# Fordism

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Up to the introduction of the moving assembly line at the Ford Highland Park plant in 1913–1914, automobiles were made and sold much the same way on both sides of the Atlantic; that is, they were assembled from jobbed-out components by crews of skilled mechanics and unskilled helpers at low rates of labor productivity, and they were sold at high prices and high unit profits through nonexclusive wholesale and retail distributors for cash on delivery.

Nevertheless, differences in national manufacturing traditions manifested themselves from the beginnings of the automobile industry, particularly those differences that added up to great American superiority over the Europeans in production engineering. As early as the turn of the century, it was accepted as axiomatic that, unlike European producers, "American manufacturers have set about to produce machines in quantity, so that the price can be reduced thereby and the public at large can have the benefit of machines which are not extravagant in price, and which can be taken care of by the ordinary individual."[1]

The initial capital as well as the managerial and technical expertise needed to enter automobile manufacturing was most commonly diverted from other closely related business activities, particularly from the manufacture of machine tools, bicycles, and carriages and wagons. The requirements for fixed and working capital were also met by shifting the burden to parts makers, distributors, and dealers. The automobile was a unique combination of components already standardized and being produced for other uses—for example, stationary and marine gasoline engines, carriage bodies, and wheels. Consequently, the manufacture of components was jobbed out to scores of independent suppliers, minimizing the capital requirements for wages, materials, expensive machinery, and a large

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factory. So once the basic design of his car was established, the early automobile manufacturer became merely an assembler of major components and a supplier of finished cars to his distributors and dealers. The modest assembly plant needed could be rented as easily as purchased, and the process of assembling was shorter than the thirty- to ninety-day credit period the parts makers allowed. Operating on this basis, the Ford Motor Company was able to start in business in 1903 with paid-in capital of only $28,000, a dozen workmen, and an assembly plant just 250 feet by 50 feet. The chassis (engines, transmissions, and axles) of the first Ford car were supplied by the Detroit machine shop of John F. and Horace E. Dodge, which earlier had supplied transmissions for the curved-dash Olds. The Dodge brothers became minority stockholders in the Ford Motor Company.

Demand for automobiles was so high that manufacturers were able to exact exorbitant concessions from distributors and dealers in exchange for exclusive territorial rights. European makers required advance cash deposits ranging from 10 to 33 percent on all orders, with payment in full upon delivery. In the United States advance cash deposits of 20 percent were required on all orders, with full payment demanded immediately upon delivery through a sight draft attached to the bill of lading. Moreover, cars had to be accepted by dealers according to a prearranged schedule, regardless of current retail sales, thereby allowing the manufacturer to gear shipments to production. Roy D. Chapin recalled that as late as 1909, when the Hudson Motor Car Company was beginning in the industry, "dealers' deposits often paid half the sum necessary to bring out a full year's production; and if the assembling were efficiently directed, drafts against the finished cars could be cashed as rapidly as the bills from parts makers came in."[2]

Skilled machinists, each capable of operating efficiently a large number of general-purpose machine tools, predominated in the work force numerically and directed production in the workplace. They were aided by unskilled helpers, who performed menial labor, such as carting and hauling material, at about half the pay of the skilled machinists. Increasingly, semiskilled specialists, who could operate one or more specialized machines, were also employed, especially in the United States. The skilled machinists had wide latitude in determining the pace of work, in setting the standards of production, and in hiring and firing their unskilled and semiskilled helpers. Consequently, there were few purely supervisory personnel, such as foremen, in the shops and small factories where components were made or assembled into completed automobiles.

General-purpose machine tools predominated over more specialized machines; there was little use of specialized jigs or fixtures to position the



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work; and tool benches equipped with the machinists' personal hand tools were placed in close proximity to machine tools. Machine tools of the same or similar type were grouped together, and material was conveyed by hand from one group of machines to another to be processed. Final fitting and finishing to acceptable tolerances generally involved hand filing and hand grinding. The principal component remained stationary on the shop floor until assembly was completed, while other components were brought to it and affixed. Thus chassis stood in rows as assembly crews moved from one to another affixing bodies and wheels.

So long as and wherever such artisanal production persisted, labor productivity was extremely low. Among even the larger French producers, at De Dion–Bouton in 1901 some 1,300 workers produced an estimated 1,200 cars; at Renault in 1902 some 500 workers produced 509 cars, and as late as 1913, 3,900 workers produced 4,704 cars. British labor productivity was even lower. At Austin in 1907 it took 400 workers to produce only 147 cars, and in 1913 some 2,300 workers produced only 1,500 cars. Morris Motors, entirely an assembly operation, was the only British maker in 1913 with an annual production of more than one car per worker. Labor productivity was equally low among the makers of luxury cars in the United States. As late as 1913, and after Frederick Winslow Taylor's principles of "scientific" management of labor had been adopted to rationalize production, at Packard in Detroit it still took 4,525 workers to produce only 2,984 cars, an annual production rate of about one car for every 1.5 workers.

Such low labor productivity meant correspondingly high prices for cars. The low production runs of only a few thousand cars annually associated with low labor productivity also militated against the establishment of exclusive franchised dealerships; for to sell enough cars to survive, most dealers had to handle several competitive makes.

Artisanal production lingered on as the norm in Europe long after it was abandoned by American automobile manufacturers. Of Daimler's 1,700 production workers in 1909, for example, 69 percent were skilled, 11 percent semiskilled, and 20 percent unskilled. And over a decade later, in 1920, among the Peugeot workers at Souchaux 65 percent had a skilled rating, 25 percent were semiskilled, and 10 percent were unskilled.[3] The continuing commitment of European manufacturers to artisanal production is also evident in their attempts at late dates to institutionalize the training of apprentice skilled machinists. For example, a 1904 law in France limiting the work hours of persons under age eighteen to ten hours a day brought the dismissal of most apprentices from automobile factories, which operated for longer hours. As a consequence, Panhard et Levassor



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and Darracq set up separate workshops with three-year courses to train teenage boys as machinists. In England such a technical school was established as an adjunct to the Austin factory as late as 1919.

Data for the Ford Motor Company are in sharp contrast. On the eve of the introduction of the moving assembly line in 1913, the Ford labor force of 13,304 was already classified as only 2 percent "mechanics and subforemen," versus 26 percent "skilled operators," 51 percent "operators," and 21 percent "unskilled workers." Even in its first year of operation, 1903–1904, the Ford Motor Company had produced about 12 cars annually for every worker it employed. A comparable production rate was not achieved by Morris Motors, the largest and most efficient British producer, until a generation later, in 1934, when Morris turned out 11.6 cars per worker. Average annual output at that date for the British automobile industry was only about 6 cars per worker. Similarly, Patrick Fridenson notes that in France in 1927 it took 300 man-days to manufacture a car, whereas in the United States it took 70.[4]

## "The American System of Manufacturing"

Harking back to Adam Smith's classic exposition of the division of labor in pin manufacture in his capitalist bible *The Wealth of Nations*, Henry Ford in 1903 told John W. Anderson, "The way to make automobiles is to make one automobile just like another automobile, to make them all alike, to make them come through the factory alike—just like one pin is like another pin when it comes from the pin factory, or one match is like another match when it comes from the match factory."[5] The master of mass production described its constituents in the thirteenth edition (1926) of the *Encyclopaedia Britannica* as "the focusing upon a manufacturing project of the principles of power, accuracy, economy, system, continuity, speed, and repetition." These were all well-known aspects of an evolving American manufacturing tradition by the time they were adapted to the Model T and perfected at the Ford Motor Company.

For several reasons, the United States afforded an unparalleled market for motor vehicles, the most costly durable consumer product of the second industrial revolution. With its vast land area, hinterland of scattered and isolated settlements, and relatively low population densities, the United States had a far greater need for individualized automotive transportation than the nations of Western Europe. Even more important, great effective demand was ensured by a higher per capita income and more equitable income distribution than in European countries—an estimated average annual per capita income in 1914 of $334 for the United



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States, compared with only $243 for Great Britain, $185 for France, and $146 for Germany.

Historically, the absence of tariff barriers between the states also had encouraged sales over a wide geographic area. By 1910 this comprised a vast free-trade area of some 92.2 million people. European competition in this high-demand American market was effectively nullified by a 45-percent tariff on motor vehicles imported into the United States, reduced in 1913 to 30 percent on cars costing under $2,000 and on chassis and parts. In contrast, tariffs ranged from only 3 percent in Germany to 12 percent in France and Belgium, and the United Kingdom was free of tariffs on cars until the imposition in 1915 of the 33⅓-percent McKenna duties, which Ford and General Motors avoided paying by forming British subsidiaries.

Such market conditions combined with low raw material costs and with a chronic shortage of labor, especially skilled labor, to encourage the mechanization of industrial processes in the United States. This necessitated the standardization of industrial products and resulted in the early establishment of volume production of standardized commodities. The consequent American superiority in production was acknowledged by Europeans by the mid-nineteeth century. In the hope of learning from the United States, the British Parliament, for example, in 1854–1855 solicited several reports on what came to be called "the American System of Manufacturing."[6]

The automobile was neither the first nor a unique commodity that Americans excelled over Europeans in producing. Saul in particular has dealt in detail with the so-called invasion of European markets by American products form 1895 through 1914. He views this invasion as being "due to a new technology in which the major elements were standardization and mechanization, the use of interchangeable parts and the development of the art of management to plan and coordinate these processes of mass production. Firearms, sewing machines, typewriters, agricultural machinery, and watches were some of the products of this new approach." Particularly pertinent to the later dominance of the American automobile industry was the "unprecedented import of locomotives," invasion in "an industry in which Britain considered herself supreme." Compared with the British locomotive, the American locomotive, "though less perfect technically, was cheaper, more flexible, and rode better on a poor track.... The Americans also had the advantage in that their locomotives were less complex, parts were made interchangeable, and the design standardized so that it was possible to build for stock."[7]

The British and French automobile industries suffered from the inordinate influence of too many formally trained engineers, who sought



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technical perfection in automotive design at the expense of standardizing design at the point where an automobile was a commercially satisfactory product, then concentrating on cutting production costs to lower its price. Moreover, French and British automotive entrepreneurs consistently underestimated the potential market for cars. "Even if we set aside the story of what happened in the United States automobile market after 1909 as hardly relevant to the European scene," remarks Laux, "the French development of a mass market for cars in the 1920s (passenger car production climbed from 41,000 in 1921 to 212,000 to 1929) strongly suggests that it was waiting to be tapped before 1914." And Richardson points out that in 1926 it was believed by British automobile manufacturers that no one with an annual income less than £450 could afford to own a car, which meant a possible home market for only 835,000 motor vehicles. Yet British registrations exceeded the million mark as early as 1930, demonstrating that effective demand was greater than had been assumed. Most important, the level of demand was taken as a given by French and British automotive entrepreneurs, and in contrast with the drive at Ford to expand the market for the Model T, little was done by the Europeans either to lower the unit costs of cars or to raise the purchasing power of workers as consumers.[8]

Underlying American excellence in production was a machine tool industry vastly superior to that of Europe. Nathan Rosenberg has demonstrated that technological innovation in the nineteenth-century machine tool industry had an exponential impact, because innovations in machine tools revolutionized the manufacture of not just one but many diverse industrial products.[9] Because of the much larger domestic market in the United States compared with European countries, American machine tool makers had come to specialize in single types of tools that could be produced in volume, while European machine tool makers continued to make a variety of tools for much smaller markets. During the nineteenth century the American machine tool industry had become accustomed to providing specialized machine tools for the quantity production of many items, most importantly firearms, sewing machines, and bicycles. Moreover, "technological convergence" occurred, because machine tools used for the manufacture of these diverse items performed roughly the same functions of boring, cutting, grinding, planing, and otherwise shaping materials. Thus, improvements made in the machine tools for manufacturing one item were incorporated by the machine tool industry in tools performing comparable functions designed for manufacturing other items.

As a consequence, the American machine tool industry was well equipped to meet the great demand of the automobile industry for special-



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ized tools. Early French automobile manufacturers were dependent upon American firms for some 70 to 80 percent of their machine tools. Even when European metalworking factories adopted American-made machine tools, observers reported that they failed to achieve as much production from them as American workers did. And in some cases European workers refused to operate semiautomatic, specialized machine tools because their introduction threatened the craft tradition well established in European factories.[10]

A number of innovations in specialized machine tools for the automobile industry were introduced in the United States even before American output of motor vehicles overtook the French. At the Paris Exposition of 1900 new cutting tools made from High Speed Steel, developed by Frederick Winslow Taylor for the Bethlehem Steel Company, were shown to increase by a factor of three the cutting speed of machine tools. Innovations in 1903 included a multiple drill press to work cylinder blocks and heads, a machine to grind cylinders, a lathe to turn camshafts, and a vertical turret lathe specially designed to turn flywheels. A crankshaft grinder developed by Charles Norton in 1905 duplicated in fifteen minutes what had previously required five hours of skilled handwork. It was these great American improvements in cutting and grinding tools that permitted the use of lighter but tougher hardened alloy steels in mass-produced cars such as the Ford Model T.[11]

Though it led the industry in developing the mass-produced, low-priced car, the Ford Motor Company was far from unique in its effort to increase output greatly after 1908. With the appearance of the first reliable, moderately priced runabouts in the Ford Model N and Model T and the Buick Model 10, many of Ford's competitors also began to attempt to cut manufacturing costs and capitalize on the insatiable demand for motorcars by working out similar solutions to their common production problems. For example, innovations to reduce the time and cost of final assembly similar to those worked out at Ford were independently conceived by Walter P. Chrysler after he replaced Charles W. Nash as head of Buick in 1912. Buick production was more than quadrupled from 45 to 200 cars a day by changing outmoded procedures for finishing the body and chassis, which had amounted to "treating metal as if it were wood," and by installing a moving assembly line that consisted of "a pair of tracks made of two by fours" along which a chassis was moved from worker to worker by hand while being assembled. Chrysler recalled that "Henry Ford, after we developed our [assembly] line, went to work and figured out a chain conveyor; his was the first. Thereafter we all used them. Instead of pushing the cars along the line by hand, they rode on an endless-chain conveyor operated by a motor."[12]



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Charles E. Sorensen, who was in charge of production at Ford, was well aware that his company's contribution to mass production lay primarily in its refinement of the integration and coordination of the process of final assembly. In his 1956 autobiography he recalled: "Overhead conveyors were used in many industries including our own. So was substitution of machine work for hand labor. Nor was orderly progress of the work anything new; but it was new to us at Ford until Walter Flanders showed us how to arrange our machine tools at the Mack Avenue and Piquette plants." The significant contribution that Sorensen claimed for the Ford Motor Company was "the practice of moving the work from one worker to another until it became a complete unit, then arranging the flow of these units at the right time and the right place to a moving final assembly line from which came a finished product. Regardless of earlier uses of some of these principles, the direct line of succession of mass production and its intensification into automation stems directly from what we worked out at Ford Motor Company between 1908 and 1913."[13]

Before the moving assembly line was introduced at Ford, continuous-flow production had been achieved in a grain mill designed by Oliver Evans in the late eighteenth century, and in Admiral Isaac Coffin's 1810 oven for baking ships' biscuits in England. By the late nineteenth century in the United States it was common in flour milling, oil refining, breweries, canneries, and the disassembly of animal carcasses in the meat packing industry.

Yet in his definitive history of the rise of mass production, David A. Hounshell concludes that despite these earlier origins and uses of the constituent elements of mass production, "it is only with the rise of the Ford Motor Company and its Model T that there clearly appears an approach to manufacture capable of handling an output of multicomponent consumer durables ranging into the millions each year."[14] Indeed, the very term "mass production" dates from Henry Ford's 1926 *Encyclopaedia Britannica* article of that title. Until then, the system of flow production techniques perfected at the Ford Highland Park plant was popularly referred to as "Fordism."

## The Revolution at Highland Park

At Ford the moving assembly line was first tried one Sunday morning in July 1908 at the Piquette Avenue plant during the last months of Model N production. The parts needed for assembling a car were laid out in sequence on the floor; a frame was next put on skids and pulled along by a



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towrope until the axles and wheels were put on, and then rolled along in notches until assembled. This first experiment, however, was not elaborated into the installation of moving assembly lines until 1913, because the extensive changes in plant layout and procedures, in Sorensen's words, "would have indefinitely delayed Model T production and the realization of Mr. Ford's long cherished ambition which he had maintained against all opposition."[15]

There was general agreement in the automobile industry that the 62-acre Highland Park plant that Ford opened on January 1, 1910, possessed an unequaled factory arrangement for the volume production of motorcars. Its well-lighted and well-ventilated buildings were a model of advanced industrial construction. It is clear, however, from the fact that much of the plant was several stories high that it was not designed with moving assembly lines in mind. Its designer was the eminent Detroit architect Albert Kahn, who earlier had designed the reinforced-concrete Packard plant on Grand Boulevard in Detroit—"the prototype for twentieth-century industry."[16] Kahn went on to design the gigantic Ford River Rouge plant, the General Motors Building, and Chrysler's Detroit facilities.

Elementary time-and-motion studies begun at the Piquette Avenue plant were continued at Highland Park and in 1912 led to the installation of continuous conveyor belts to bring materials to the assembly lines. And with the move to Highland Park, manufacturing and assembling operations began to be arranged sequentially, so that components traveled to completion over the shortest route possible with no unnecessary handling. This entailed the abandonment of grouping machine tools together by type in plant layout.

Magnetos, motors, and transmissions were assembled on moving lines by the summer of 1913. After production from these subassembly lines threatened to flood the final assembly line, a moving chassis-assembly line was installed. It reduced the time of chassis assembly from twelve and a half hours in October to two hours and forty minutes by December 30, 1913. Moving lines were quickly established for assembling the dash, the front axle, and the body. The moving lines were at first pulled by rope and windlass, but on January 14, 1914, an endless chain was installed. That was in turn replaced on February 27 by a new line built on rails set at a convenient working height and timed at six feet a minute. By the summer of 1914 productivity in assembling magnetos had more than doubled, and chassis assembly took under two hours, about one sixth the time required with artisanal production methods. "Every piece of work in the shop moves," boasted Henry Ford in 1922. "It may move on hooks or overhead chains going to assembly in the exact order in which the parts are required;



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it may travel on a moving platform, or it may go by gravity, but the point is that there is no lifting or trucking of anything other than materials." [17]

In a plant that employed fewer than 13,000 workers, by 1914 about 15,000 specialized machine tools had been installed at a cost of $2.8 million. "The policy of the company," relate Allan Nevins and Frank E. Hill, "was to scrap old machines ruthlessly in favor of better types—even if 'old' meant a month's use." [18] After 1912 the 59 draftsmen and 472 skilled tool makers in the tool department were constantly devising new specialized machine tools that would increase production. By 1915 they had turned out over 140 specialized machine tools and several thousand specialized dies, jigs, and fixtures. Jigs and fixtures to set up and/or position work were called "farmers' tools," because with them green hands could turn out work as good as or better than skilled machinists. Machine tools became larger, more powerful, more specialized, and semiautomatic or automatic. A prime example was a special drilling machine supplied by the Foote-Burt Company. This machine drilled 45 holes simultaneously in four sides of a Model T cyclinder block and was equipped with an automatic stop and reverse. The cylinder block was positioned by a special jig, so all the operator had to do was pull the starting lever and remove the finished block.

At the industrial colossus that Ford began building on the River Rouge in 1916, Fordism was intensified. Nevins and Hill write that by the mid-1920s "in conveyors alone it was a wonderland of devices. Gravity, belt, buckle, spiral, pendulum gravity roller, overhead monorail, 'scenic railway' and 'merry-go-round,' elevating flight—the list was long both in range and in adaptation to special purpose. . . . At the entrance of the machining department, the various castings were routed mechanically to 32 different groups of machine tools, each unit then passing through a series of machine-tool operations—43 in the case of the Ford [Model T] cylinder block—before the finished shining element emerged, ready to be routed to assembly." By 1924 the River Rouge foundry cast over 10,000 Model T cylinder blocks a day, and by 1926 the 115-acre plant boasted some 43,000 machine tools and employed 8,000 tool and die makers. At the changeover to Model A production in 1927 the Ford Motor Company was estimated to have about 45,000 machine tools worth $45 million. Part of the Model A retooling involved the introduction of the electric welding of parts by self-indexing automatic welders to replace the traditional bolting together of subassemblies. These automatic welding machines were the forerunners of our current Unimate robots.[19]

This intensified Fordism, notes Fridenson, tremendously raised the capital invested in plant in relation to revenue at Ford—from 11 percent of revenue in 1913 to 22 percent in 1921, and to 33 percent in 1926—even



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as Ford inventories shrank by half and the time to fabricate a Model T from scratch fell from fourteen days to four. "The result was declining profit margins for Ford beginning in 1923," he observes. "The cost of producing a Ford touring car reached 93 percent of the selling price by 1926, and some models were sold to dealers at less than cost."[20]

The Ford Motor Company set the pace and direction of a new social order based on mass production and mass personal automobility in the United States until the mid-1920s, when Hudson surpassed and other American automobile manufacturers began to equal Highland Park's efficiency in production. The mass-production techniques innovated there were widely publicized and described in detail, most notably by Horace L. Arnold and Fay L. Faurote in their 1915 *Ford Methods and the Ford Shops*. Within a few years moving assembly lines had been installed by all major American automobile manufacturers. Production reached peak efficiency at Hudson, where by 1926 assembling an automobile took only ninety minutes, and cars rolled off its four final assembly lines every thirty seconds.

Although the mass-production techniques developed at Highland Park to meet the tremendous demand for the Model T became synonymous in the mind of the public with Henry Ford's name, the evidence is unequivocal that both the Model T and mass production, in Reynold Wik's words, "represented the efforts of a team of engineers, rather than the inspiration of one man, Henry Ford." C. Harold Wills, the chief engineer, and Joseph Galamb head a long list of Ford employees whose collective efforts were more significant than Henry Ford's inspiration in creating the Model T. Charles E. Sorensen, his assistant Clarence W. Avery, William C. Klann, and P. E. Martin deserve the lion's share of credit for the moving assembly line worked out at Highland Park, while the specialized machinery was designed by a staff of dozens of engineers and skilled tool makers headed by Carl Emde. "Henry Ford had no ideas on mass production," claimed Sorensen, the man best qualified to know. "Far from it; he just grew into it like the rest of us. The essential tools and the final assembly line with its integrated feeders resulted from an organization which was continually experimenting and improvising to get better production." Nevins and Hill agree: "It is clear that the impression given in Ford's *My Life and Work* that the key ideas of mass production percolated from the top of the factory downward is erroneous; rather, seminal ideas moved from the bottom upward."[21]

The business success of the Ford Motor Company depended on the talents of many other individuals. For, as John Kenneth Galbraith says, "if there is any uncertainty as to what a businessman is, he is assuredly the things Ford was not." The marketing of the Model T was handled by



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Norval A. Hawkins, a sales and advertising whiz. Fred Diehl was in charge of purchasing. The Ford domestic and foreign branch plants were set up by William S. Knudsen. The man who oversaw the entire operation and provided the main business brains for the company until his resignation on October 12, 1915, was James Couzens, a minority stockholder as well as vice-president and treasurer. Sorensen called the period from 1903 to 1913 at Ford the "Couzens period. . . . Everyone in the company, including Henry Ford, acknowledged [Couzens] as the driving force during this period." After Couzens left, Ford "took full command, and the company was never so successful again," observes Galbraith. "In the years that followed, Ford was a relentless and avid self-advertiser. . . . Only the multitude remained unaware of the effort which Ford, both deliberately and instinctively, devoted to building the Ford myth. . . . He was the first and by far the most successful product of public relations in the industry."[22]

## The Selden Patent Suit

Henry Ford missed no opportunity to claim personal credit for both the low-priced reliable car and the mass-production techniques that together revolutionized American life. He promoted himself as the champion of the small businessman and of the common man's personal automobility against the forces of monopoly in the bitter and divisive 1899–1911 Selden patent controversy. Ironically, the man who most strongly opposed the preposterous claim that George B. Selden invented the gasoline automobile emerged from the controversy falling just short of making the same claim for himself. Even more ironically, the opponent of monopolization on the basis of the Selden patent came to account for about half of United States production of motor vehicles by the outbreak of World War I.

Probably the most absurd action in the history of patent law was the granting of United States patent number 549,160 on November 5, 1895, to George B. Selden, a Rochester, New York, patent attorney and inventor, for an "improved road engine" powered by "a liquid-hydrocarbon engine of the compression type." The Selden patent thus covered the basic elements necessary for constructing a gasoline-powered automobile. Selden got his idea for the vehicle after seeing the two-cycle engine patented in 1872 by George B. Brayton of Boston, which was exhibited at the 1876 Philadelphia Centennial Exposition. His own patent application was filed in 1879. He then used evasive legal tactics to delay the patent's acceptance until conditions seemed favorable for commercial exploitation. This enabled him to maintain adequate security for his claim while he



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deferred the start of the seventeen-year period of exclusive rights to his invention provided by law. His hand was forced in 1895—in part because the patent office was tightening its rules on delayed applications but more because events indicated that the time was now ripe for implementing the automotive idea. Selden had not yet built an operational model of his design when the patent was issued; and, as we have seen, the state of the prior technological art in no sense supported his allegation of priority.

To hedge its bet on the electric car, the newly formed Electric Vehicle Company bought the rights to the Selden patent in 1899 and began litigation to enforce the patent against the Winton Motor Carriage Company, then the leading American manufacturer of gasoline-powered cars. Before a decree was entered on March 20, 1903, that the Selden patent was valid and that he had infringed, Alexander Winton capitulated rather than continue what appeared to be a hopeless legal battle.

Other major American manufacturers of gasoline-powered cars, who initially had viewed the Selden patent as a threat, began to realize that it might provide a means of regulating competition. Under the leadership of Henry B. Joy of Packard and Frederick L. Smith of the Olds Motor Works, negotiations were undertaken with the Electric Vehicle Company to form a trade association under the Selden patent; the fruit of these negotiations was the establishment on March 6, 1903, of the Association of Licensed Automobile Manufacturers (ALAM). Licenses to manufacture gasoline automobiles were granted to a select group of thirty-two established companies. They agreed henceforth to pay the association quarterly royalties, amounting to 1.25 percent of the retail price of every gasoline automobile they produced. One fifth of the royalties was to go to Selden, two fifths to the Electric Vehicle Company, and two fifths to the ALAM for a war chest to finance litigations against infringers.

Although the licensed companies did compete against one another, the ALAM threatened to monopolize automobile manufacturing in the United States. The association tried to exercise arbitrary power over entrances into the industry by granting licenses only to manufacturers with prior experience in the automobile business, which theoretically precluded the admission of new firms. It further tried to preserve the status quo in the industry by setting production quotas. The Mechanical Branch of the ALAM was organized in 1905 for the ostensible purposes of facilitating the interchange of technical information and encouraging intercompany standardization of components. But it was in fact conceived primarily as a legal tactic in the Selden patent litigation against nonmember companies; it collapsed when the patent was initially upheld by the courts in 1909. The ALAM threat of litigation proved an ineffective deterrent to new en-



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trances, and the Selden patent was widely disregarded. The vast majority of gasoline automobile makers operated without licenses.

From the consumer's point of view, the influence of the ALAM was regressive, because the main interest of the licensed makers was in maintaining high unit profits. The ALAM companies did not seriously attempt to cater to the needs of a broad middle-class market until they were forced to by the more responsible so-called independent manufacturers, such as Ransom E. Olds at REO; the Thomas B. Jeffery Company, which made the low-priced Rambler car; Benjamin Briscoe at Maxwell-Briscoe; and Henry Ford. The outstanding exception among the ALAM companies was William C. Durant of the Buick Motor Car Company, who paid his Selden patent royalties reluctantly and was considered a maverick within the ALAM fold. "In any given year between 1903 and 1911, the ALAM [companies] never had more than four makes selling for less than $1,000," William Greenleaf points out. "In contrast, it was generally agreed that the majority of independent makers produced low-priced cars. Their ranks could . . . cite an average price that was $1,500 below the ALAM average. In 1909 the independents offered twenty-six models costing $1,000 or less."[23]

Henry Ford had gained a national reputation as a racing driver by beating Alexander Winton at the Grosse Pointe, Michigan, track on October 10, 1901; by that time he had also made two unsuccessful attempts to enter automobile manufacturing, with the Detroit Automobile Company in 1899 and the Henry Ford Company in 1901. When with new backers he organized the Ford Motor Company on June 16, 1903, the ALAM made the mistake of rejecting his application for a license on the ground that he had not demonstrated his competence as a manufacturer of gasoline automobiles. (George Selden's application, as it happens, was rejected on the same ground.)

Assured of the support of the department store magnate John Wanamaker, his eastern agent, Ford determined to stay in the automobile business and to contest to the limit of his resources the lawsuit for infringement that was immediately brought against him by the ALAM. Suit was also brought against Panhard et Levassor and the manager of its New York City branch; the Paris firm of Henry and Albert C. Neubauer, which exported Panhard and Renault cars to the United States; John Wanamaker and C. A. Duerr and Company, agents for Ford cars; and the O. J. Gude Company, a New York City advertising firm that had bought a Ford car from Duerr.

The ALAM advertised, "Don't buy a lawsuit with your car." Ford countered this threat with an offer to bond his customers against any suit for damages that the ALAM, might bring against them. Through a clever



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propaganda campaign that brought favorable publicity, he turned the Selden patent fight into a great benefit to his business. Ford gained public sympathy by contrasting his own humble midwestern origins and status as a pioneer automotive inventor and struggling small businessman with the image of the ALAM as a group of powerful and parasitical eastern monopolists.

At the 1905 Chicago automobile show, twenty independent makers banded together to fight the Selden patent by forming the American Motor Car Manufacturers' Association (AMCMA). Ford, Maxwell-Briscoe, and REO were the most important of the forty-eight manufacturers that ultimately joined the AMCMA. Ford vice-president James Couzens became the AMCMA's first chairman. He explained to reporters, "We manufacturers on an independent basis have simply decided to take the bull by the horns and cooperate for mutual benefit." Henry Ford promised, "I am opposed to the Selden patent first, last, and all the time and I will fight it to the bitter end." But the other members of the AMCMA lacked Ford's determination. *Automobile* reported in late 1906, "No fight is made against the patent by the association, although the members, along with some forty other makers, do not believe in it. The Ford Motor Company, one of the leading members of the AMCMA, is fighting the idea single handed, in an effort to disprove the claims made." [24] The journal overlooked Panhard et Levassor, which considered capitulation for a time but ultimately stuck it out with Ford "to the bitter end."

The ALAM won a fleeting victory when the United States Circuit Court of the Southern District of New York upheld the claim against Ford and Panhard et Levassor in 1909. The AMCMA immediately disintegrated, and most of its members sought and received licenses from the ALAM, swelling the latter's membership to eight-three. The independent makers who joined were allowed to pay a reduced royalty of 0.8 percent on their production since 1903. The ALAM's new liberality resulted from the recent bankruptcy of the Electric Vehicle Company and from the ALAM's mindfulness that its exclusive rights under the Selden patent were due to expire in 1912. Ford, too, was now invited to become a licensed manufacturer, but he declined, because the ALAM refused to reimburse him for his legal expenses. He decided to continue the fight by appealing the decision in the higher courts.

The collapse of the ALAM followed a written decision of the United States Circuit Court of Appeals for the Second Circuit that was handed down on January 11, 1911. That decision sustained the validity of the Selden patent for motor vehicles using the Brayton two-cycle engine. But it declared that Ford and Panhard et Levassor had not infringed, because



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they powered their cars with Otto-type four-cycle engines. Almost all other manufacturers used the four-cycle engine, too. The decision made the Selden patent worthless. Its lateness, however, meant that it merely formalized and hastened a bit the imminent breakup of the ALAM.

In the aftermath of the Selden patent fight, the secondary functions that the ALAM and AMCMA had filled as trade associations were assumed by the Automobile Board of Trade, which became the National Automobile Chamber of Commerce (NACC) in 1914, the Automobile Manufacturers Association in 1932, and the Motor Vehicle Manufacturers Association in 1972. The technological functions of the ALAM Mechanical Branch were transferred in 1910 to the Society of Automotive Engineers. To prevent another costly patent controversy from ever again arising in the automobile industry, the NACC instituted in 1914 a cross-licensing agreement among its members. Although the Ford Motor Company was not a party to this agreement, Henry Ford conformed to its principles. The use of Ford patents without payment of royalty fees was liberally extended to competitors, and they reciprocated. Up to the outbreak of World War II, the Ford Motor Company permitted 92 of its patents to be used by others and in turn used 515 outside patents, without any cash changing hands.

The patent-sharing arrangement encouraged the widespread diffusion of technological innovations among competing firms and prevented monopolization of automobile manufacturing based on exclusive control of patents. "The patent policy of the Ford Motor Company and the cross-licensing agreement of other automobile producers," concludes Greenleaf, "are tantamount to radical surgery upon the body of the American patent system. Both patterns have preserved free technology along the frontiers of the automotive industry where conflicts over patent rights might well have hampered it."[25]

Nevertheless, for other reasons the American automobile industry did develop into a joint-profit-maximizing oligopoly by the late 1920s, as Detroit's "Big Three" came to dominate worldwide automobile manufacturing.



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# The Rise of the Giants

# 5

Closure of entry into automobile manufacturing did not occur in the United States until the market for new cars reached saturation in the late 1920s. But by 1910 it was evident to perceptive entrepreneurs that the era of artisanal production and freewheeling competition among many small producers was about over. Considerably heavier outlays of capital were becoming necessary to ensure success. With a view to reducing unit costs of production, improving the quality of the product, and ensuring the supply of components, the industry leaders early turned toward a policy of reinvesting their high profits in the expansion of plant facilities, both to increase the output of completed cars and to undertake the manufacture of many components formerly jobbed out. The nature of this trend was evident by 1910 to Walter E. Flanders, the Ford production manager from August 1906 until April 1908, when he left to go into business for himself with the EMF car. Flanders knew that "to equal in quality cars now selling at $700 to $900, it is not only necessary to build them in tremendous quantities, but to build and equip factories for the economical manufacture of every part." The formation of General Motors and the opening of the Ford Highland Park plant gave substance to Flanders's assertion that "henceforth the history of this industry will be the story of a conflict among giants." [1]

As the large-volume producers turned to integrated manufacturing operations, the automobile industry, both in the United States and in Europe, became capital intensive. As early as 1903 Renault made its own engines, and by 1905 it had its own foundry and body shop. Laux notes that Renault's "policy of vertical integration, by which he made more and more of his components himself, a policy that between the wars even led him to make his own steel, rubber tires, and electricity, was followed not

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