

GERMAN EXPRESS LOCOMOTIVE WITH AUXILIARY DRIVING AXLE.

BY FRANK C. PERKINS.

It may be of interest to note some of the details of a recently constructed German express locomotive which has been on exhibit at the Paris Exposition and which has been ridiculed by some prominent engineers. It may, however, be wise to suspend judgment until careful examination is made of detail drawings and full data is studied. It is a four-coupled compound locomotive for express work and has a small pair of carrying wheels behind, two pairs of large, coupled, driving wheels, and a four-wheeled auxiliary driver truck acting like a "donkey" assistant. This leading pair of small drivers can be raised from the rails or pressed upon them at will by means of a lever. It was built by the Locomotivfabrik Krauss & Comp. Actien-Gesellschaft of Munchen for the Bavarian State Railways.

The object of the designer of this engine, as stated by himself, is to provide a locomotive which, in general, "has the qualities of a four-coupled engine, but is able to increase any time it is needed, its cylinder power, as well as its adhesive weight, in proportion of 3 to 2, so that it can exert temporarily a tractive power corresponding to six coupled wheels."

It may be wise to consider the reasons given for this consideration before criticising the design too severely.

The engine runs under ordinary conditions on five axles, viz., a four-wheeled truck in front, two coupled axles and trailing axle carried in a Bissel truck. Besides that, it is fitted with an auxiliary driving axle, which is placed between the two truck axles, though it does not form part of the truck, having its bearings guided by horn plates extending down from the main frame plates outside the bogie frames. The center pin of the bogie, fixed on the casting forming the main cylinders, is placed just before the auxiliary axle. The latter takes its motion from two equal-sized outside cylinders fixed on the main frames in front of the leading wheels. The valve gear of the auxiliary engine is a modification of Joy's arrangement.

As already remarked, the auxiliary engine is not always in motion, but it is only used when starting and accelerating heavy loads, or when climbing steep gradients, in which cases the locomotive is able to exert the pull of a six-coupled engine. For by far the greater part of the run, therefore, the small engine is stationary, its drivers being not in contact with the rails but kept about 1.2 inches above them by the force of the two large spiral springs located immediately below the running board. These act upon the axle by means of a horizontal cross-shaft just behind the main cylinders and a vertical rod, which is attached to two transverse plates connecting the axle-boxes. When the auxiliary engine is wanted to assist the main one, the action of steam admitted to two cylinders of 7 inches diameter, which can be seen directly above the leading bogie wheels, overcomes the tension of the springs and presses the axle down against the rails, at the same time, of course, discharging the two bogie-axles of a part of their ordinary load. As the bearing-springs of the three hind axles are connected by the compensating levers, their charge cannot be altered in any way by the depression of the pilot axle.

The diameter of the cylinders of the auxiliary engine is 10.24 inches, while the stroke is 15.75 inches. The wheel base of the bogie is about 3½ feet, while the total wheel base is nearly 30 feet. The engine has a total length over buffers of over 38 feet, and has a total weight of 68 tons. This weight is divided as follows: Leading bogie wheel, 14 tons; rear bogie wheels, 10.9 tons; main drivers, 14.1 tons; coupled wheels, 14.1 tons, and trailing wheels, 14.1 tons.

The diameter of the main cylinders is 17.3 inches and 25.6 inches respectively, the stroke 26 inches, and the diameter of the coupled wheels 6 feet 1½ inches.

The throttle valve of the main engine is situated in the dome, that of the auxiliary one in the smoke-box in the main steam pipe; as a result the small engine receives steam only when both regulators are open. To prevent any mistakes on the part of the driver, the handle of the auxiliary regulator and that commanding the three-way cock (which admits and releases the steam to and from the charging cylinders and is placed on top of the smoke-box behind the chimney) are made mutually interlocking in such a manner that steam cannot be given to the small engine unless the axle has been lowered before, and that the axle cannot be raised again until after the auxiliary regulator has been shut.

In order to avoid excessive bulk and weight of the auxiliary gear, the wheel diameter has been chosen as small as possible, viz., the same as that of the carrying wheels, 3 feet 3 1/3 inches. This size is quite sufficient, considering the fact that the assistance of the small drivers is only wanted at relatively low speeds, of about forty miles an hour at most. The tires have no flanges.

The device has been in regular service on a single-driver express engine of the Bavarian State Railways since the year 1896, and has never given trouble. The switching in and out of the small drivers at a speed of

about 45 miles an hour is done without the slightest difficulty, and the wear and tear of the auxiliary gear is trifling.

The reasons why the builders prefer the described arrangement to the use of six coupled wheels are two: the fact that the size of the main engine's cylinders can be better proportioned to the requirements of high speed, and the possibility of a free disposition of the boiler, especially the firebox and grate, granted by the absence of a third pair of big drivers.

The main engine, which actuates the four coupled wheels of 6 feet 1½ inches diameter, has inside cylinders, whose center line has an inclination of 7 per cent to clear the bogie; while the valve faces and spindles are placed horizontally outside and above the cylinders. The engine is compound, having a high pressure cylinder of 17.3 inches and a low pressure one of 25.6 inches diameter, the common stroke being 26 inches. The valve gear is of the Heusinger-Walschaert type, but as there is no room for eccentrics, the motion of the expansion links is taken from the connecting rods.

The reversing screw is arranged vertically on the plate form, directly above the reversing shaft, and handled from the foot plate by means of a horizontal spindle and a pair of beveled pinions. The different sets of valve gears are connected with each other in such a way as to give for the forward motion the following coincident cut-offs:

	P. C.	P. C.	P. C.	P. C.	P. C.
High pressure.....	30	40	50	60	78½
Low pressure.....	53½	64½	72	78½	87
Auxiliary cylinders.....	v	16	23½	35½	77½

As an experiment, the alternating parts of the main engine are perfectly balanced by bob-weights, which are disposed in the prolongation of the inclined plane of the cylinder centers, and are hidden by the casing between the coupled trailing wheels. They consist of cast iron blocks guided like crossheads between slide bars and driven by special connecting rods.

The boiler, with a deep firebox laterally extended beyond the frames and wheels, is similar to those of the Palatinat express engines built in 1898, which have given every satisfaction. But it is somewhat larger and has the "extended wagon top" form, the hind ring of the shell, which bears the dome, having the same diameter as the upper part of the firebox casing. The tubes are supported by a third tube plate near the mid of their length. The chimney is prolonged into the smoke-box. The blast orifice of the auxiliary cylinders is annular round the main blast pipe. The spark arrester is of Sturm's patented system with an automatic flap, which is only shut when steam is on.

The length of the grate of this engine is 5 feet 3.78 inches, while its width is 5 feet 10.87 inches. Its grate area is 31.3 square feet, and fire-box has a front height of 6 feet 1.62 inches and a rear height of 5 feet 5.36 inches.

The boiler inside the largest ring has a diameter of 5¼ feet, and inside the smallest ring, 4 feet 8.14 inches.

It has 238 tubes, ranging in diameter from 1.85 inches to 2.05 inches. The tubes are 16 feet 8.79 inches long, and give a heating surface of 2,134.3 square feet, while the total heating surface of the boiler is 2,265.3 square feet, and the normal boiler pressure used is 200 pounds per square inch.

The engine is fitted with an automatic mechanical sander of the builder's system, with four pipes, leading to the main as well as to the auxiliary drivers. The Westinghouse air-brake acts with four blocks on the coupled wheels. The registering speed indicator, of Hausshalter's system, receives its motion from the crank pin of the right-hand coupled wheel. The tender, containing 3,970 gallons of water, runs on two trucks, and is similar to the Bavarian State Railways standard type.

The Carrara Quarries in American Control.

The entire Carrara quarries of Italy, noted for the splendid quality of their statuary marble have passed into American hands. Senator Proctor, of Vermont, now has a large portion of the marble output of the world under his control. Now the Carrara quarries, instead of being owned by a number of people who were warring with each other, will reap great benefit by the consolidation. The cost of production will probably be largely reduced, and the modern American methods which will be introduced will probably increase the output. We have already illustrated the primitive methods used in the famous Italian quarries.

A COMMISSION has been appointed to examine into the rapid death of the elm trees in New Haven, and it is found the trees are dying from lack of plant food in the streets, mutilation by horses, poisoning by illuminating gas and by insects and elm tree beetles. Some time ago an attempt was made to attribute the death of trees to stray electric currents.

Engineering Notes.

We regret to note the death of Samuel T. Leake, who made a fortune by the invention of a cotton bale band.

Queen Victoria's new royal yacht, the "Victoria and Albert," is to be altered and completed under the direction of Designer Watson.

The Pennsylvania Steel Company has successfully completed the Gokteik Viaduct in the Shan Hills, India, the highest railway bridge in the world, and it has been formally handed over to the railway company.

A thirty-story building is to be erected at the south-eastern corner of Broadway and Thirty-third street. The lot is 118 feet 6 inches wide on Broadway and 97 feet 7½ inches deep on Thirty-third street. It will be the highest building in the city.

Carrier pigeons will be used on the car ferries of the Pere Marquette Railway Company this winter. This plan of communication is to be used because of the dangers of the winter navigation, boats having been, in times past, caught in the ice, with no way of sending for aid.

An expert miner of Oakland, Cal., will soon start to Africa on a mission which is both romantic and eminently practical. He goes in quest of "King Solomon's Mines," which were made famous by a well-known story of an English fiction writer. Mr. Farrell goes to Africa as an expert for a large London syndicate.

The steamer "Sonoma," built for the Oceanic Steamship Company, has arrived in San Francisco, making the trip from Philadelphia in thirty-eight days nine hours, making no stops. The best previous trip was forty-three days six hours, made by a sister ship. The new vessel will be used between Honolulu and Australia.

A French engineer, named Levavasseur, has devised a new screw propeller which performs the dual offices of a helix and a rudder contemporaneously. It is portable, and can be fitted to any kind of craft, readily and quickly, a feature which recommends its adoption for river and coast navigation. Experiments with the device have been carried out at Trieste with conspicuous success. At full speed the propeller makes fifteen hundred revolutions per minute. It is actuated by a motor driven by petroleum and benzine.

The Secretary of Agriculture has established in the Division of Chemistry a laboratory for testing physically and chemically all varieties of road materials. The laboratory will be ready for operating about the first of December, and any person desiring to have road materials tested in this laboratory is advised to write to the Office of Public Road Inquiry or the Department of Agriculture for instructions in regard to the methods of selecting and shipping samples, and they will be tested in the order in which they are received.

A curious discovery has been made during the dredging operations at the mouths of Morlya and Shoalhaven Rivers in New South Wales. These rivers run through an auriferous district, and at the estuary sand bars and alluvium are deposited. This obstruction has to be constantly removed by dredgers in order to allow the channels of the rivers to be kept open for navigation. This mud was then taken out to sea in hoppers and discharged. A workman one day, impressed by the curious nature of the soil, panned a little off, and was surprised to find a small sediment of gold dust. He communicated his discovery to the authorities, and further investigations proved that the alluvium was freely charged with this metal. It was therefore decided to extract this gold, and the mud is now run through an automatic gold-saver before being dumped into the sea. It is anticipated that the quantity of gold recovered by this means will defray the total cost of the dredging operations.

Russia is suffering from a scarcity of coal, which threatens to severely hamper several of her industries. The demand for coal and fuel of all kinds considerably exceeds the supply, and the scarcity has resulted in a heavy rise in prices. The railway companies have had further concessions granted to them, with a view to overcoming the crisis, and also to develop the native supplies. They have had their term for importing foreign coal duty free extended for another twelve months from last September, and it appears that the period will be further increased. It is estimated that the output for the current year of European Russian coal will be over 1,600,000 tons short of the demand. Russia during recent months has been a heavy purchaser of English coal, but the heavy rise in price of the English product has prevented the supply being continued. A cargo of American coal has recently been delivered at Cronstadt, at a freight of about \$4.25 per ton, and it is stated that inquiries have been made regarding the cost of shipping American coal to Odessa. Considering the vast quantities of petroleum to be found in Russia, it is surprising that more extensive use is not made of liquid fuel.

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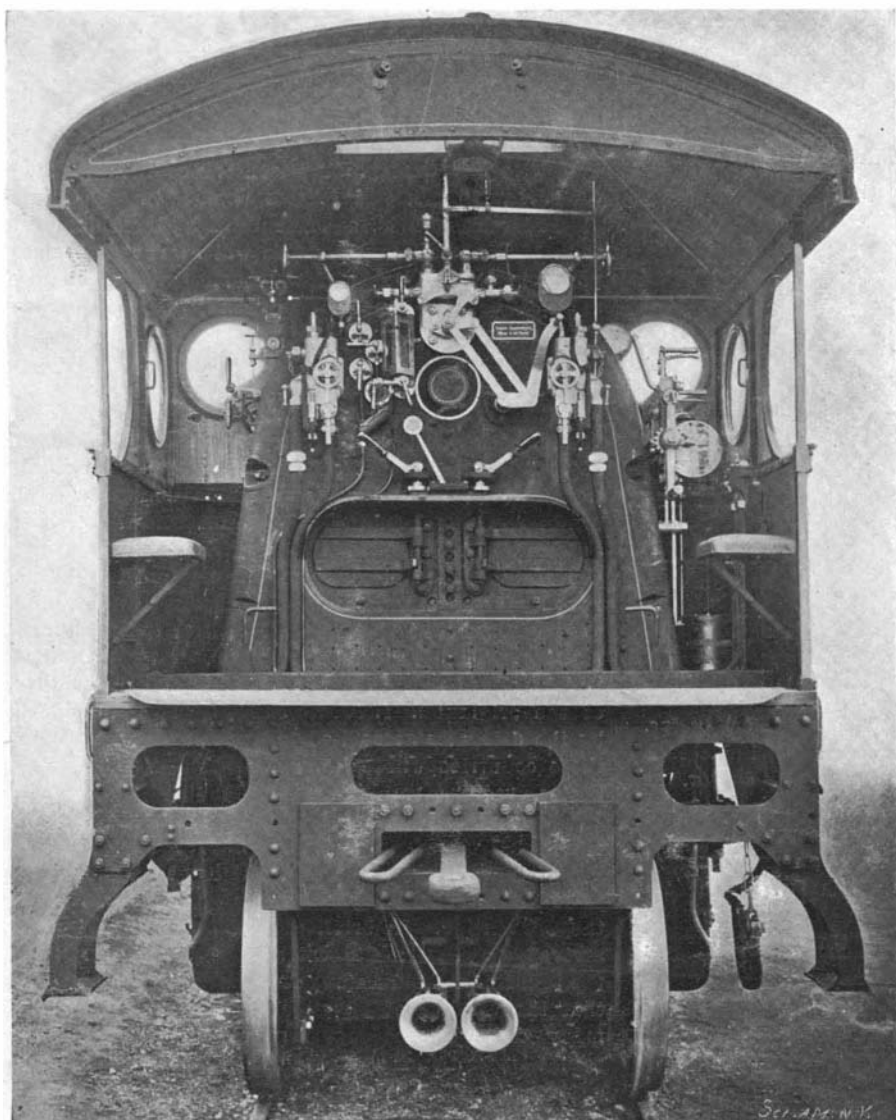
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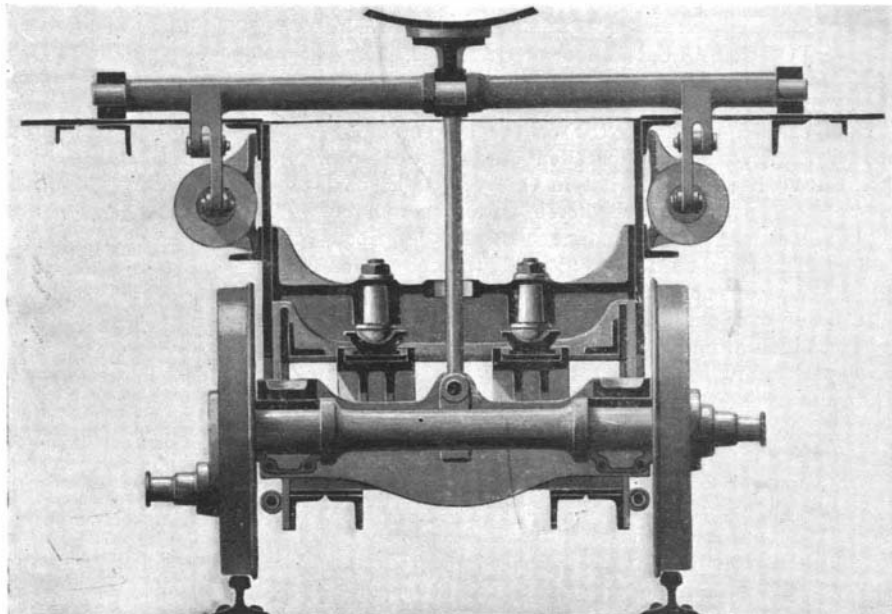
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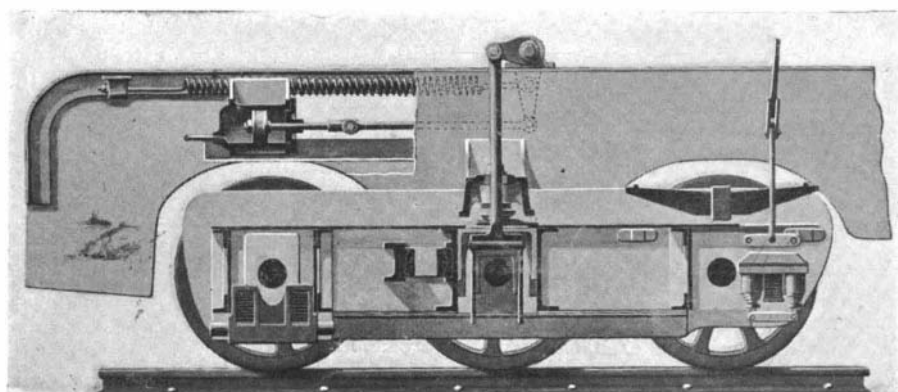
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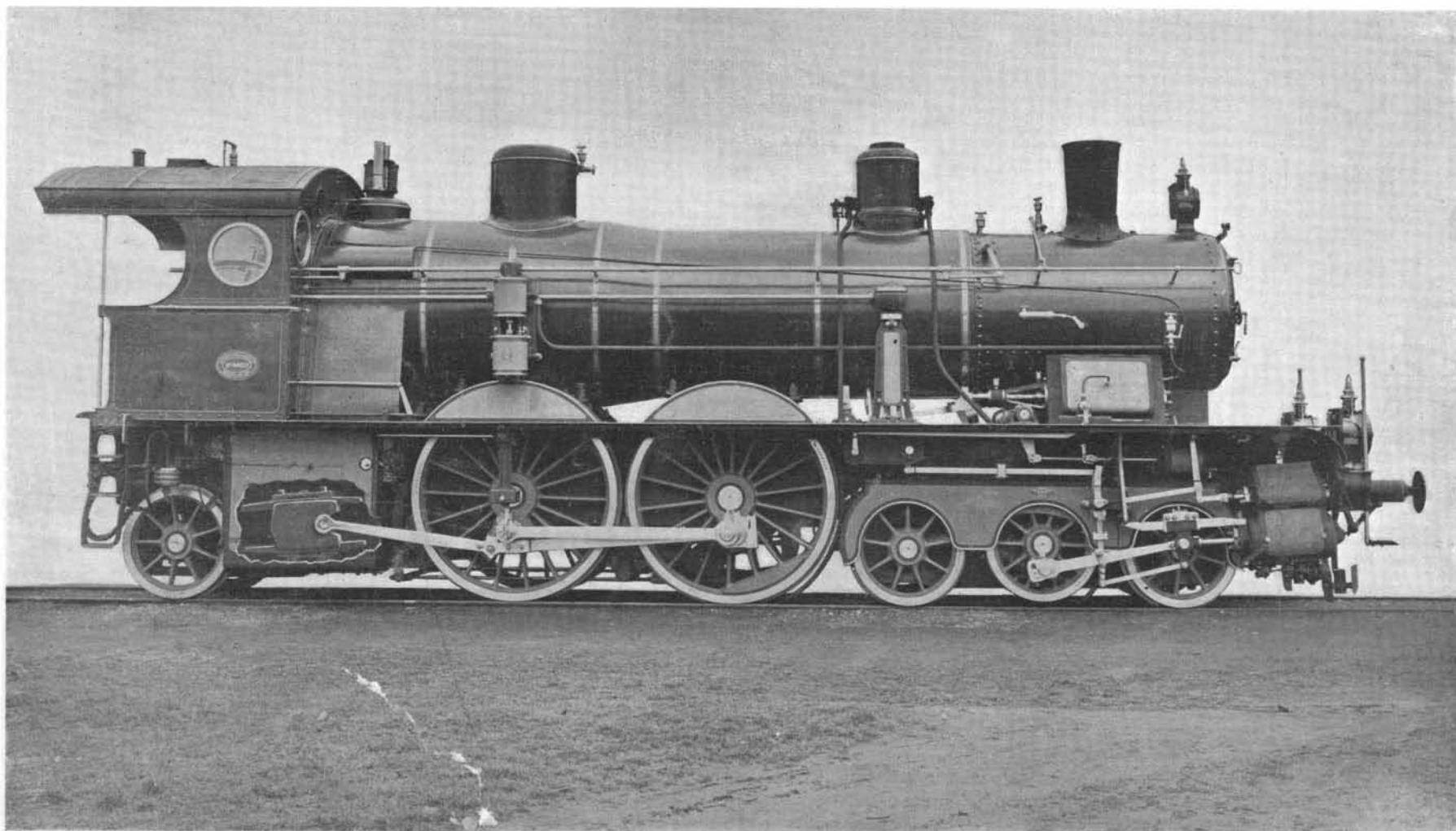
Interior of Cab.



Transverse Section through Auxiliary Driving Truck, showing Method of Adjusting Auxiliary Drivers.



Longitudinal Section through Truck, showing Drivers Depressed.



GERMAN EXPRESS LOCOMOTIVE WITH AUXILIARY DRIVING TRUCK AND RECIPROCATING COUNTERBALANCE.—[See page 55.]