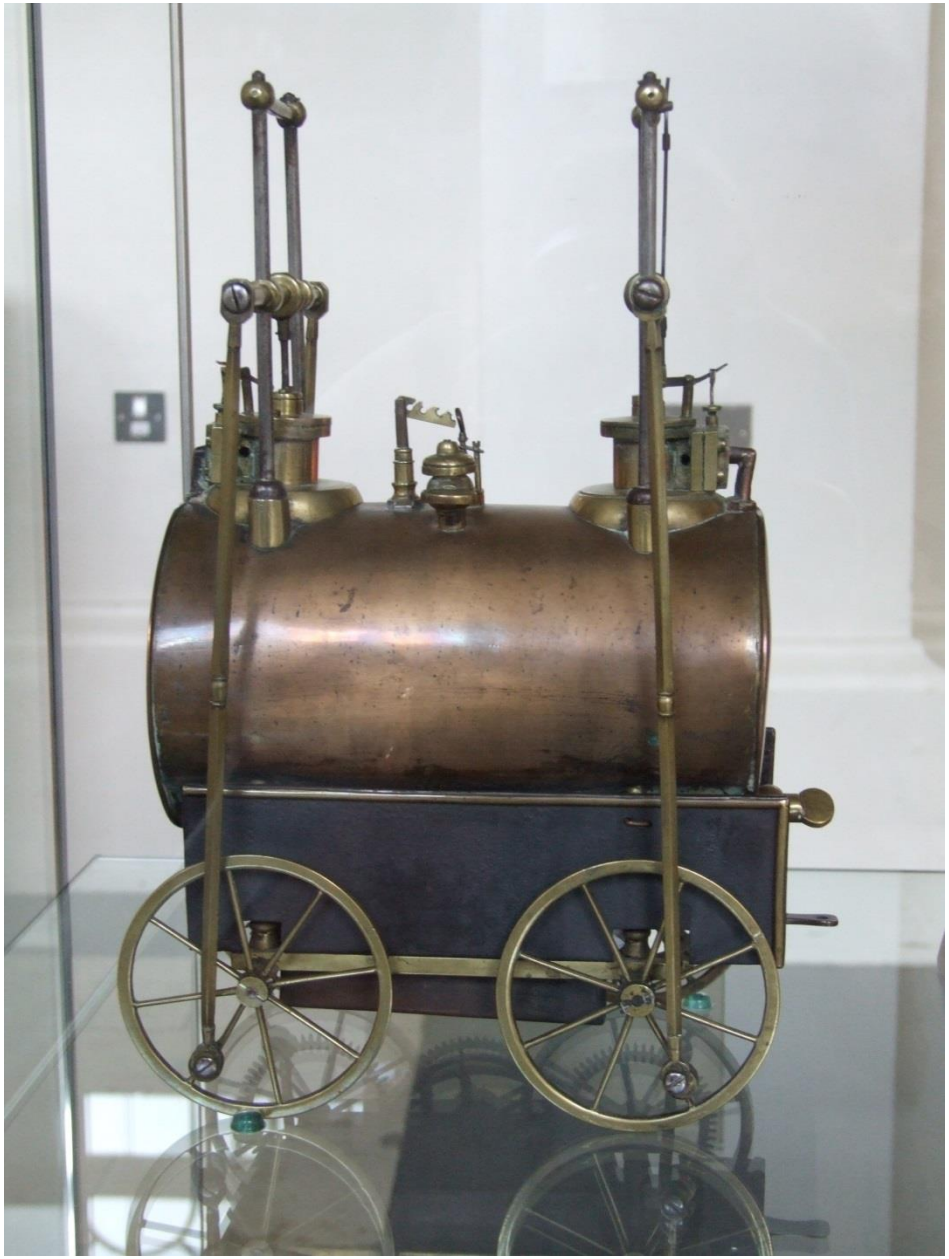
The largest steam engine in America is the Cornish engine at Iron Mountain, Michigan

What did we make in Cornwall?



144” steam cylinder cast at Harvey’s of Hayle for …

… one of the Cruquius pumping stations in The Netherlands

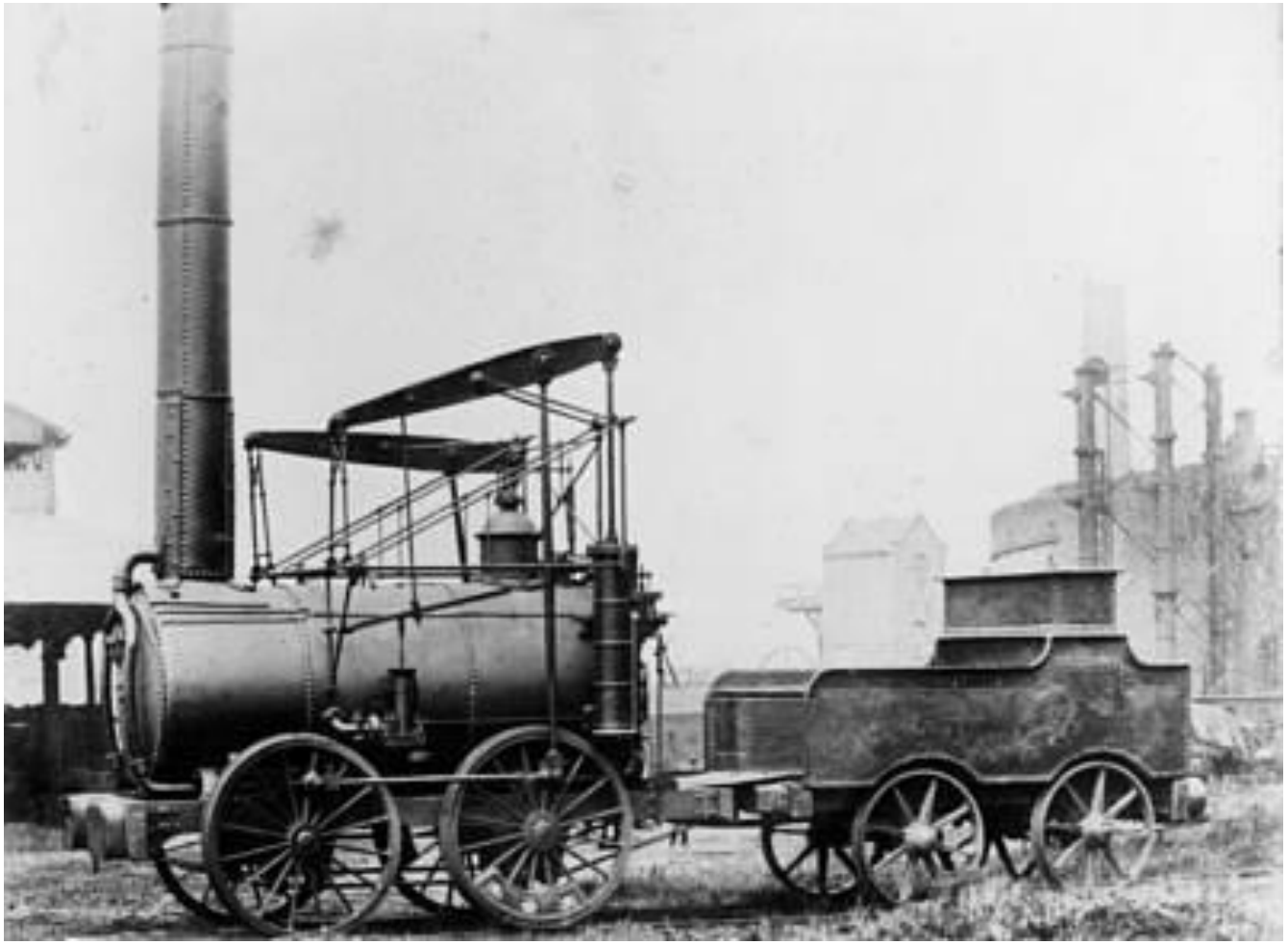


Locomotive
Sans Pareil

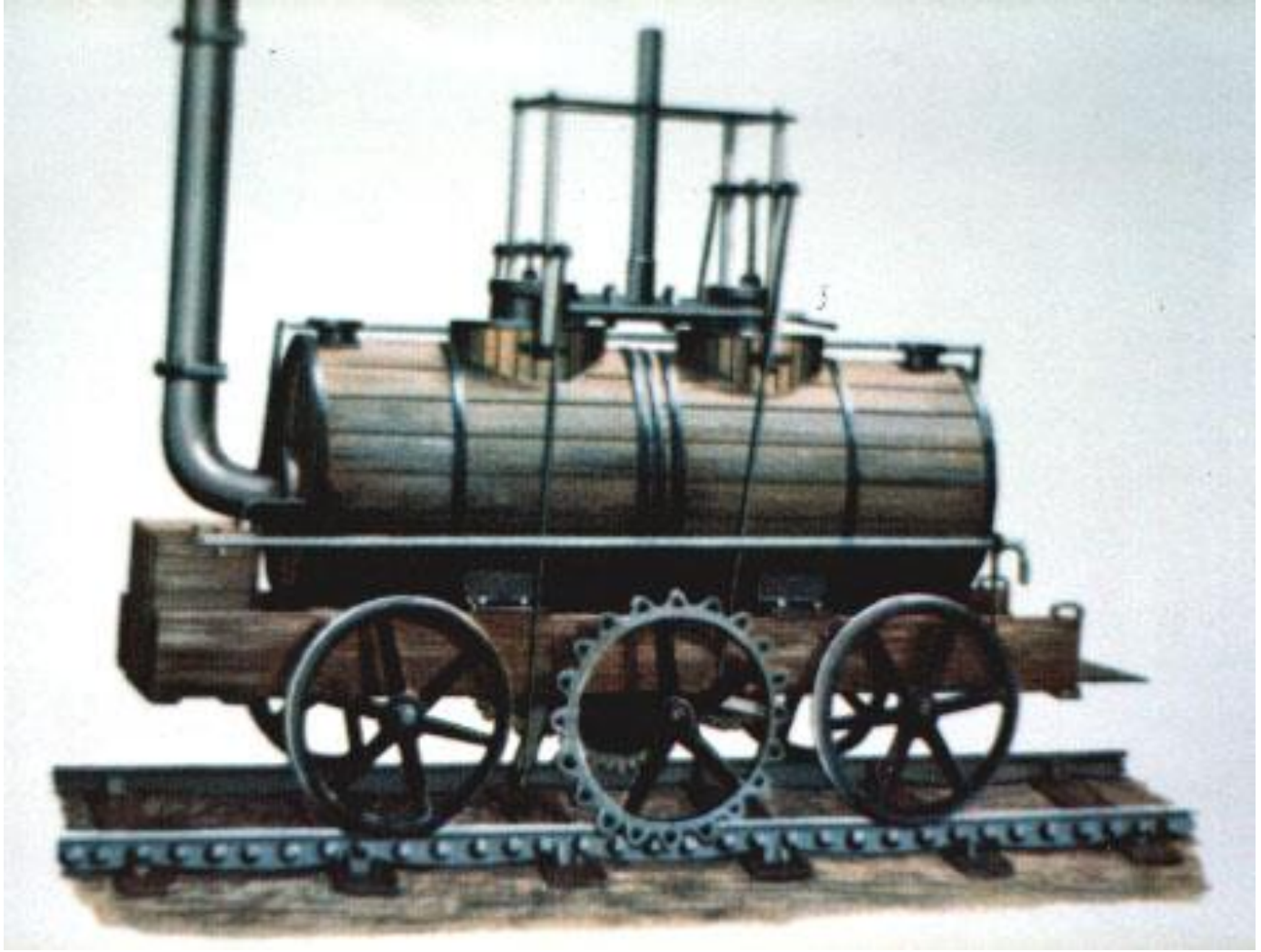
Period 1809 – 1814

Experimental Trevithick-type, twin cylinder model locomotive possibly connected to Timothy Hackworth and Wylam Colliery

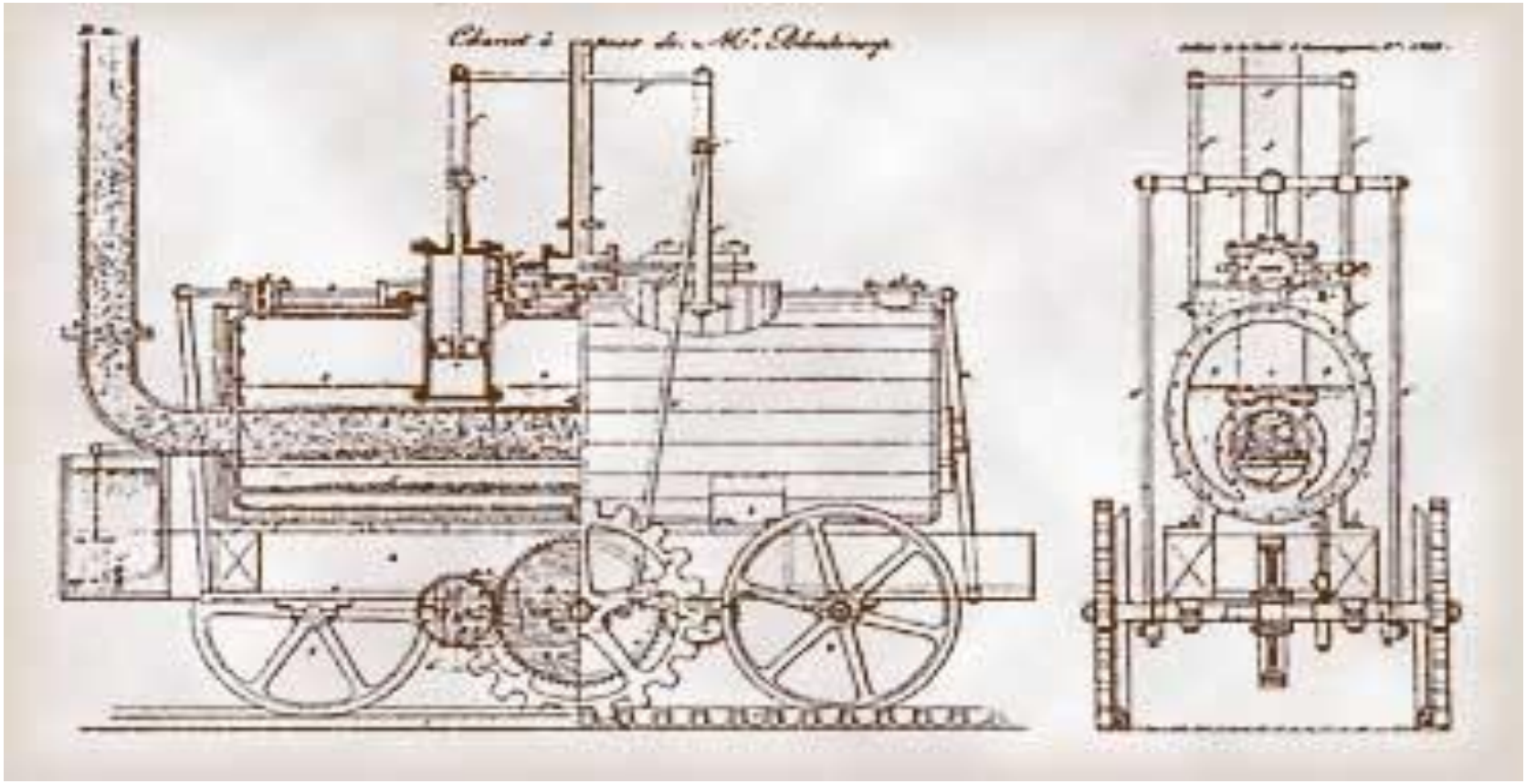
Stourbridge Lion, a Rastrick locomotive shipped to the U.S. in 1828



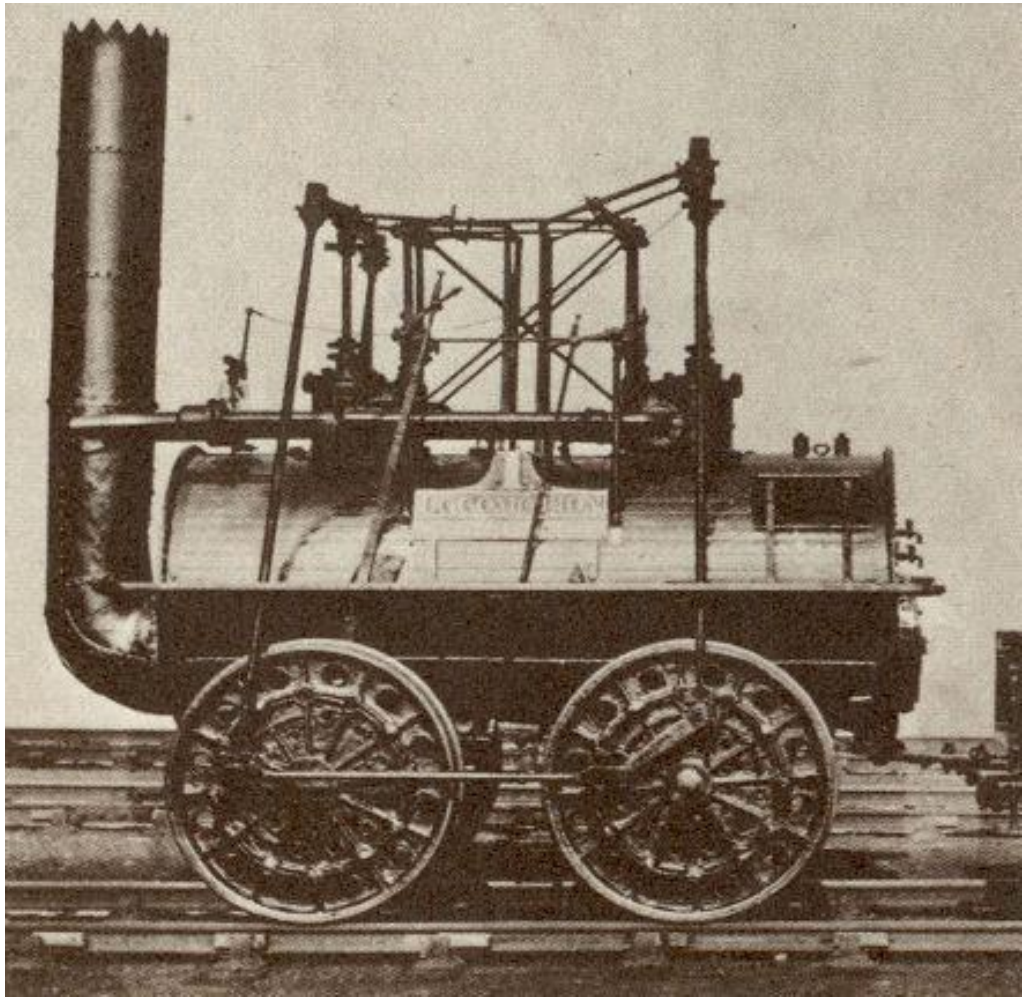
Agenoria, built by Rastrick at Stourbridge, 1829



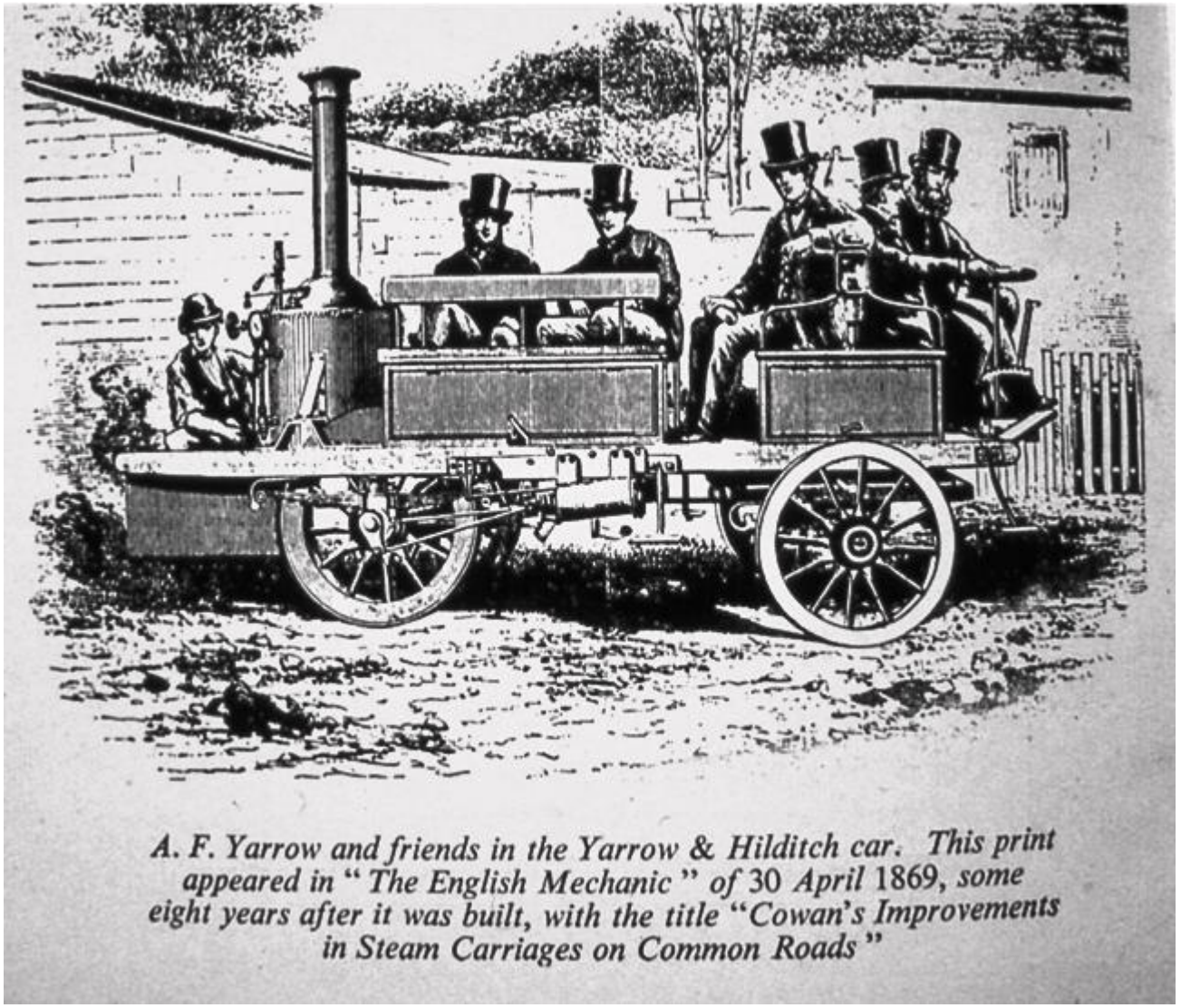
Blenkinsop's Middleton Colliery engine of 1812 built by Matthew Murray of Leeds. George Stephenson of Killingworth Colliery examined the engine.



Murray built several engines that were exported to Germany, Belgium and Russia. He paid a Royalty of £30 to Trevithick for each of the engines built.



George Stephenson’s *Locomotion 1* 1825

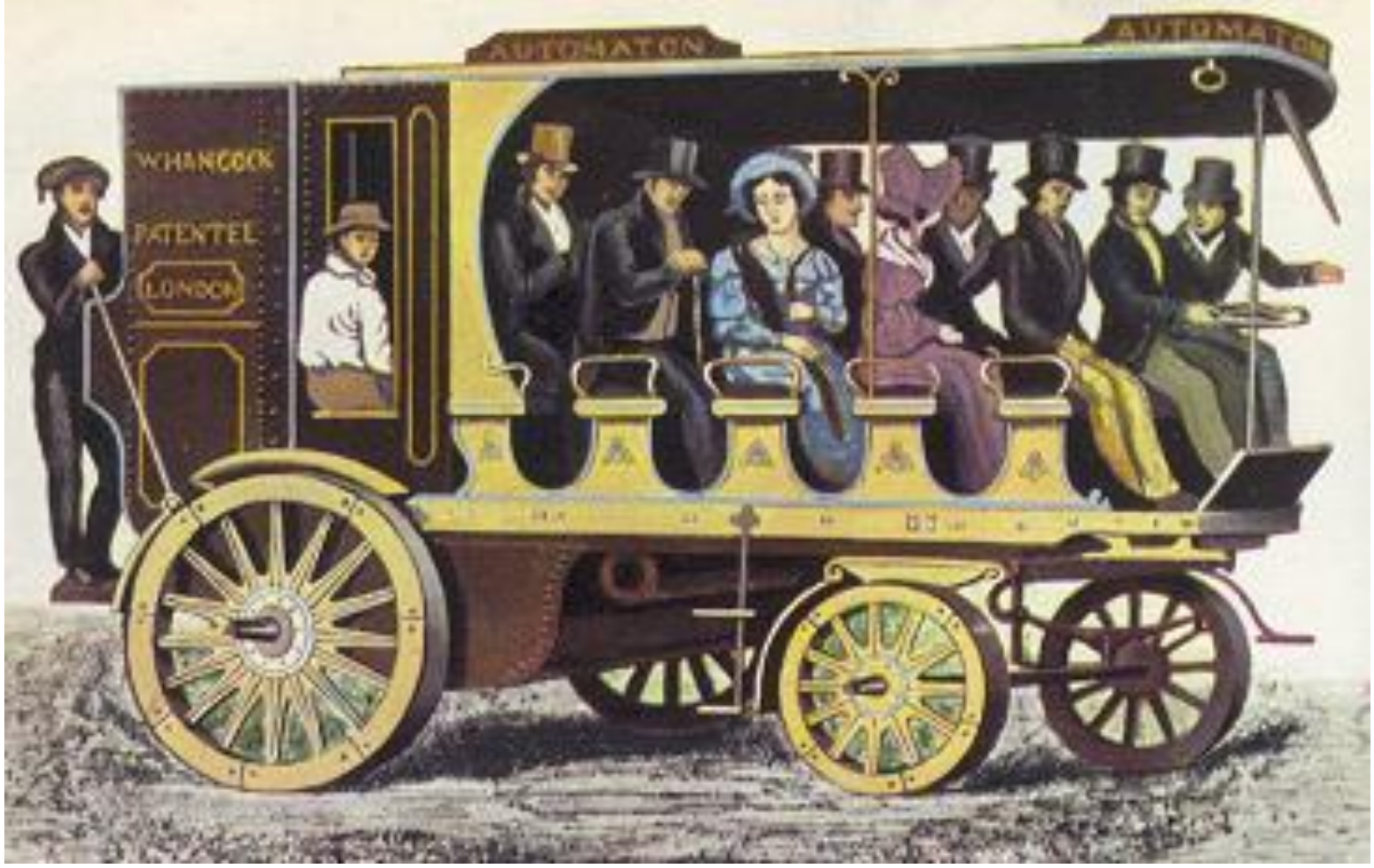


A. F. Yarrow and friends in the Yarrow & Hilditch car. This print appeared in "The English Mechanic" of 30 April 1869, some eight years after it was built, with the title "Cowan's Improvements in Steam Carriages on Common Roads"

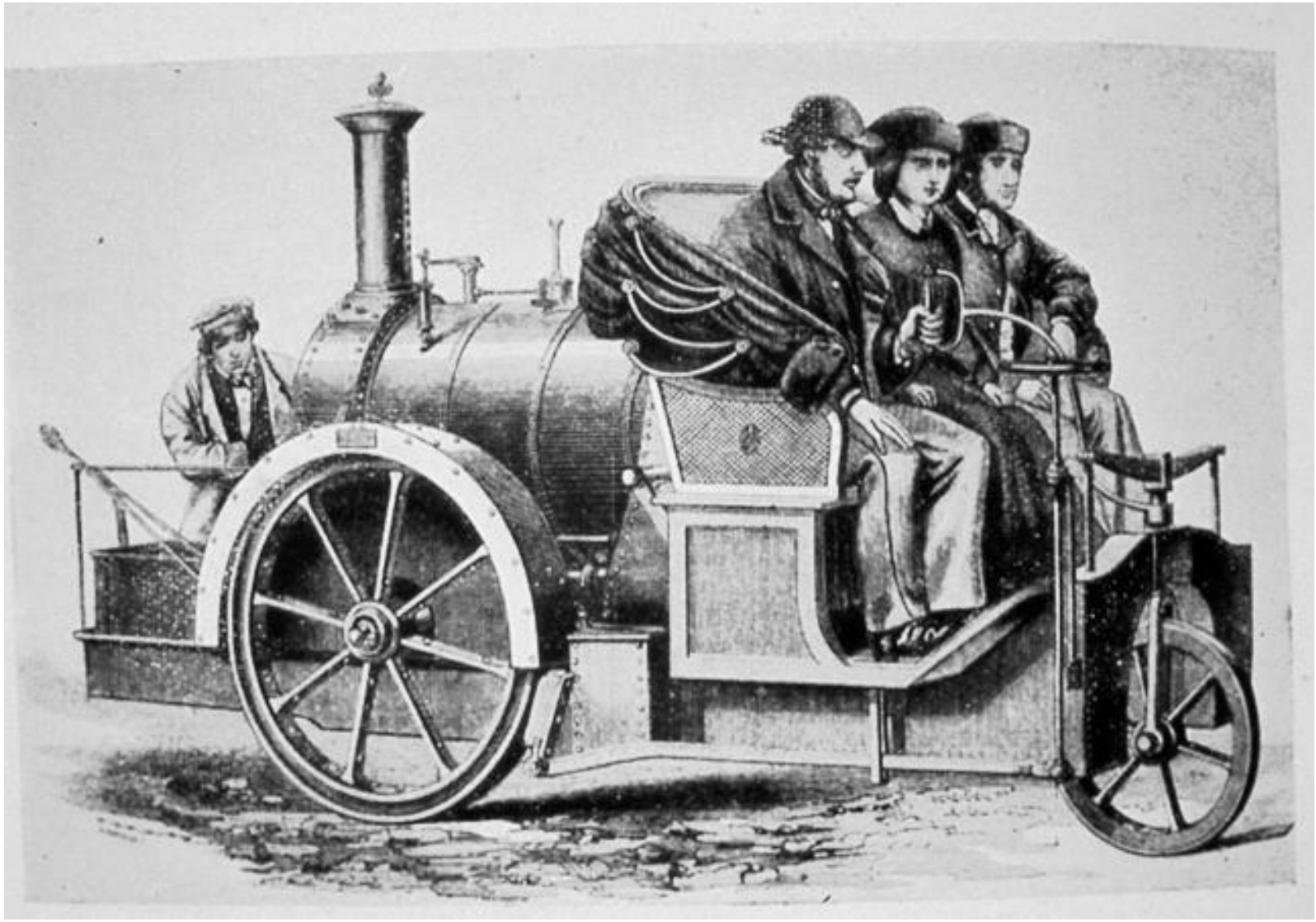
Yarrow & Hilditch car of 1860

This steam car started the motor export trade and was still listed in Tangye's catalogue in 1876

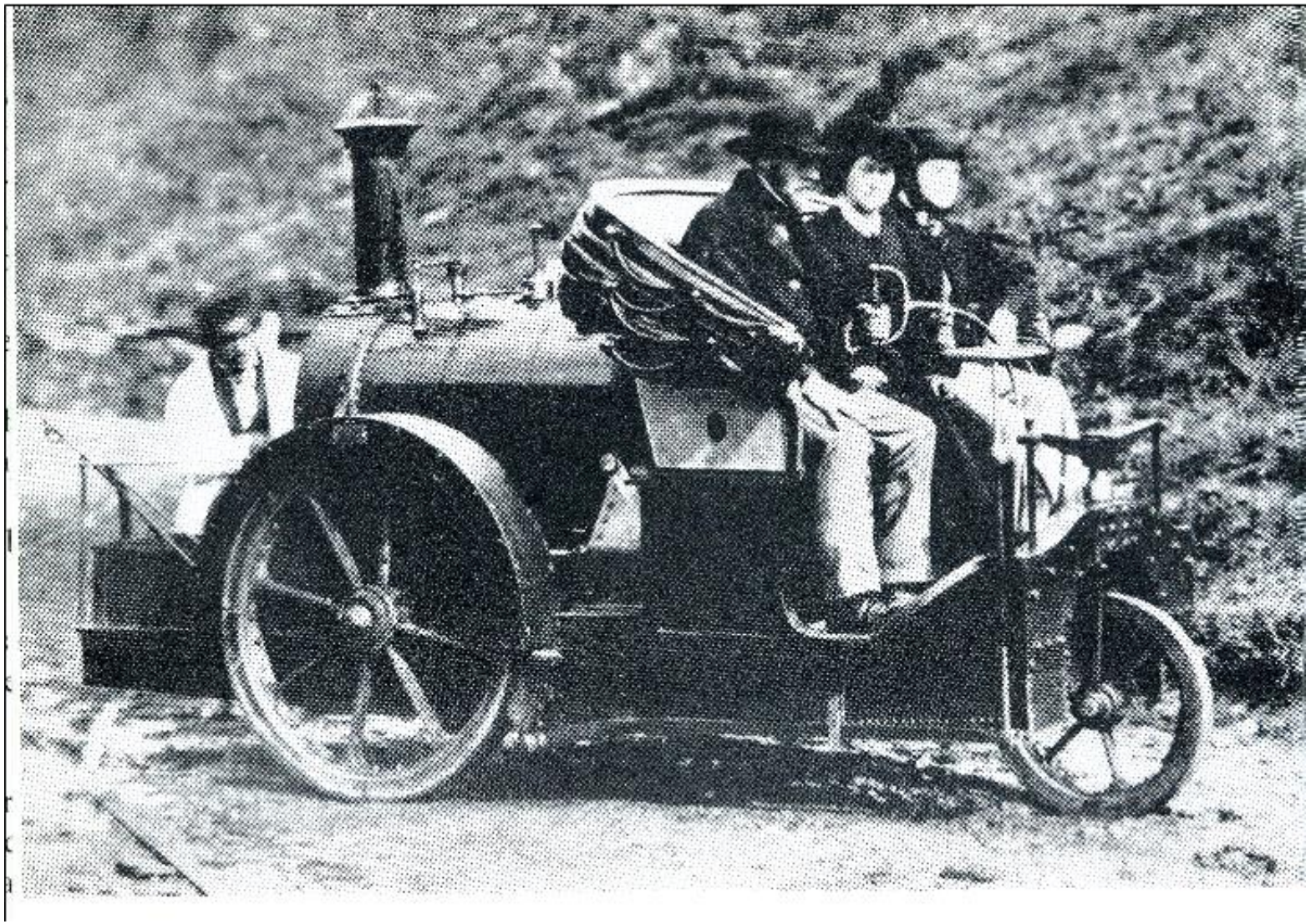
Hancock's 1833 'Enterprise' steam coach, built to operate between London Wall and Paddington, via Islington



Hancock's 1836 22-seat *Autotomaton,* completed over 700 journeys between Paddington, Islington, Moorgate & Stratford, carrying over 12,000 passengers at speeds in excess of 20 m.p.h.



The Earl of Caithness in a Rickett of 1860



The original photograph

Note the section of railway line

The Locomotion or Red Flag Act

1865 - Locomotive Act (amended 1878) - restricted the speed of horse-less vehicles to 4mph in open country and 2 mph in towns. Act required three drivers for each vehicle - two to travel in the vehicle and one to walk ahead carrying a red flag... - the Red Flag Act.

Repealed 1896/7

Cylindrical boilers have headed the world's trains.

And today, high pressure steam provides power in nuclear power stations to drive …

… the mighty turbines that produce our electricity.

Sir Humphry Davy 1778 - 1829

Young Humphry entertaining the crowds in London with his chemistry tricks

Sir Humphry Davy
Scientist
1778 - 1829

‘Whenever speculation leads to practical discovery, it ought to be well remembered and generally known. One of the most common arguments against the Philosophical exercise of the understanding is ‘Cui bono’ [who will benefit]. It is an absurd and common place argument: but much used: so that every fact against it ought to be carefully registered. **Trevithick’s engine will not be forgotten, but it ought to be known and remembered that your reasoning and mathematical enquiries led to the discovery’.**

Davy to Gilbert, 23 October 1804

All pressure vessels follow Trevithick’s original design

Thank you

Any questions?

chairman@trevithick-society.org.uk