The Janney Coupler

For more than a century, across all of North America, nearly every railroad locomotive and all kinds of passenger and freight cars have coupled reliably to each other. The knuckle or vertical plane coupler patented by Eli Janney in 1873 (with improvements in 1879 and 1882) makes these connections possible. FIG 1 – MODERN PHOTO Janney's automatic coupler has improved the productivity of every railroad, curtailed train accidents, and saved generations of railroad personnel from the grievous injuries inflicted by the link and pin couplers it replaced. The innovation also knitted individual companies into international networks by allowing cars to interchange across different lines, speeding the movement of goods and people to their ultimate destinations. Its design details have evolved, chiefly in strength improvements to accommodate heavier cars and longer trains – which today are often a mile long. Yet older couplers work reliably with the latest models. Given all its advantages, it is no surprise that railways in much of the world use the Janney design. The adoption of this quietly revolutionary technology entailed forty years of challenging experiments, negotiation, cajoling, and regulations. The path to success was never straight.

For their origins in the 1830s, nearly all American railroads relied upon basic "link and pin" couplers. When connecting two freight cars, a brakeman guided one car's iron link (much like a large chain link) into a pocket on the other car, then dropped a pin through a hole into the pocket to make the connection. FIG 2 – link and pin Such couplers were simple and cheap, so their use spread widely. But they also proved troublesome. Trainmen had to step between moving cars to couple them, their hands vulnerable to crushing as they guided the link into the pocket. In a single year, 1888, coupler accidents killed 300 with over 6700 injured (Aldrich, 111). The pins and links were never standardized and often went astray, so yardmen lost valuable time in making up trains. As trains started or slowed, pins and links could break under the strain, often leading to catastrophic accidents.

From the beginning, railroad managers and equipment suppliers understood the shortcomings of link-and-pin. By the 1870s, the backers of hundreds of patented coupler designs promised salvation (White 496-514). This innovative babble may actually have delayed effective solutions. Rather than making the wrong choice (and at great expense), a wise railroad officer likely felt it better to wait for a clear winner to emerge. The master mechanics and master car builders, the managers who would make this choice, knew the coupler problem really had two aspects: how to identify a better technology, then how to ensure its widespread adoption? After the Civil War, trains grew longer, railroad companies spread across vast territories, and the interchange of freight cars became commonplace, with cars traveling on "foreign" roads far beyond the rails of their owner. In short, America's diverse railways sought to become integrated systems in the Gilded Age, just as their managers became more sophisticated and professional. All these factors raised the stakes in the coupler problem, making its solution both more pressing and more difficult.

In particular the passage of freight cars across different lines revealed the clashing arguments for and against a new standard automatic coupler. Interchanging cars would flow more smoothly *after* the country had a single standard. But without advance agreement nationally, an effort by one road to adopt a new automatic coupler would prove troublesome when its cars had to interchange with old-style link-and-pin couplers. For many major carriers circa 1890, from 17 to 45 percent of their cars were "off-line." Why invest money for new couplers on cars that were not even on the property? As a leading railway economist wrote in 1887, "owing to the continuous interchange of cars, no real benefit would be derived from such a coupler until it had come into almost universal use" (Arthur Mellen Wellington, quoted in Aldrich 109).

For these reasons, durable progress began with passenger service. Those cars seldom interchanged with other carriers, so any railroad was free to adopt a fresh approach, unconstrained by the practices of connecting lines. Freight was mute, but after accidents passengers complained, sued, or died – all reasons to improve safe operations. By 1875, the "Miller hook" coupler was in widespread usage in the passenger services of 574 railroads across the country (Churella 578). Much like crochet hooks, Miller's design (patented in 1863) held cars tightly together, while car men could set or release the couplers using side levers. FIGURE 3 – miller hook patent They did not need to step between moving cars. Miller's design also greatly curtailed the "slack" common in trains with link-and-pin couplers. Slack had its pros and cons. On starting, the locomotive would pull the first car into motion, then the slack (the loose connections provided by each coupler) "ran-out" the length of the train. Thanks to slack, the locomotive incrementally took on the load of a long and heavy freight. In passenger service, however, the sharp jerk when the last car began to move was not a welcome experience for the customers aboard.

Railroads were paid to care for passengers, but railroad managers believed their employees should to take care of themselves. Despite the demonstrated success of Miller's and other automatic couplers in passenger service, freight cars and the men they mangled got little improvement. Seeing this injustice, a crusading editor and engineer Matthias Forney campaigned during the 1870s against coupling injuries in the trade weekly, *The Railroad Gazette* (Aldrich 108). In the 1880s a reformer named Lorenzo Coffin took up the cause. Many denounced him as a crank or gadfly. But Coffin got safety regulations enacted by the Iowa legislature in 1890 and by the US Congress in 1893 (White 517). The federal statute would eventually prove effective, but only in concert with developments stretching over many decades in the industry itself.

The key changes first happened in brakes, not couplers. In 1869, George Westinghouse, Jr. patented a system of air brakes. Until that time, railroads relied upon haphazard makeshifts to slow or stop their trains. Locomotives and cars each had their own brakes, shoes that pressed against the wheels when actuated by mechanical linkages. But it took brakemen, riding atop the freight cars (and leaping from one to the next) to set and release the car brakes – as directed by whistled commands from the engineer. FIGURE 4 – brakeman atop car It was miserable work, another aspect of railway operations that posed hazards for everyone involved. With Westinghouse air brakes, a compressor at the locomotive supplied an airline running beneath the cars. By turning a single valve, the engineer engaged or released all the brakes in a train nearly simultaneously. George Westinghouse worked closely with the Pennsylvania Railroad to test his equipment, and in 1870 the PRR committed to installing Westinghouse brakes throughout its passenger services. The Pennsy led the country in the sophistication of its technologies, operations, and management. Its endorsement boosted Westinghouse's product nationally.

Airbrakes for freight trains were another story entirely. The country had 13,000 passenger cars in 1880 compared to 500,000 cars in freight services (White, Passenger Car, pp. 657-8). Adding air brakes or automated couplers to that huge fleet was a daunting challenge. But systemic thinking and professional management exerted their own pressures. To lift productivity and profits, railroad managers wanted above all to run longer trains. Average weights for freight trains grew by 20 to 120 percent at different companies in the decade following 1873 (White 70). These longer freights nearly demanded better brakes. In 1886 and 1887, the Chicago, Burlington & Quincy ran a series of exhaustive tests on different air-brake types, using 50-car freights across its Illinois and Iowa routes. With the railway trade press watching closely, the tests showed two conclusive results. An improved Westinghouse air brake offered great benefits in overall train control and stopping distance. The tests also showed that "slack was undesirable," as trains had to behave as a single unit when braking (Aldrich 110). Adopting air brakes required a replacement for the link-and-pin coupler. There was no other choice.

A Confederate veteran, Eli Janney was a store clerk in Alexandria Virginia after the war when he began developing a new approach to coupling. His 1873 patent demonstrated the basic concepts that continue to this day. FIGURE 5 – PATENT DRAW Janney's coupler resembles a human hand, its fingers curled together – but not closed like a fist. When two cars come together, the knuckled hands grasp, closing on each other other firmly – and automatically. Trainmen did not have to risk injury to make the connection. To release the coupling, car men pulled levers that opened the knuckles. Often called a "knuckle coupler," Janney's design also resulted in far less slack between cars. And it had another advantage, working well even when the couplers on each car varied in their height above the rail. Because link-and-pin couplers made a loose connection, their slack accommodated varied drawbar heights. With its "vertical plane" design, Janney's coupler made reliable and tight connections despite differing drawbar heights, a common issue when coupling loaded to unloaded cars. And the cars were more likely to stay coupled even on rough track or in the aftermath of collisions. In sum, Janney's design offered great operational advantages. But how to encourage or require the railroads to convert to this new approach?

Adoption proved very challenging. In 1874, Janney convinced officers of a Pennsy subsidiary, the Pittsburgh, Fort Wayne, and Chicago, to run extensive tests on his first designs. The trials demonstrated needed improvements, while convincing the Fort Wayne to adopt the improved model on all its passenger cars by 1878 (White 510, Churella 578). A year later, the PRR and most of its other subsidiaries committed to the improved Janney coupler in nearly all their passenger services. Improvements in strength (covered by a new patent in 1882) convinced the PRR and the Burlington to start installing Janney couplers on freight cars during the 1880s. Finally, a trade group of railway officers and suppliers, the Master Car Builder Association, sponsored a three-day "Olympics of car couplers" in

September 1885, testing 42 unique models in a Buffalo, New York freight yard of the Erie Railroad. Yet "nothing was really settled" according to the leading authority (White 511-515).

The MCB clearly favored Janney's design, but its rules prohibited the Association from endorsing any patented or proprietary technology. If the rule made ethical sense, it also obstructed efforts to achieve a new and better standard coupler. In 1888, the leadership of the MCB persuaded the Janney patent-holders to waive a key aspect of the patents: the contour or shape of the closing knuckles or jaws. Now the path was cleared for the MCB to endorse Janney's basic concept, renaming it the MCB coupler. But a new obstacle quickly arose to block national standardization. With the profile in the public domain, many manufacturers crowded into the market, all selling couplers whose knuckles had the standard profile required to mate. But those makers redesigned the other parts to become unique, proprietary designs. In 1891, 19 "major firms" offered MCB couplers; a decade later there were over 90 (White 515). Cars in interchange service with MCB couplers would couple up readily enough. But carriers now had to stock hundreds of spare parts to repair broken couplers of "foreign cars" that interchanged onto their lines. It was a nightmare. No wonder that MCB adoption proceeded slowly. In 1890, MCB couplers were on less than 14 percent of the national fleet of freight cars. Long before then, Janney had sold his patent rights to the Pittsburgh machinery firm that made his design. In the end, he received scant reward for all his efforts.

By the early-1890s, major carriers like the PRR had fully committed to air brakes and the MCB coupler in freight and passenger service, ordering all their new cars with those appliances and retrofitting older stock as it came into the shops for periodic rebuilding. Despite that progress, the pace of change nationally was slow. In 1893 freight cars with air brakes accounted for less than 10 percent of the US fleet. Spurred by this slow rate of improvement – and by Lorenzo Coffin's campaign -- Congress passed the Safety Appliance Act of 1893. The statute required air brakes and automatic couplers on all trains operating in interstate commerce within five years. The deadline was draconian, but law's details show that legislators had some insight into the difficulty of imposing national standards for technologies. The air brake rule actually required that trains had *enough* cars with airbrakes by 1898 so that the engineer had full control over the train. Some old-style hand-braked cars could remain in service until replaced in the normal course of business. And like the Master Car Builders Association, the statute did not specify the Janney coupler per se. Any type of automatic coupler that kept men out of harm's way was ok. Nonetheless the carriers pleaded for delay, and Congress granted an extension for compliance to 1900.

Historians differ on whether these legislative actions were necessary or effective. Albert Churella argues that "in the case of air brakes and automatic couplers, effective federal safety legislation lagged behind railroad practice" (Churella 580). Mark Aldrich concedes that "there is little evidence that it [the 1893 statute] speeded up the diffusion of brakes and automatic couplers but contemporaries certainly thought that it did" (Aldrich 111). The unstated corollary to these arguments is that railroads' general drive to lift productivity was perhaps more important than the law in driving the adoption of Janney couplers. Whatever the motive, during this period (1890-1909) the rate of coupling accidents fell by half (Aldrich 114). Aldrich also argues that the law was a starting point, not a culmination, since "the new appliances revealed [in their initial use] that better safety required much organizational change and learning" (Aldrich 112).

That learning process extended well into the first decades of the 20th century. In 1899, the MCB created detailed specifications for couplers, and it mandated ongoing tests to ensure their strength. Leading makers adopted cast steel to improve strength. In 1905, the Interstate Commerce Commission forced railroads to refuse to accept cars in interchange service (i.e.: cars from another carrier) if their couplers or brakes were defective. And in 1916, the American Railway Association (successor to the MCB) finally settled on a single coupler design, with *all* its parts and profile standardized. This "Type D" coupler became the American national standard, and its use spread to other countries.

Thanks to these developments, the basic Janney design of 1878 finally became the sole standard in use nationally by 1916, with few exceptions (Aldrich 113). All this took place against a larger backdrop of change, nearly a revolution in American railroad practice at the turn of the 20th century. The carriers invested heavily in new, powerful locomotives; new steel freight cars replaced wooden types; and train weights, speeds, and frequencies all grew (Martin, chapter 3). In just a decade (1900-1910), the national fleet of freight cars grew from 1.3 to 2.1 million (White 611). The adoption of standard couplers was one crucial element in this massive investment in railway productivity.

This story does not end in 1916. American railroads and car builders have periodically adopted successive standard coupler designs (Types E and F) as freight cars have grown in size and capacity. The Type H for passenger service, known as a "tight-lock" coupler, helps keep cars from uncoupling during derailments, greatly improving passenger safety during these accidents. FIGURE 6 – TELESCOPED CARS. FIGURE 7 – MODERN PASSENGER DERAILMENT Most of these types will couple with the others, and all are "right-handed" when viewed from above. All are known today as AAR couplers, the name reflecting the Association of American Railroads, successor to the Master Car Builders Association. Four firms still make these essential components, including Eli Janney's original manufacturer, McConway & Torley. Modern couplers retailed for about $1,000, they reliably haul loads exceeding 10,000 tons, and they are a central part of railroad efficiency and capacity. If he did not make a lot of money, Eli Janney left his mark on history.

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