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An Early Patent of a Two-Wheeler on Rails

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An Austrian patent taken out by Franz Aloys Bernard in 1837 in Vienna shows an early idea of what today is called a rail-bicycle. While those modifications with flywheels inspired by the steam engine were probably never built, there is a hint that the simplest one was actually tried in Karlsruhe during the time when Karl von Drais tested his four-wheeled railway car.

When those impressive figures¹ on the energy costs per kg body mass for different animals appeared in the literature, with a man on a bicycle hitting an absolute low, a reviewer joked that the most efficient form

of land transport presumably would be to teach a horse to ride a bicycle. With the advent of the railways on the Continent, something similar was indeed discussed in places without coal mines. Thus when

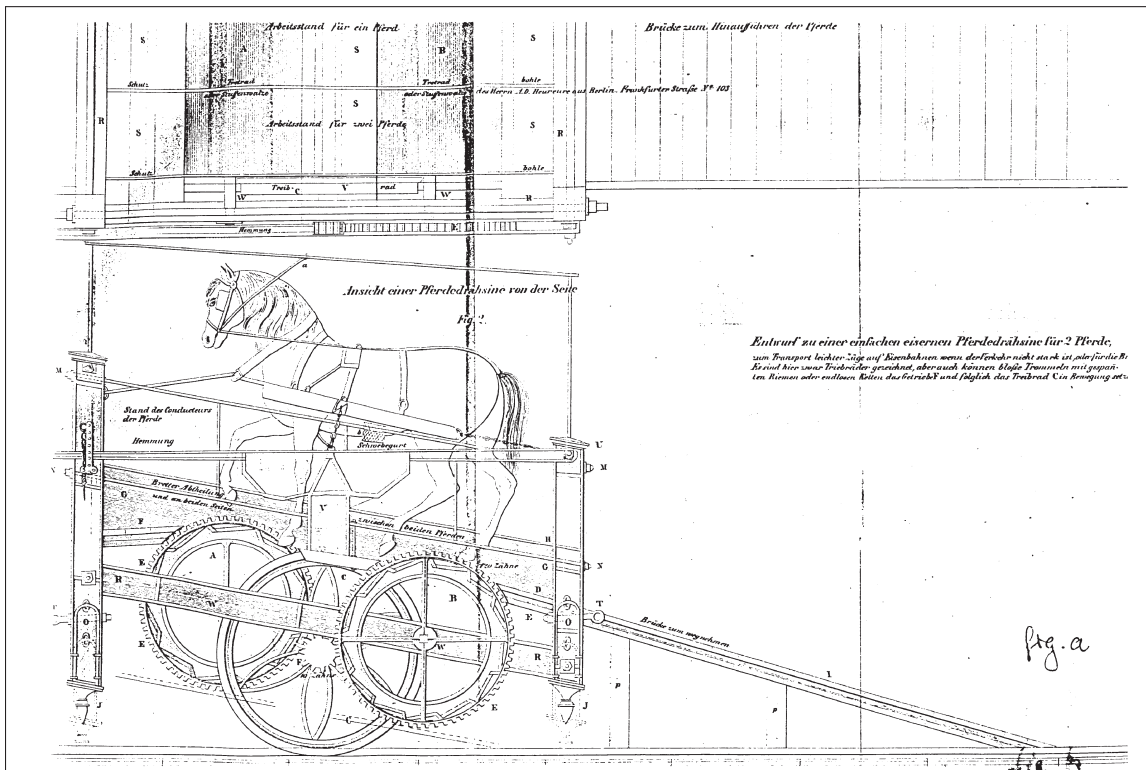


Fig. 0801.
Horse-drawn
Draisine
drawn by
August Beyse,
as published
in Ref. 5.

the Grand-Duchy of Baden started its railway system between Heidelberg and Mannheim early in 1840, there was a discussion about avoiding the importation of the expensive coal. Two locomotives were built by Sharp, Roberts & Co. in Manchester and driven by the engineer Thomas Turner who was hired from there. The machine company of Kessler & Martiensen, near the capital Karlsruhe, started building locomotives at about the same time.

Returning from his seven-year stay in Brazil (1821–1827), Karl von Drais lived as a bachelor in Mannheim on his salary as a former forest official, which had been granted to him as an inventor’s pension. After the death of his influential father, he was afflicted with epileptic seizures inherited from him. In 1832, he traveled to London and presented his “writing machine” to the editor of the *Mechanics Magazine*,² a machine which punched holes forming letters into a strip of paper, built before his emigration. He continued to react to technological news with own projects, for example, when an American grass-mowing machine pushed by horses rather than pulled (to avoid the trampling of the grass) became known on the continent, Drais experimented in 1837 with a carriage pushed by horses from the rear to avoid the driver getting dusty.³

Still devoted to lightweight construction and saving energy, he proposed in a petition⁴ to the State Parliament of Baden a railway locomotive driven by horses upon it facing backward and trotting on a kind of moving carpet. While we do not have a drawing of this, we do know of a drawing influenced by it. August W. Beyse, a consulting engineer to various German railways, published a similar proposal in a book⁵ that obviously was meant to advertise his skills

and services (see Fig. 0801). He had studied the British railways for two years and had built a steamboat in London according to his design. His so-called “Horse Draisine” uses a felt-covered step cylinder as a driving mechanism for the horses to trot on. This had already been in use at a manufacturer in Berlin called A.D. Heuruse, to operate textile machinery. We know of one more design by a mechanic named Schmidt of Heidelberg, from a report in the *Mannheimer Journal* of 2 January 1839:

Mechanicus Schmidt from Heidelberg, who spent four years in the workshops of the famous Sir von Reichenbach, has operated a sawmill for years with horses that need so little space for their movement that this contraption could be placed on a standard railway wagon without them losing force or having an inconvenient position. His proposal for this is said to have been accepted as correct by the railway superiors in Karlsruhe and he is said to have received an order to make a drawing and, if there are no changes necessary, to build a full-size wagon.

In 1843, Mannheim newspapers reveal that Karl von Drais built an experimental rail car. The *Mannheimer Morgenblatt* of 8 March 1843 printed a letter of Drais to the editor answering to previous news stating that it be “... not correct, that the railway locomotive built by the factory of Messrs. Kessler and Martiensen at Karlsruhe be called Railway Draisine since the same has no resemblance to a draisine but for the roundness of the wheels and that this title is based on misnaming.”

This railway locomotive can be identified as the so-called Rail Crank Car pictured in the first printed

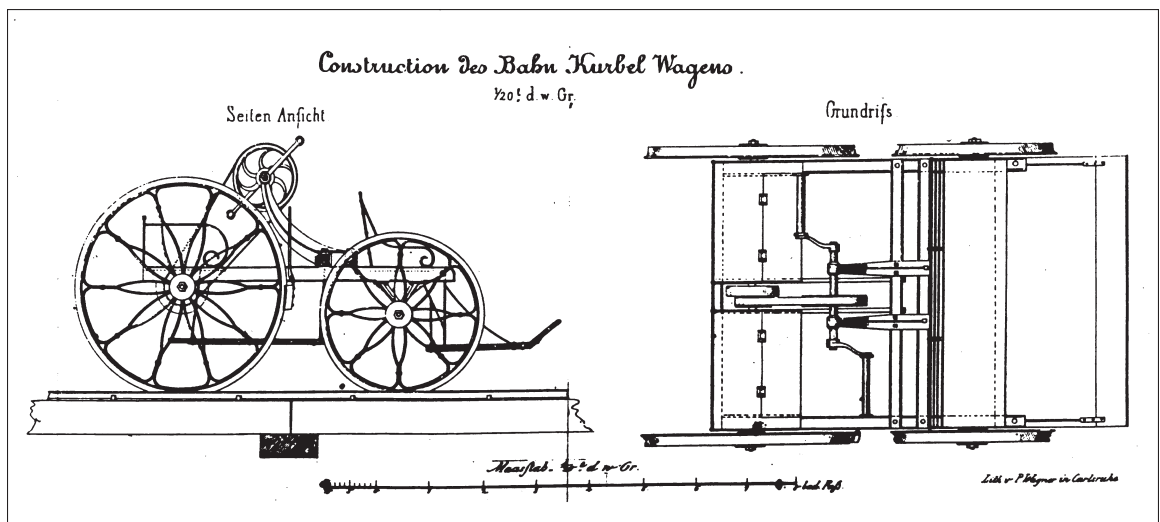


Fig. 0802. Rail Crank Car built by Grandducal Badenian State Railways in Karlsruhe, from Ref. 6.

report⁶ of the Badanian State Railways (see Fig. 0802) Accordingly on its frame there are

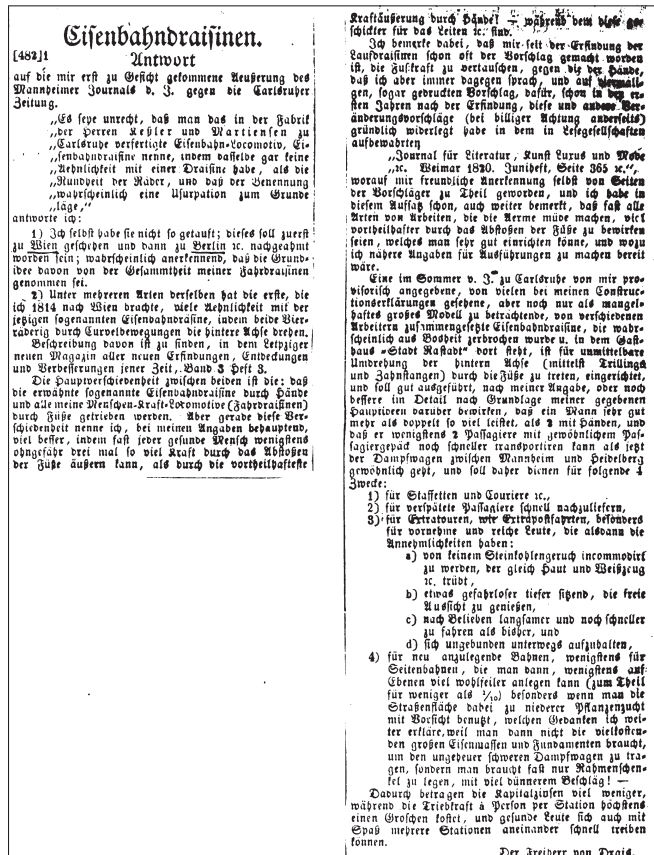
“... 2 seats with backrests made from iron rods and foot rests; on the front seat up to four persons may be seated; the back seat can be lifted up such that two workers can operate the crank either upright or seated, the rotation of which is transmitted by leather belts in a ratio of 1:2 onto the back axle of the car. Two workers can move the car plus two-three persons at 22 kilometers per hour at best, but have to be replaced every half an hour.”

In fact, the *Mannheimer Morgenblatt* reported on 28 March 1843 that first the margrave and then the Grand Duke himself had been taken for a spin on it from Karlsruhe and back.

Drais' letter to the editor regarding the wrongful naming states (Fig. 0803):

I did not baptize it as such myself; this is said to have happened first in Vienna and then imitated in Berlin, probably

Fig. 0803. Drais' letter to the editor of the *Mannheimer Morgenblatt* (8.3.1843) describing his rail car.



because the basic idea of it was taken from the range of my driving draisines.

About the Berlin precedence, I could not find any evidence, but one may speculate that this hear-say piece of information may stem from the fact that Beyse had called his above design “Horse Draisine” and that its driving mechanism stemmed from Berlin. It could well be that Drais mixed up oral reports, before the book appeared, to the end that he believed that the whole horse-draisine idea came from Berlin, whereas Beyse presumably drew it according to what he had learned from the State Railways officials.

As to Vienna, I had more luck when researching for the 1985 Drais memorial exhibition.⁷ The archive of the Technical University in Vienna holds the Austrian patents and among them is Consig: No. 2700, applied for 30 Oct.1837 and granted on 26 Feb.1838 to Franz Aloys Bernard, a silk manufacturer in Vienna. Austrian patents of that time were neither formalized nor printed, but consisted of the hand-written application with official notes put on them. The text by Bernard includes a sheet with drawings (Fig. 0804) and their descriptions and says (my translation):

For preliminary release: To be able to give to the well-known swift-running machine such a fitting that this can be used on a railway track and therefore be pushed forward by a single person with a quarter of the requisite expenditure of force.

Consequent to the above: also a further improvement of this machine by application of centrifugal force such that thereby such a machine can be moved on a railway track with even more reduced expenditure of force.

Invention also emerging from the above improvement: To give this machine with identical expenditure of force by two persons such a fitting that ten or more persons are moved with speed as indicated, including the further advantage that such a machine can be used on two railway tracks running in parallel, which contains the construction of a car moving on four wheels.

To the persons using them, this range of railway machines put into more detailed connection are preferentially suited for quick travel, all the more since these provide a healthy exercise equal to riding. Especially the former ones are suitable to give most advantageous service to rail guards, since those can quickly cover long stretches of railways

and survey the requisite good condition of these without difficulty.

Franz Aloys Bernard

Nothing more is known about Bernard, or if one of these machines was ever built and used by him. On the single track, it is of course impossible to balance a rigid two-wheeler for longer periods of time, rather one imagines the rider to fall on his feet alternatively that were used to push the vehicle anyway. Follows:

Description: Fig. 1. Side view of the simple swift-running machine for use on railways. A the wheels on the continuous rail B. C the seat of the one operating this machine, with screws to move it up and down. This seat and that of the following machines can also be provided with wooden or metallic springs or be suspended from these in place of the screws.

Fig. 2. Front view of this machine. The wheel E running on rail D. View of the seat with chest banisters F for keeping balance with the arms.

Fig. 3. Improved machine with flywheels G applied.

Fig. 4. Back view of this machine with flywheels H.

Fig. 5. Front view of this machine similar to fig. 2.

Fig. 6. Machine for any number of persons , here designed for 4 of them. The flywheel J, here at center, is moved by the rail wheel K. Seats L for riding ones are provided with balancing arms except the first one M.

Fig. 7 is the cross section of this machine through the center with the flywheel N that is moved by the rail wheel O. Since the seats of this machine resemble those in fig. 2 a drawing for them is not needed.

Fig. 8. Cross section through back part of the machine car with wheels P running on 2 rails and with a “fly-cob” Q mounted instead of a flywheel that is turned by the spur wheel R fastened to the axle S of the rail wheel. The remaining frame of the car has two simple wheels mounted in front. The seats and frames for luggage can be mounted at will and built in various designs. Thus multiple designs can be devised, yet these cars must contain 1 or 2 seats like above to enable their propulsion.

Franz Aloys Bernard in Vienna

Clearly, it is the steam engine which is the model for the leg power here, most distinctly recognizable from the regulator-like design pictured in Fig. 8. The idea that a dead centre has to be overcome by added rotary mass (as in Fig. 4) or by an additional flywheel (as in Fig. 6 and 8) has been corrected by cycling experience ever since. We know today that the inert mass of the rider plus the machine is sufficient to

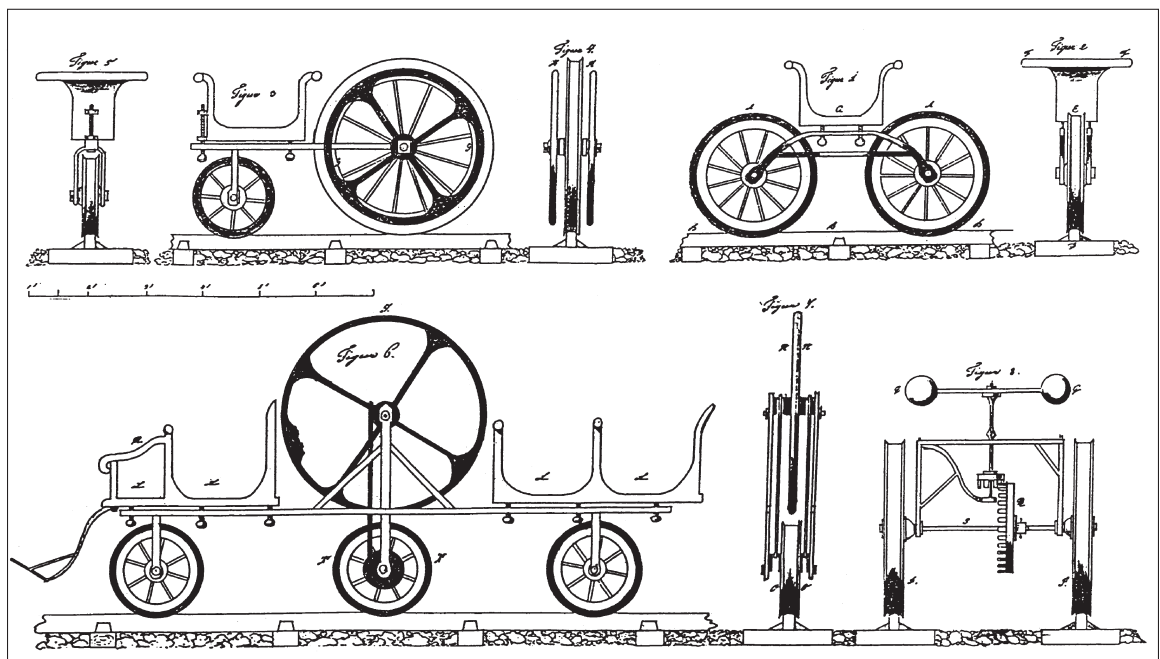


Fig. 0804. Drawings from Bernard's patent of 1838.

sustain the linear motion and we make the rotary mass of the wheels as small as possible. An interesting aspect is the proposal of a passive seat (Fig. 6) for the superior who is not expected to work himself for his locomotion. Note also that the simple machine of Fig. 1 has a Janus-faced design such that it needs not be turned around when returning home, yet a parking stand as in Drais' and Johnson's velocipedes is lacking. Bernard's patent was certainly inspired by the start of steam operation on the Linz-to-Budweis railway including Vienna in 1836, that had begun as a horse railway in 1828.

Drais' Experimental Rail Car

So this was the Vienna predecessor which Drais did not know from the patent (since this was filed in Vienna and not printed nor distributed), but only from hearsay, otherwise he would not have wondered why people called these rail vehicles draisines. They did so because this first one was a two-wheeler on rails, as the common running machine or draisine was a two-wheeler on the road back in 1817. In his letter to the editor Drais states that he always criticized propulsion by arm power, because leg power is three times more powerful. He adds:

In summer last year [1842] I presented a provisional railway draisine in Karlsruhe that was seen by many people while I explained that its construction was merely a rough and approximate model. This was assembled by different workers and is still in the inn "Stadt Rastatt," after it was meanly broken up. It is designed for immediate rotation of the hind axle via lantern pinion and tooth racks by the

feet treading. If built well according to my design it will ensure that one man performs more than twice as well as two with their hands and that he can transport at least two passengers plus usual luggage faster than the present steam wagon between Mannheim and Heidelberg. Thus it will serve the following purposes:

- 1) for relays and couriers
- 2) for delivering late passengers
- 3) for extra trips like extra-mail trips, especially for noble and rich people who can have the following amenities:
 - a) not to be bothered by coal smoke, which darkens the skin and white clothing
 - b) to enjoy the view sitting lower which is a bit less dangerous
 - c) to ride slower or faster at will, and
 - d) to stop on the way casually
- 4) for future railways to be built, at least for branch lines, that can be constructed much cheaper (partly less than 1/10th), at least on plains. This is because one does not need those huge and costly masses of iron and foundations to carry the eminently heavy steam wagon, but has to lay merely door frames with thinner mounts. The track area may be used to grow low plants.⁸

In this way the capital interest is much lower and the cost for propulsion power per person and station one penny at most. Healthy people could propel themselves fast for several stations with fun.

Jost Pietsch has attempted a reconstruction with tooth-rack foot levers engaging into the pinion lantern — a rather complicated device. Since Drais was always known for trying the most simple mechanisms to avoid unnecessary friction, I propose another reconstruction attempt (Fig. 0805), with the pinions of

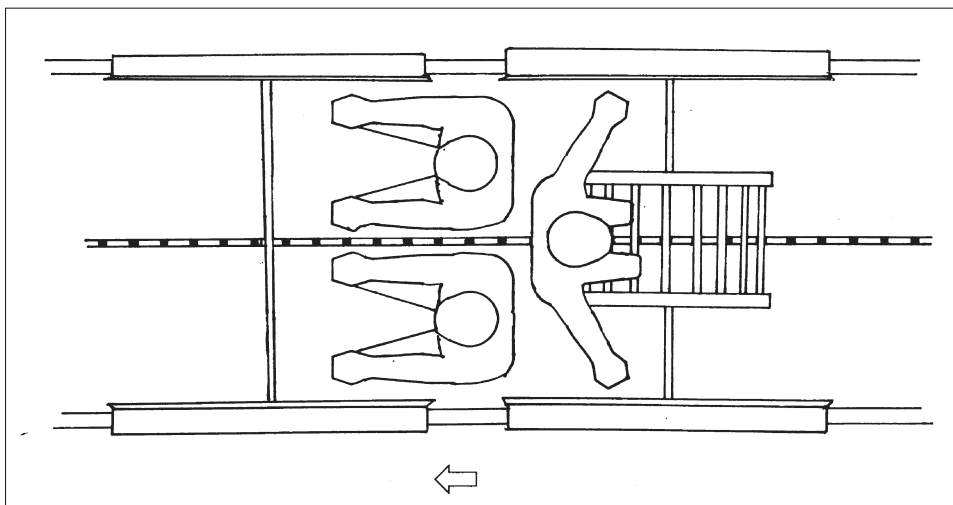


Fig. 0805. Reconstruction attempt of Drais' Railway Draisine according to Ref. 1.

the wide lantern engaging directly into a central tooth rack between the two rails — as in later cog railways. The driving man sitting on a suspended leather seat would be oriented backwards and engage his feet into the pinions of the lantern near its centre. The passengers sit lower between the low front wheels, but this reconstruction attempt, of course, remains speculative. But in those early days of the railways, it was certainly believed that the friction of lightweight vehicles was not enough for the wheels not to slide. Rather a cog railway was thought to be in order to substitute for friction.

Drais also reported that the keeper of the inn mentioned above had built and tested in Karlsruhe a “peculiar running draisine” (on one rail?) that may have been like Bernard’s simple one. His own running machines for street use (hobby horses), Drais would not have called peculiar. The inn keeper’s name was Louis Schmidt, aged 40, who had completed an apprenticeship as a mechanic. He could have been an early example of what is called a rail-biker today. Still today, in the German speaking countries, the term “draisine” describes precisely what was meant here: a means of personal transport on rails.

Endnotes

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| <p>1. V. A. Tucker, <i>American Scientist</i>, Vol. 63 (1975) No. 412.</p> <p>2. Reported in <i>Mechanics Magazine</i>, Vol. 62, No. 464 on front page.</p> <p>3. Michael Rauck, <i>Karl Freiherr Drais von Sauerbronn— Erfinder und Unternehmer (1785-1851)</i>, Wiesbaden-Stuttgart, 1983, fig. on p. 26.</p> <p>4. Generallandesarchiv Karlsruhe, signature, GLA 231/1237.</p> <p>5. A. W. Beyse, <i>Neueste Erfahrungen im Eisenbahnwesen</i>, 3. Heft. Macklot, Karlsruhe, 1844.</p> | <p>6. <i>Ausführliche Nachweisung über den Eisenbahnbau im Großherzogtum Baden nach dem Stand am 1.1.1844</i>, Karlsruhe 1844.</p> <p>7. Stadtarchiv Karlsruhe (ed.): <i>Karl Friedrich Drais von Sauerbronn 1785–1851. Ein badischer Erfinder. Ausstellung zu seinem 200. Geburtstag</i>. Karlsruhe 1985.</p> <p>8. The idea of a greened light rail came up again during the soft-technology movement, see: Christopher Swan, “Light Rail — How to make it work,” <i>Coevolution Quarterly</i>, No. 26 (Spring 1980).</p> |
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