Organizing a Market for Technological Innovation: Patent Pools and Patent Politics on American Railroads, 1860-1900

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The American patent system has not worked out as its creators imagined it would. By this I do not mean to suggest that the system has failed to "promote progess in Science and the Useful Arts," as the Constitution intended. The first two centuries of United States history were characterized by extraordinary technological change, and the patent system was there throughout. Whether a causal connection can be drawn between the two, no one can say for sure. What we can say with certainty is that the system has functioned--or been used--in ways no one attending the Constitutional Convention had in mind. A system designed for individuals operating in free or large markets has, ironically, provided a basis for some of the most infamous attempts by corporations to stablilize or control markets. The system has even pawned a particular brand of *interfirm* organization, the patent pool.

Most of what we know about patent pools comes from studies of the manufacturing sector. In steel, electric generating equipment, telephony, radio, and chemicals, to cite some of the most familiar examples, producers collaborated during periods of rapid technical development rather than risk stumbling over each other's patents. Nearly thirty years ago, in his overview of American industry during the era of big business, Edward C. Kirkland shrewdly identified the psychology of corporate managers who joined such pools and connected it to the business climate of the times. "In the era of enough uncertainties," wrote Kirkland, "the patent system with its threats of infringements, court suits, and damages presented producers with the additional prospect of losses of great magnitude . . . . Uncertainties of this sort businessmen met, as they met others during this period, by cooperation" [23, pp. 190-191].

One of the most effective and comprehensive patent pools of the nineteenth century existed in the transportation sector, among American railroads. This pool functioned not so much to facilitate production of patented articles but to enable consumers to make use of them more easily. Operating informally almost from the beginning of the industry, it grew steadily more institutionalized and more effective during the decades that followed the Civil War. By gathering information about technology and coordinating legal action among railroads, rather than actually collecting

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patent rights, the pool virtually removed patent rights from consideration in railroad innovation. This paper seeks to explain the origins and functions of the railroad patent pool and in doing so suggests that corporations reacted to the patent system in more varied fashion than studies of the manufacturing sector have led us to believe.

Basics: Competition, Technology, and Suppliers in the Railroad Industry

The conditions that sustained the railroad patent pool existed long before the pool itself. Indeed, these conditions were to a considerable degree inherent to railroading and thus were present virtually from the start of the industry. I have examined these conditions much more fully in other contexts so in the interest of time I will focus on three elements [45].

Fundamentally, any patent pool is based upon the willingness of its members to cooperate in matters involving new technology. American railroads always exhibited a high degree of cooperation in technical affairs. Extensive correspondence among managers at different lines, frequent trips by skilled mechanics, a proliferation of technical journals and associations all suggest that in technical matters railroads harbored no secrets.

In large part because of the importance of system, innovation in the railroad industry assumed a certain character. Over time, railroads found themselves operating amid greater constraints while searching ever more diligently for ways to cut costs. Technological innovation had to conform to those criteria. To their good fortune railroads found they could gain extraordinary economies by incrementally increasing the scale of their existing technology without dramatically altering the contours of the basic system. Cars grew in capacity from 10,000 to as much as 100,000 pounds, locomotives developed far more power, and the weight of rails increased from about 60 to over 100 pounds per yard [12]. In none of these areas of technology can one point to major devices that made the change in scale possible. Rather, the changes seem to have depended on the steady accumulation and systematic evaluation of craft knowledge gained from practical experience and on the ability to use new materials, especially metals.

The nature of railroad technology contributed significantly to the third aspect of the industry that facilitated creation of patent pools--the relationship between railroads and their suppliers. If one group had a genuine interest in remaining outside the cooperative technical effort and maintaining proprietary control of technology through patents, it was suppliers. Because of the nature of railroad technology, however, railroads often possessed technical information of importance to suppliers. Most innovations involving metallurgy or other materials, for instance, involved matching experience in service with manufacturing processes performed by suppliers. Refinements in locomotive design could not be fully evaluated without extensive tests in service. Because of their unusual maintenance requirements, railroads acquired technical capabilities that enabled them to develop remedies for technical problems themselves rather than relying on outsiders. Inventors and suppliers of railroad technology operated in a world of extraordinarily well-educated customers who could easily fend for

themselves if provoked. In addition to these technical factors, business considerations drew railroads and suppliers into unusually close relationships.

These unusual characteristics of relations between railroads and suppliers, combined with the special nature of railroad technology and the distinctive aspects of competition among railroads, produced an environment in which innovation can hardly be described as flowing from free competition among inventors seeking to meet the demands of a broad market. This environment deviated significantly from that envisioned by the creators of the American patent system. In the world of railroad technology, especially as viewed from the perspective of railroads themselves, patents had no place. Therein lies the key to the railroad patent pool.

Railroad Patent Policies

At least until the Civil War, patents were accepted as a routine component of technical affairs in the railroad industry. Between 1853 and 1865 the number of patents granted for inventions pertaining directly to railroads increased from about 50 to well over 300 per year [38]. Circulars describing patented devices flowed into the offices of railroad executives, and at least some managers paid them serious attention. In general, however, managers dealt with patents largely on an *ad hoc* basis, and consequently they never defined a coherent set of patent policies.[1] Robert Harris, chief operating officer of the Chicago, Burlington, and Quincy Railroad, exhibited a keen interest in patents, but until 1872 he did not even maintain a centralized list of all licensing agreements. Employees sometimes signed over all rights to their inventions, but by no means had this become a standard condition of employment in the industry. At best, one can identify from many separate cases certain tendencies of behavior regarding patents. Two stand out. The most important of these was a preference for obtaining licenses rather than buying patented products on the open market. Licenses guaranteed access to unlimited numbers of a given device in a standard form and enabled railroads to take advantage of the manufacturing abilities of their own shops and those of the major shops and foundries with whom they subcontracted. The second tendency was that the later a road adopted a device, the less likely it was to pay a license fee.

By 1880 this vaguely defined, highly personalized, and generally lax approach to patents had given way to rigidly formalized procedures administered within each company by its bureaucracy and at an industry-wide level through cooperative associations. Top executives stopped paying much attention to patents. Employees routinely signed over rights to their inventions to their employers. Nearly all companies belonged either to the Eastern or Western Railroad Association, which served as a central clearinghouses for information regarding patents affecting the railroad industry. All patents generated by railroads flowed to these organizations

[1]This characterization of railroad management and similar ones which appear throughout this essay are based primarily on my reading in the archives of several nineteenth century American railroads [1, 4, 28, 29].

so that railroads, as they refined their technical systems, could steer clear of innovations covered by patents held by individuals outside their employ. In legal disputes the associations coordinated defenses, drawing on the combined experiences of their members to establish precedence over an inventor or to fix a license fee far below that being asked by the owner. The associations even coordinated efforts to revise the patent laws and place them on a basis more favorable to railroads.

What prompted this shift to more institutionalized cooperative arrangements between 1860 and 1880? In one sense, the imperatives of standardization, growth, and bureaucratization account for the change. As in every branch of railroad administration, an ad hoc approach to patents meant frequent duplication of effort and excessive involvement of top management [3].

But the associations that formed the core of those policies had their origins in more proximate causes. During the 1860s legal decisions in several cases of patent infringement threatened the railroads with enormous liabilites. These potential damages resulted from a new interpretation, known as the doctrine of savings, which passed all economic savings derived from unauthorized use of a patented device back from the infringer to the holder of the patent. This doctrine, which was sanctioned by the Supreme Court, emerged from a series of patent cases involving inventions and patent arrangements typical of railroad innovation at the time. Consequently, it posed a serious threat to all innovation in the industry. Railroads sought through newly formed patent associations either to have the doctrine reversed or to eliminate the conditions that permitted its application.

The doctrine of savings marked a serious and carefully reasoned effort by the judicial system to take a system of patent law that had been conceived for a market economy and apply it to an environment characterized by limited or nonexistent markets. Traditionally, courts had assessed damages by determining the profits made through sales to consumers who had not infringed. Those convicted of infringement paid three times the profits lost. In situations where the patent holder sold licenses instead of finished products, damages totalled three times the established license fee. This method presumed that enough transactions had taken place to establish a market price for either the product or the license. Over time, patent holders convinced the courts that in industries such as railroading, with its limited number of potential customers, the market never established a fair value for an invention. A few railroads bought licenses at a discount before a device had proven its worth, then others infringed, figuring they would at worst pay three times an artificially discounted price. Once courts accepted this argument, as they had good reason to do, they searched for alternative means of calculating damages. They settled on the savings provided [42].

Of the cases that established the new legal terrain by far the most important to the development of railroad patent policies involved "double-acting" brakes. These brakes, which first appeared around mid-century and within a dozen years had become almost universal in both freight and passenger service, enabled a brakeman to apply retarding force simultaneously to both trucks of a car by turning a single brake wheel.

Railroads could accomplish this effect by adding familiar mechanical linkages, arranged any number of different ways, to their existing brakes. Most companies converted their fleets in a piecemeal fashion as cars came into the shops for repairs [42]. In many respects, then, double-acting brakes could serve as a prototype for the generic sort of innovation that characterized much technological change in the railroad industry.

Like many such innovations of the period, double-acting brakes had in fact been patented. Indeed, between 1849 and 1853 the United States Patent Office had issued three separate patents covering the double-acting principle and had granted a re-issue on the first of the three [38]. The initial grant and re-issue went to Nehemiah Hodge; the second to Francis A. Stevens; and the third to Henry Tanner. The Tanner patent, though not issued until 1852, was derived from an application submitted in 1847 by two other inventors who had since assigned rights to Tanner.

During the 1850s, as they adopted various forms of double-acting brakes, many railroads obtained licenses under one patent or another. Some used Stevens but licensed Hodge, others the reverse. Almost every possible permuation appeared. Threats of legal action reached the B&O by mid-century, and by 1862 major railroads located in Chicago found themselves in federal court defending separate infringment suits involving the Tanner and Stevens patents. Ownership of the Stevens patent apparently had passed to a Mr. Enigh, who now sued the Burlington for infringement [5,6,24,25,37,43]. Meanwhile, Thomas Sayles, who once claimed to own all three patents, pressed a suit against the Chicago and Northwestern for infringing the Tanner patent [32]. To John Cochrane, a patent lawyer employed by several railroads in the East, the prospect of the joint suits was appalling. Either Tanner or Stevens should go to court and get the other patent overturned, he complained, because two valid patents could not exist for the same thing. Instead, the owners "agreed among themselves to extort money from railroad companies under the pretense of a patent which they know must be invalid"[7]. The strategy, however appalling, proved effective in the Chicago courtrooms. In 1865 Sayles obtained the first of what would prove to be a series of victories [32], and the following year Enigh won his case against the Burlington [9,24,43]. To make matters worse for the railroads, both patents received seven-year extensions at about the same time [39,40].

This series of defeats gave birth to the railroad patent associations. Early in 1867 the major Chicago roads and other western lines agreed to join the Western Railroad Association, which would conduct common defenses in patent suits and monitor all issues relating to patents in the industry [42]. About a dozen major eastern roads agreed to form an identical organization [19,20]. Lines would pay annual fees, assessed on a mileage basis, and in return receive full legal services, including consultation on the legal status of all inventions. Members agreed to provide any information regarding disputed technologies and to inform the associations of inventions developed in their own shops. Any member who reached a settlement with an individual currently bringing suit against another member would sacrifice its rights to defense by the association [11]. These terms, which to a considerable degree merely formalized practices railroads had

previously performed on an occasional basis, met with widespread approval. By 1876 the WRA included 81 lines operating 32,000 miles of track [42, pp. 225-226], and nearly every major line in the East belonged to the ERA [22].

The brake cases occupied the vast majority of the energies of these associations during their first decade or more. Lawyers who had argued the cases filled the only full-time positions and they continued to devote themselves to the many appeals that followed.

Ironically, the associations ultimately enjoyed less success in the brake cases than in most other aspects of their work. The WRA lost its appeal to the Supreme Court in the Stevens case in 1868 and Enigh proceeded to secure settlements with many railroads for $25 per car for each year of infringement [9]. For much of the 1870s the associations suffered a series of setbacks in the Tanner case as well. The federal courts in Illinois rendered decisions against the Chicago and Northwestern in 1871 and 1873. The latter decree, moreover, affixed damages of $455 per car for each year of service, for a total of nearly $64,000 on the Chicago and Northwestern alone. These damages, based on savings in brakemen's wages and in wheel wear, represented the largest yet awarded using the doctrine of savings principle. Two years later the court reduced the allowance for wheel wear, but damages remained over $300 per car per year, with appeal to the Supreme Court the only legal option left [32,39].

At that point the WRA reoriented its efforts toward obtaining legislative relief. In 1873 the Association mounted a lobbying effort that blocked Sayles from obtaining a second extension of the Tanner patent [14,15,17,18,21,47]. Lawyers from the WRA also drafted legislation that would have placed a stringent statute of limitations on damage suits, cleared many patents off the books, and compelled courts to assign reasonable license fees as a basis for damages, without regard to savings. Bills with these or similar provisions remained before Congress for nearly a decade. Hearings by the Committees on Patents attracted the most respected patent lawyers from around the country, and in 1879 the WRA's bill occupied weeks of debate in the Senate just prior to adjournment. During one or more sessions both houses of Congress passed bills containing many of the provisions railroads desired. But no bill ever emerged from conference and became law [8,13,30,31,41,42,46].

The pain of this narrow miss in Congress was softened considerably by the decision of the Supreme Court in the Tanner case in 1878. The court ruled in favor of the Chicago and Northwestern on grounds that use of the Stevens brake did not infringe the Tanner patent. While this judgement did not provide relief for railroads that had infringed Stevens and left the doctrine of savings intact, it did prevent Sayles from collecting the enormous damages awarded in Chicago under that doctrine. Perhaps more importantly for the long run, the court based its decision on the grounds that railroads had previously employed on an experimental basis devices that performed on the same principles as the Tanner brake. Though these devices were "not so perfect as that of [Tanner]" and though railroads had never actually patented them, their use invalidated Tanner's claim to have achieved a basic principle. "Like almost all other inventions," wrote Justice

Bradley, "that of double brakes came when, in the progress of mechanical improvement, it was needed; and being sought by many minds, it is not wonderful that it was developed in different and independent forms." Expressing a philosophy of technical change in which the railroads could find great comfort, he continued, "if the advance towards the thing desired is gradual, and proceeds step by step, so that no one can claim the complete whole, then each is entitled only to the specific form of device which he produces" [32].

With this rationale, the Supreme Court effectively sanctioned the sorts of legal arguments that the railroad associations would almost always be capable of advancing. With access to nearly all companies in an industry that continually experimented, the lawyers at the ERA and the WRA could readily establish precedence and undermine broad claims pertaining to virtually any aspect of technology. Since courts had the right to review questions pertaining to originality at every stage of appeal, the railroads stood an excellent chance of escaping liability at some point in the judicial process. With courts willing to consider techniques that had not been patented as evidence of priority, moreover, the associations or their members would not have to take out patents themselves in order to accomplish their goal. They needed only to pool information.

Facing such prospects, inventors would often compromise with the railroads without any litigation. Indeed, aside from the brake cases, virtually no patent disputes went to trial. Under these circumstances, association lawyers devoted their efforts to gathering information on patents and experiments, so that they could readily advise railroads on how to innovate without encountering patents or how to avoid paying large fees for technologies covered by patents. The files of the Baltimore and Ohio and the Chicago, Burlington, and Quincy contain numerous examples of their work in this regard [1,4].

Perhaps the best testimony to the effectiveness of the pools came from the reactions of inventors. Never an easy group to organize, inventors banded together to fight the patent associations. A group known as the Inventors Protective Agency, formed in the early 1880s to counter the legislative efforts of the railroads, unsuccessfully challenged the legality of the railroad associations [27,33]. Other inventors accepted the associations and submitted their patents for approval or certification. To facilitate such evaluations, the ERA had by the mid-1870s acquired testing apparatus similar to that used in the mechanical laboratories some railroads had recently opened. By 1880, however, requests for certification had become so common that the manager who replaced Harris as the Burlington's representative to the WRA saw them as an opportunity to place the organization on a self-supporting basis. At his suggestion, the WRA began to charge a regular fee for this service [2]. A few years later, the secretary of the ERA promoted the idea of a Bureau of Inventions, whose staff would pass judgment on the technical merits as well as the legal status of all new devices [10,34].

In performing these evaluations, the lawyers who worked for the associations tread a fine line between advancing the interests of inventors and acquiring knowledge that would preserve the freedom of railroads to

innovate without liability. In 1878 the longtime secretary of the ERA, S. M. Whipple, was forced to resign after he lent his name and title for use in an inventor's advertising [26]. The Burlington's representative returned from a meeting of the WRA in 1886 with a warning that some manufacturers had begun to get one device certified then offer a different version for sale [35].

Issues such as these signalled that the formalization of railroad patent policies had reached its logical conclusion. The idea of a Bureau of Invention was clearly the brainchild of a second generation of administrators, not of the lawyers who had founded the Associations while in the heat of battle over the brake cases. These administrators performed tasks that, while important and effective, had become so routine that many subscribers failed at first to recognize their usefulness. Many executives learned of the associations only upon entry to the inner circle of management, and at first encounter economizing managers such as Charles Perkins of the Burlington sometimes questioned their value [36]. In its published annual reports the secretary of the ERA each year explained the functions of the organization, generally in tones that were decidedly defensive, as if he felt compelled to justify his existence [10]. In this context the proposed Bureau of Inventions appears as an attempt by professional administrators to secure the continuing vitality of an established, static institution.

Not surprisingly, nothing came of the proposed bureau. The very idea ran counter to the association's primary objectives of reducing the importance and visibility of invention. Railroads left the business of evaluating technology to engineering organizations where their own employees coordinated studies and reached considered judgments. Interestingly, the constitutions of these organizations expressly prohibited the advocacy of specific, patented articles in their specifications and standards [44]. Their members conceived of problems to be worked out, not inventions to be made. To them, as to Justice Bradley, innovation flowed steadily if inconspicuously from the routine.

Conclusions

In some respects the railroad patent associations lend considerable credence to Edward Kirkland's characterization of the corporate response to patents as "cooperation" in the face of "uncertainty." When the courts and some clever dealers in patents threatened to transform each infringement suit from a nuisance into a potential source of substantial liability, railroads responded with concerted action. But when compared to the patent policies of firms such as the electrical suppliers, those of the railroads indicate that the interplay between corporations and the patent system produced varied results. Railroads tended naturally to pool their technology, and for them the patent system functioned primarily as a threat to that natural process. They saw nothing of the opportunities to monopolize or stabilize markets that people in the manufacturing sector found so enticing, and occasionally so inescapable, in the patent system.

Neither approach, of course, could easily have been anticipated by those who in 1789 conceived of the patent system as a means to secure for

the public the benefits of progress in the useful arts by grant of limited monopoly. Manufacturers certainly tried to make much more of that monopoly than was intended, and railroads no doubt tried to make far less. Whether one or the other of these approaches had a more or less deleterious effect on the ability of the public to secure its benefits, we cannot know for sure.

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