

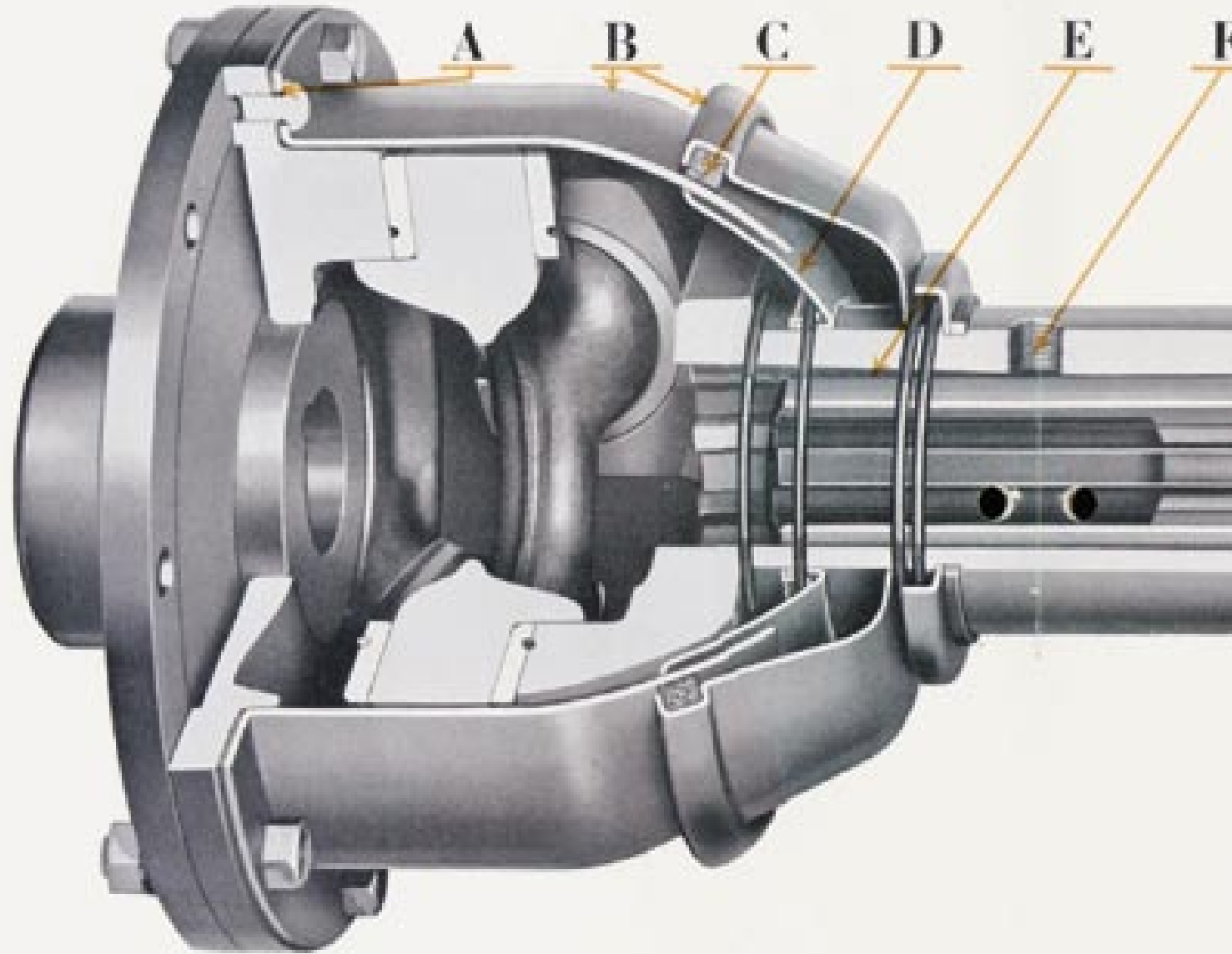


The Story of the Dana Corporation

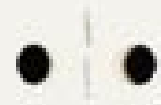


SEALED AGAINST LUBRICANT LOSS

Spicer



This Joint May Be Lubricated with
Either Heavy Oil or Grease



The Story of the Dana Corporation

Published by the
Dana Corporation
Toledo, Ohio

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Dedicated to all past, present, and future Dana people.



Introduction

Countless dates and events – major and minor – mark the first 100 years of the Dana Corporation: Clarence Spicer's first patent in 1903, Charles Dana's election as president in 1916, the acquisitions of Parish Pressed Steel and Salisbury Axle in 1919, production of the first Jeep® axle in 1940.

No event, though, is more important than Clarence's first step in growing his company when he hired his first three employees in the fall of 1904. The success of his startup business notwithstanding, Clarence's patented idea, the encased universal joint, was destined to play a part in the future of the motor vehicle industry. It was truly a breakthrough invention.

Jeep is a registered trademark of DaimlerChrysler Ag.

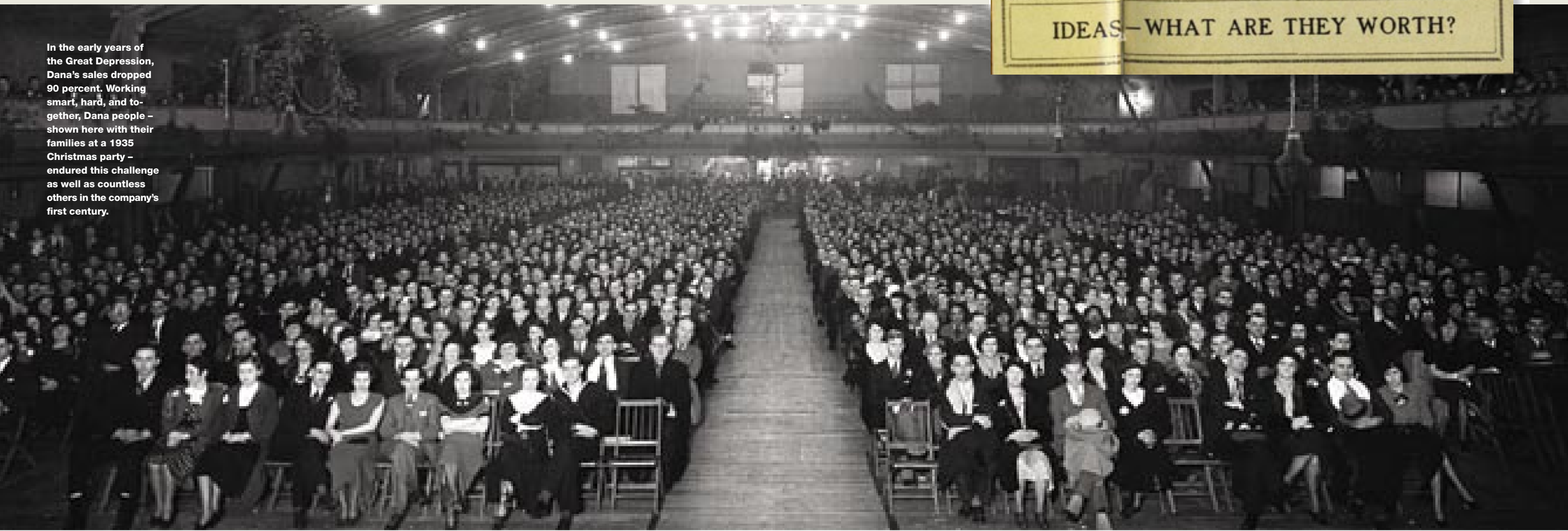
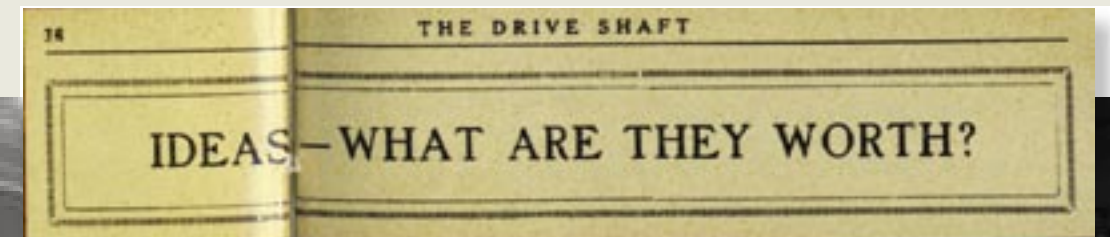
The survival of his business, however, was not so certain. In the fall of 1904, it depended exclusively on the collective ideas and efforts of the young engineer and his three employees. They, and the tens of thousands of Dana people who followed them, rose to the challenge.

As customers' needs changed, as they always have and always will, Dana people around the world have continually found better ways to meet them. Better designs. Better materials. Better products. Better ways – in 25-square-foot increments – to make and deliver those products.

The contributions of the company's namesake, Charles Dana, were many, immense, and long-lasting. In one respect, however, his legacy boils down to

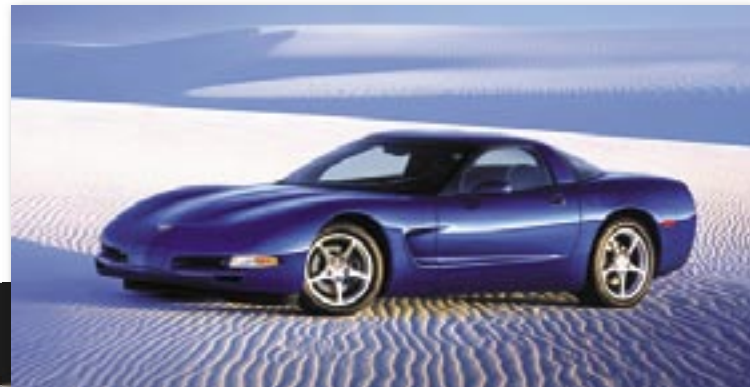
The Dana Corporation grew out of the idea of the encased universal joint in 1904. Since then, millions of ideas from Dana people around the world have sustained the company's growth and success. Ideas have proven to be invaluable.

In the early years of the Great Depression, Dana's sales dropped 90 percent. Working smart, hard, and together, Dana people – shown here with their families at a 1935 Christmas party – endured this challenge as well as countless others in the company's first century.



Dana people and products have helped to drive history's greatest vehicles – from the Model T and the World War II-era Jeep to

London taxicabs, 18-wheel rigs, giant earth-moving machines, and every car on the NASCAR® racing circuit.



In Reading, Pennsylvania, Ann Mitzel and others apply a technology that originated in the driveshaft group, magnetic-pulse welding, to frames. Dana's Technology Roundtable was created to promote the exchange of product and process technologies across the company.

From the vacant corner of a New Jersey factory to operations spanning 30 countries, Dana has grown to rank among the world's largest suppliers to the vehicular industry. Shown here is Sergio Luis Marques Ferreira in the Sorocaba, Brazil, axle facility.

one simple fact – he found a better way to organize and finance Spicer Manufacturing, the precursor to the Dana Corporation, and then dozens of other companies that joined Dana while he presided over the company.

Today, Dana designs and manufactures far more than driveshafts. Teams of people turned other inventors' ideas into successful companies. Neff Parish's steel frame, Clark Salisbury's axle, the Teetors' piston ring. The engine gaskets from the Victor brothers and Hugo Reinz. Ricardo Bruno Albarus' replacement u-joints. Joseph Long's radiator. Ben Hopkins' thin-wall bearing. And many others.

Clarence Spicer, Charles Dana, and the leaders who followed recognized the value of informed, trained, and involved people. Though Dana University wasn't founded until 1969, formal employee education began in the 1920s, if not before. To make the most of each person's abilities, Ren McPherson, Dana's third chairman, threw out stacks of policy and procedure manuals to simplify the company's operations. As a result, every individual in the company became an expert – an accountable expert.

Relatively few organizations endure to celebrate their rooth anniversary, and none reach such a milestone without setbacks, Dana included. The name of the company itself bears testament to the fact that Clarence Spicer and others encountered difficult times. Yet within the vehicle industry, with its recurring cycles, Dana continues to set the standard. Its stability has been proven.

Clarence Spicer, Charles Dana, and the leaders who followed all repeated the truth time and time again: it's not the bricks and mortar, it's not the machinery, it's not the policies. It's the people who make the difference. Good people, good company.

This book chronicles the history of the Dana Corporation, of Dana people. It's not about one product, or one person. It's about a lot of people working together to find a better way to serve the world's leading vehicle manufacturers. ♦



"There is only one thing really worthwhile about an organization, and that is its men and women," said Charles Dana in 1934. John Howard is shown here in the Pottstown, Pennsylvania, drive-shaft operation in the 1950s.



1904-1913

CLARENCE SPICER BETS ON THE MOTOR CAR,
HIS INVENTION, AND HIMSELF

“The automobile was not the result of a single invention. Rather, it came into being through a centuries-long process and the combined efforts and experiments of many skilled and talented men.”

- ENZO ANGELUCCI AND ALBERTO BELLUCCI,
The Automobile

Clarence Spicer started his universal joint company on April 1, 1904. Despite the momentum of motor vehicles and the uniqueness of his product, the business venture must have still felt like a leap of faith. Just in Clarence’s lifetime, incredible advancements had been made to the motor vehicle behind names still familiar today – Karl Benz and Gottlieb Daimler in Germany, Louis Renault and the Peugeot brothers in France, and Ransom Olds, David Buick, and Henry Ford in the United States. And yet, motor vehicles were still viewed by most people as noisy, dirty, unreliable, and dangerous. In short, they needed more development to replace the horse and buggy. Though he had no business or manufacturing experience, Clarence believed in the future of the motor vehicle – and in himself. This belief, and his patented idea, moved the industry forward.

THE STUDENT AND HIS IDEA

In the spring of 1902, as a sophomore at Cornell University, Clarence designed a motor car. This design and the ensuing prototype were the beginnings of the Spicer universal joint. Motor vehicles of the day transmitted engine power to the wheels through two sprockets connected by a chain, much like a bicycle. The parts were loud, unreliable, and difficult to lubricate. This, in turn, caused frequent breakdowns on the unpaved, uneven roads of the time. Clarence devised a better way to transmit engine power. He placed universal joints on the ends of a tubular shaft and, for the first time ever, encased the joints in bowl-shaped housings to retain their lubrication and shield them from road debris.

The principle of the universal joint, a coupling device that enables angular motion in all directions and the transmission of rotary motion, was discovered in the 1500s by Jerome Cardan, an Italian mathematician. English scientist Robert Hooke later applied the principle to the inner workings of a telescope. And then, some 400 years later, Clarence Spicer successfully applied the principle to motor vehicles through a school assignment. Seeing potential in Clarence’s research, his professors provided extra time for him to explore and experiment. They also encouraged him to file a patent application.



As a young boy, Clarence Spicer maintained the mechanical equipment on his parent’s dairy farm in central Illinois. As a young man, he bet his future on one of his first inventions, the encased universal joint.

A better way – before the Spicer® universal joint (left), engine power was noisily

and unreliably transmitted to the wheels via two sprockets and a chain (right).



As part of a class assignment at Cornell University in 1902, Clarence Spicer designed and built a steam-powered car, which piqued his interest in power transmission and ultimately led to the encased universal joint.

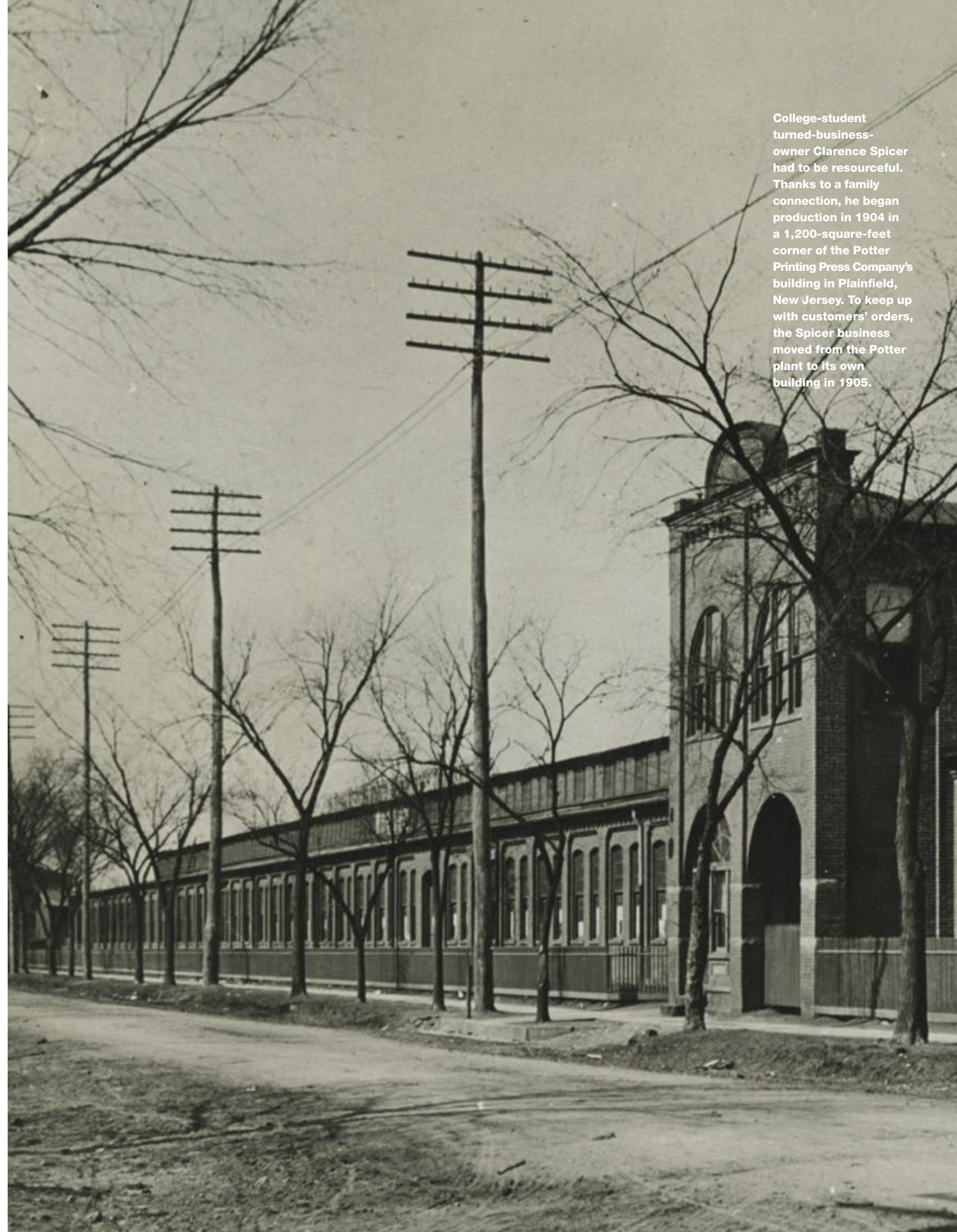
On May 19, 1903, Clarence was issued U.S. Patent No. 728,779, titled “Casing for Universal Joints.” An early automotive journal described his invention as a “dust proof, oil tight, frictionless joint cover or casing.” The publicity generated immediate interest from the growing number of vehicle manufacturers, who asked Clarence to produce his invention or to grant them permission to manufacture the joints.

Clarence and his wife, Anna, carefully considered the options and decided he would make the universal joints on his own. Clarence was confident in the future of motor vehicles and in his own creativity and perseverance. The Spicers’ decision was accompanied by ample prayer as well; both were devout Seventh Day Baptists.

SETTING UP SHOP

With their three children, Clarence and Anna moved from Ithaca, New York, to Plainfield, New Jersey, and C.W. Spicer, as the company was first called, was open for business. By this time, car makers were switching from sprockets and chains to

College-student turned-business-owner Clarence Spicer had to be resourceful. Thanks to a family connection, he began production in 1904 in a 1,200-square-foot corner of the Potter Printing Press Company’s building in Plainfield, New Jersey. To keep up with customers’ orders, the Spicer business moved from the Potter plant to its own building in 1905.



Clarence Spicer never sought the spotlight, but his creativity placed him at the center of automotive engineering for 35 years. Early company engineers pictured here are (left to right): H.T. Wyatt, G.L. Tarbox, G.F. Weigand, Clarence Spicer, J.W.B. Pearce, and L.C. Conradi.

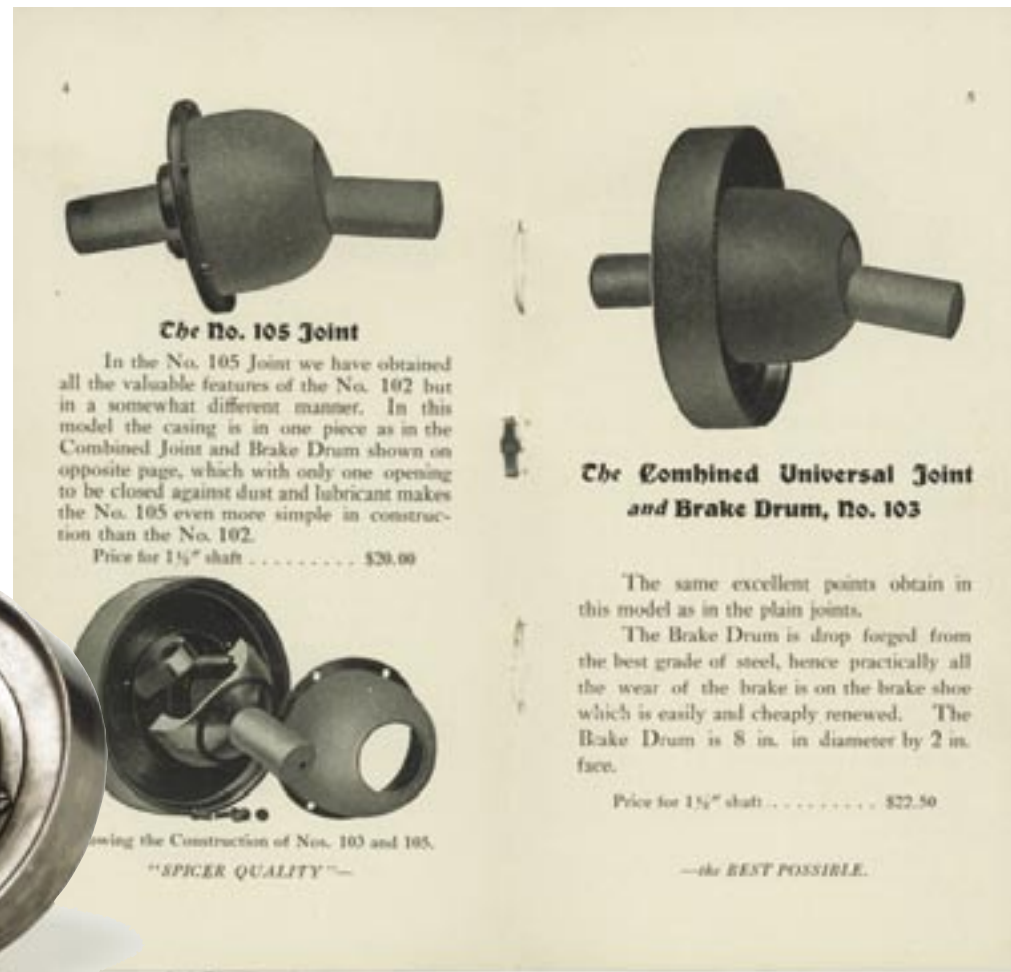


propeller shafts with universal joints for power transmission. New manufacturers were now designing their vehicles from the outset with Clarence's invention in mind. As he wrote in an early company history called *Our Majority*, these manufacturers "were overnight springing up like mushrooms."

Clarence chose Plainfield for business, as well as personal reasons. The growing commercial town provided space, tools, equipment, rail transportation, and skilled workers. It was also well situated to serve the U.S. automobile industry, then located largely in the Northeast. Clarence also had two important family connections there. The first was a cousin, George Babcock, who became the biggest financial supporter of the business. Another influential kin, an owner of the Potter Printing Press Company, agreed to manufacture universal joints for Clarence's initial orders. In addition, the Seventh Day Baptist Church had a strong presence in the Plainfield area.

Dana people work hard. Clarence Spicer even put the belief on paper: "Employees have toiled incessantly, often nights as well as days, to make Spicer Universal Joint what it is today ... success would have been entirely impossible except for them." Circa 1910.





What distinguished Clarence Spicer's universal joint from others was the patented bowl-shaped housing around it that retained lubricant and shielded against dirt and dust from the unpaved roads. Customers clamored to get the product.

LOTS OF PRAYERS AND ORDERS

In the summer of 1904, the Potter concern received a large order for printing presses, which ended its short run of universal joints. Clarence soon filled a rented corner of the Potter plant with new equipment and his first three employees. C.W. Spicer began to manufacture its own joints in earnest. Anna handled the office work and prayed for the payroll.

The first universal joints were shipped on September 12, 1904, to the Corbin Motor Vehicle Company in New Britain, Connecticut. By May 1905, Clarence wrote, "We were in the midst of producing more orders than the organization could properly handle. The largest one, which stands out strongest in my mind among the incidents of



that first strenuous Spring rush, was an order for 96 sets from the Wayne Automobile Company. [It] required a great amount of night and overtime work for several weeks to the extent of almost making physical wrecks of the members of the organization."

To help secure additional financing, the Spicer Universal Joint Manufacturing Company was incorporated in New Jersey on May 25, 1905. Authorized capital stock was \$35,000, divided into 700 shares. Clarence headed the company as president. In the ensuing 12 months, Spicer posted sales of nearly \$40,000. The next year, sales more than doubled to \$83,000.

To expand production, the company moved from the Potter plant to its own building on Madison Avenue in Plainfield. Clarence and a dozen employees

The Spicer Mutual Aid and Athletic Association was organized May 6, 1911. Long, hard workweeks surely made the baseball diamond a welcome respite for these men. Circa 1910.

In 1903, Olds Motor Works produced a third of all American vehicles – the five-horsepower “Curved Dash” car. One of Spicer’s biggest customers in the early years, Olds placed the largest order of 1906: 25 sets of universal joints and shafts for \$407.25.



produced propeller shafts and universal joints at the rate of 150 sets per month. Gradually, this plant was enlarged and new machinery was installed. Within a few years, a forge shop was added, but the noise from the hammers forced its relocation from the urban neighborhood to rural South Plainfield in 1910.

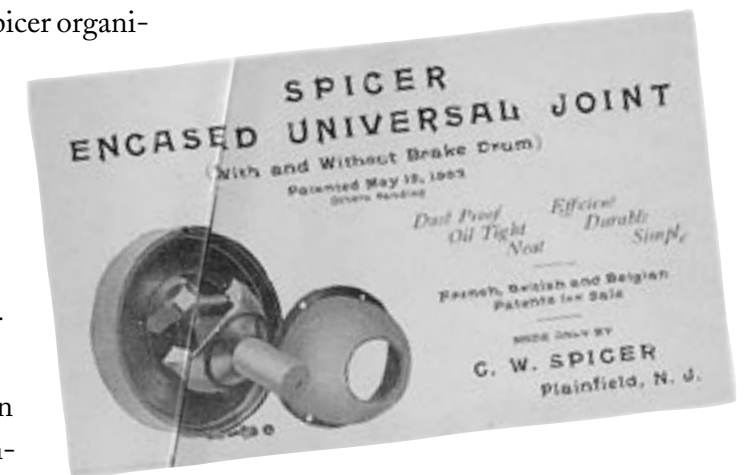
THE UNIVERSAL JOINT MAN

Word was getting out about “C.W. Spicer, the Universal Joint Man,” as the company’s early advertising described him, and Clarence was frequently on the road demonstrating his product to potential – and receptive – customers. Those who used Spicer universal joints on their early vehicles included: Aerocar, Buick, Lozier, American, St. Louis, Apperson, Olds, Packard, Wayne, Moline, and Stevens-Duryea.

In the early years, Clarence wrote, the Spicer organization was determined to “anticipate the universal joint requirements of tomorrow and therefore to constantly improve in every possible way the design, material, and workmanship.” Clarence was eventually issued 27 U.S. patents and five French patents on universal joints and propeller shafts over the course of 35 years.

By 1913, Spicer’s customer list had grown to more than 100 vehicle manufacturers including: Cadillac, Chevrolet, General Motors, Diamond T, E.R. Thomas, Chalmers, Flint Wagon Works, Auburn, Hudson, J.I. Case, and Oakland. Early buyers of “u-joint” replacement parts included: Newstadt Auto Supply, Newark Garage and Repair, and Imperial Garage.

At least three independent sales agents were also visiting customers on behalf of Spicer. Advertisements ran on a regular basis in such publications as *Horseless Age*, *American Machinist*, *Motor Age*, an aftermarket journal; and *Commercial Vehicle*. Raising product awareness extended beyond the United States as early as 1907, when Anna Spicer recorded a \$10 expense in the company’s ledger for advertising Spicer products in Mexico and Panama.



Cadillac began purchasing Spicer universal joints in 1910. Its founder, Henry Leland, the “Master of Precision,” made a profound impression on Clarence and emphasized the importance of making every piece right the first time. Pictured is a 1910 Cadillac car.



A BUSINESS AT RISK

Approaching its 10th anniversary, the Spicer Manufacturing Company, renamed in 1909, seemed perfectly positioned for continued success. Clarence had wagered a decade earlier that if motor vehicles took off, so would his product and his business. He was right. The growth of motor cars was phenomenal. In 1904, when Clarence shipped his first universal joint, 23,000 automobiles were produced in the U.S. By 1913, production had increased 20-fold to nearly half a million. Vehicles were proving immensely popular in Europe as well. Spicer’s sales topped \$10 million (about \$200 million in present-day value).

But the industry’s growth strained the Spicer company’s resources – and its founder’s time and abilities even more. Ever-increasing orders were followed by more complex, larger-scale manufacturing problems. New space and equipment were constantly needed to keep up with customers’ orders. Short and long term, the company sorely needed more money. Clarence’s words on the struggles: “So many different customers demanding immediate shipments that the very best we



In 1908, two Americans won the famous New York-to-Paris race via Seattle, Japan, and Siberia, in a Thomas Flyer. This remarkable “stock” car included parts from four future Spicer operations – Salisbury, Brown-Lipe, Parish, and General Drop Forge. By 1909, Thomas cars also came equipped with Spicer “u-joints.”

could do was get them out in a way to keep the customers in even half-way good humor even at the expense of shop cost.”

Competition also changed the landscape for Clarence. Competitive products were often lower-priced and in many cases violated his patents, enmeshing him in patent infringement lawsuits. International opportunities, where Clarence also lacked experience, vied for his time and attention as well. As early as 1911, the export-import house of J. Glaenger of Paris, France, was working with Spicer Manufacturing to sell its universal joints in France and Belgium.

Without additional capital and talent, Clarence’s business was at risk of becoming one of the many casualties of the early automobile industry – some 1,500 manufacturers and suppliers had already failed. At the close of 1913, he decided to pursue investments in the company more aggressively. The financing, as well as the management talent he needed, arrived in one unlikely person – a young prosecuting attorney from New York. ♦

CLARENCE WINFRED SPICER

Clarence W. Spicer was born on November 30, 1875, on a dairy farm in Edelstein, Illinois. His parents, John and Cornelia (Babcock) Spicer, had migrated there from New York in 1865 after John's failed attempt to enlist in the Union Army due to ill health.

Clarence, like many turn-of-the-century inventors, grew up on a farm that was becoming increasingly mechanized. Due to his father's disinterest in machinery, Clarence became responsible for keeping the equipment in good working order. The creamery's reputation for being one of the best equipped illustrated his technical abilities at an early age.

Insisting on a good education in their Seventh Day Baptist faith, John and Cornelia sent Clarence in 1891 to Alfred Academy, a preparatory school in Alfred, New York. Like Edelstein, Alfred was rural and quiet. "As a home for students, it is comparatively free from the ordinary allurements of vice and dissipation," read an Alfred College catalog of the time. Clarence was involved with the Young People's Society for Christian Endeavor in Edelstein and Alfred. It was through this organization or possibly in a first-year algebra or Latin class that he met his future bride, Anna Burdick.

Clarence studied at the academy for three years, missing the third term in 1893 to join his father at the Columbian Exposition, also called the World's Fair, in Chicago. John's passion for quality, which earned him top honors in the butter competition there, was a trait passed on to his son. After completing studies at the academy, Clarence returned to Edelstein where he oversaw the installation of the farm's mechanical refrigerating system, a new technology at the time.

Clarence and Anna, "one of Alfred's most lovely daughters" according to the *Alfred Sun*, were married on December 1, 1896. Though Clarence could have stayed in his family's successful dairy business, he chose instead to take his wife and first son back to New York in 1899 for additional studies at Alfred College. These courses in turn allowed him to really

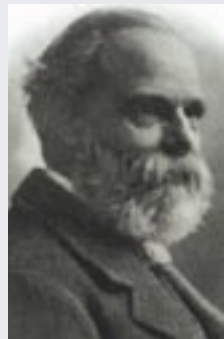
pursue his passion by enrolling in Cornell University's Sibley College of Mechanical Engineering and Mechanical Arts.

Robert Thurston, the dean of Sibley College and a pioneer in mechanical engineering, became a trusted mentor to Clarence during his time at Cornell. Thurston served as the first president of the American Society of Mechanical Engineers, and his professional acquaintances included Alexander Graham Bell, Thomas Edison, John Ericsson, and Lord William Thompson Kelvin. The primary reason Clarence decided to leave school in 1904 was to begin producing and selling his universal joints, but his mentor's death the previous year may have been another contributing factor. Clarence and Anna named their second son Robert Thurston Spicer.

The following profile ran in the Sibley College yearbook, circa 1904: "Clarence Winfred Spicer comes from that little gem of a town in Illinois called Edelstein. He attended the public schools at that place, but at the age of 14 had the teachers so nearly 'stopped' that he himself was given a teacher's certificate. Not being the biggest man in school, he decided not to use it. He attended Alfred University from 1891 to 1894, and while there met his future 'better half.' From 1895 to 1900, 'Spice' spent most of his time inventing things. He left Sibley in 1904 and has wasted most of his time communicating with his foreign patent agents."

As history would clearly prove, the time Clarence invested in writing, filing, and tracking his patents was far from wasted.

Robert Thurston was a pioneer in mechanical engineering and a mentor to Clarence Spicer at Cornell University.



Clarence Spicer was passionate about his business and his family. His wife Anna (center) was the company's first bookkeeper.

Clarence's advice to his sons was: If you see something wrong, fix it. From the oldest, his sons were Harold, Robert, John, and Wilfred.



1913-1929

**CHARLES DANA TAKES CONTROL,
AND THE SPICER BUSINESS TAKES OFF**

“The only organizations that last a long time,
do good and useful work, and are profitable,
are those that are, and have been, well organized.”

– GEORGE MATTHEW ADAMS, AUTHOR

On December 16, 1913, the board of directors of Spicer Manufacturing Company gathered for a special meeting in Plainfield to consider a loan from a prosecuting attorney named Charles Dana. Charles was ambitious, successful, and well connected. It was likely business affairs – he was also president of two utility companies – that took Charles to the office of Spencer Trask and Company in New York City just before the holidays.

Charles was also opportunistic. During his visit to Trask, an investment bank, he learned of a struggling but promising automotive outfit in New Jersey. The company’s president, Clarence Spicer, had just visited Trask in desperate need of financing. Charles agreed to lend the company \$15,000, secured by mortgage on the company’s real estate, for a year. With little choice – the money was needed to cover a bank loan and probably operating expenses as well – Spicer’s directors accepted his terms.

Though Charles continued to practice law, he became increasingly involved with the company, providing financial, legal, and management advice, and even calling on customers. On February 24, 1914, Spicer’s board elected Charles a director. Two months later, as the company’s new vice president, he reported excessive overtime as the main cause for its losses. Furthermore, based on two meetings with the head of General Motors, Charles warned that Spicer risked losing GM’s business if prices weren’t quickly reduced.

By early 1915, Charles owned nearly half the company. He acquired 600 shares from George Babcock, Clarence’s cousin who had grown frustrated with the lack of stock dividends. According to minutes of the board meeting a year later, “Charles spoke of his contributions to the company and his desire to devote his energy to it to the exclusion of any other businesses and opportunities ... He spoke of these matters verbally, at length, and in detail.” Charles was then, at the age of 34, elected president of the company.

Immediately afterward, he asked Clarence, whom he replaced as president, to stay with the company as vice president and chief engineer. According to Wilfred Spicer, Clarence’s youngest son, his parents walked the streets of Plainfield nearly



Seeing promise in a struggling universal joint manufacturer, attorney Charles Dana became involved with the business in 1913. Two years later, he was president. In 1946, the company was renamed in his honor.



From a small, overcrowded shop in Plainfield, New Jersey, Spicer moved to a bigger, better facility in South Plainfield in 1915 – “The Factory that Made Spicer Famous.” Charles Dana invested in new equipment as well, and the output of Spicer universal joints soared.

all night talking about what they ought to do. Clarence felt compelled to stay to ensure the company and products bearing his name continued to meet his very high standards of quality and performance.

Wilfred, who worked for the company for 38 years, described the relationship between his father and Charles Dana as one of mutual respect. Over time, it must have been obvious to both men that Clarence’s strengths were to experiment, invent, and design, and Charles’ were to build, capitalize, and sell.

RELOCATING TO SOUTH PLAINFIELD

In 1914, Charles began to receive advice from Charles Nash, president of GM. Nash frequently visited Plainfield to expedite his universal joint orders and took a liking to Charles, whom he likely saw as the fix to Spicer’s tardy shipments. Nash went

so far as to take Charles through the Spicer plant and suggest new machines and methods to increase output. “I’ll make a manufacturer of you yet,” he told the young attorney from New York.

Investments in new equipment coincided with Spicer’s move to South Plainfield, where a much larger, more modern facility had been constructed in 1915. Part of the allure of South Plainfield was cheap farmland where the company had already purchased 20 acres. The relocation to the rural site created a commuting problem for Spicer employees; most lived in Plainfield, and few owned a vehicle at the time. Charles and Clarence solved the problem by purchasing used buses and providing free transportation.

Spicer’s expansion proved auspicious as the extraordinary production demands of World War I were just beginning.

During World War I, women moved into skilled and industrial labor (below). Spicer's record production,

according to the company newsletter, was "in no small way due to the patriotism of our women workers."



After the War, women continued to move into nontraditional areas of society, such as company-sponsored sports leagues. Pictured (left) is a Pottstown basketball team from 1926.



SERVING UNCLE SAM

Many governments and militaries, particularly the United States, relied heavily on horse power at the start of the Great War, but the advantages of motor vehicles were soon universally proven. Vehicles from Ford, Cadillac, Mack, Caterpillar, Rolls-Royce, Leyland, Mercedes, Peugeot, Renault, and De Dion-Bouton, among other manufacturers, were enlisted in the fighting.

American factories were humming well before the United States entered World War I in April 1917. The Spicer Manufacturing Corporation, as it was reorganized and renamed in 1916, continued to expand its South Plainfield operation to keep up with demand for its products.

Clarence Spicer was summoned to Washington to help design a standardized truck for the U.S. Armed Forces. The variety of trucks used at the time created a logistical nightmare for supply officers. The subsequent Class "B" Liberty truck

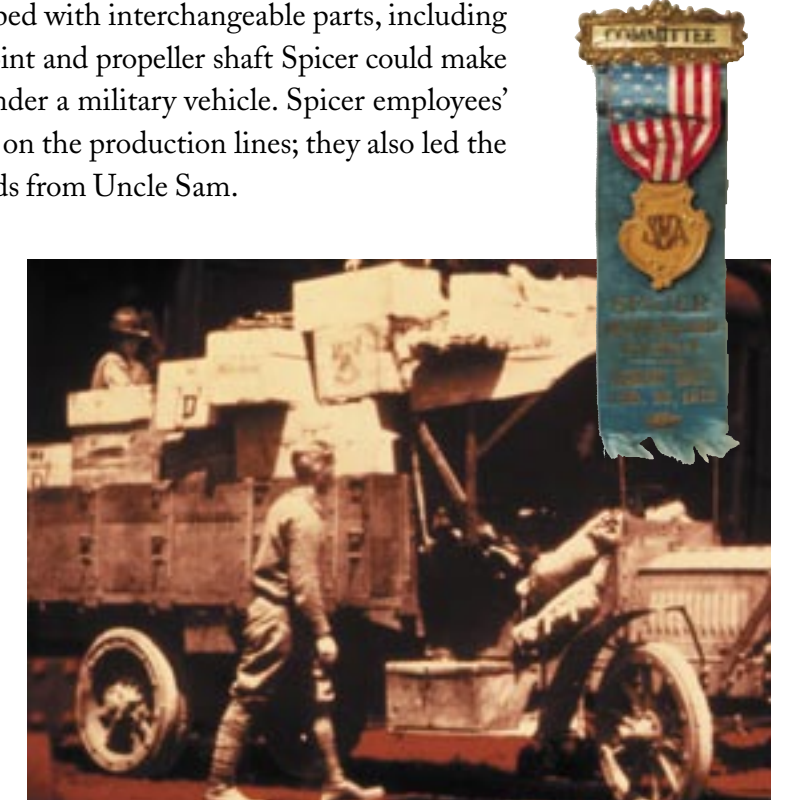
was rugged, easy to maintain, and equipped with interchangeable parts, including Spicer universal joints. Every universal joint and propeller shaft Spicer could make was pre-sold and most often installed under a military vehicle. Spicer employees' patriotism went beyond their hard work on the production lines; they also led the Plainfield district in buying Liberty bonds from Uncle Sam.

The war was personal too, as about 130 "Spicerites" served in the military. From the European battlefield, Private John H. Bamnignion wrote: "It was with the greatest pleasure that I received your letter here two days ago. I want to thank you for your kind remembrance of me ... It might interest you to know that I have taken particular notice of our product over here and without exception all of the trucks here use Spicer Universal Joint and Shaft and they are certainly put to some very severe use."

From the U.S.S. Lampson, E.F. Barker reported "living at sea from 20 to 23 days out of the month without taking your clothes off and always hugging a life preserver ... Hoping this finds you and the Spicer crowd in the best of health and spirits." Back on land, Sergeant Frank DeFilipo, in response to his mail from South Plainfield, wrote, "You cannot imagine how thankful I feel for your kindness toward a boy in the trenches. The big guns roaring through the day furnishes quite a bit of excitement."

Although the fighting of World War I ended November 11, 1918, a more deadly battle continued against the influenza pandemic; its death toll would far surpass that of the war. To fight the "Spanish flu," Spicer solicited the help of several health groups and furnished a new company nurse with a new car. Nurse Clark made nearly 3,000 house calls in 1918 and 1919. Healthy employees delivered food, clothing, coal, and other necessities to the homebound. More than 2,800 inoculations were given in the plant hospital to employees and their families. Despite all the efforts, 300 of the company's 1,000 people contracted the flu, and 10 died.

With more than 100 "Spicerites" deployed in World War I, the Spicer Mutual Aid Society helped families deal with their absence and, in at least two cases, their death.



A group of leading automotive engineers was summoned to Washington in 1917 to design the Class "B" Liberty truck for the Great War. Among them were Clarence Spicer, Alexander Brown, and Willard Lipe, the latter two of the Brown-Lipe Gear Company, which Spicer acquired in 1929.

CHARLES ANDERSON DANA

Charles A. Dana, the only child of Charles and Laura (Parkin) Dana was born in New York City on April 25, 1881. The Danas had long been a prominent New England family, and his father had retired from a successful banking career by the time Charles was born. Charles was actually named after his uncle, who had served as U.S. President Abraham Lincoln’s assistant secretary of war and later was owner and editor of the *New York Sun*.

Charles attended Cutler School in New York City, then entered Columbia University at age 17 for a bachelor’s degree in liberal arts. During his college days, and while practicing law years later, Charles spent time as a cow-hand in Chihuahua, Mexico. He heeded his father’s advice by attending law school at Columbia. With a master’s degree in international law, Charles practiced law in various capacities in New York. He was also elected three times to the New York state legislature.

By 1907, the 27-year-old attorney was president of two utility companies. His approach to the Spicer Universal Joint Manufacturing Company in 1914 was characteristically cautious. Two years passed between his initial contact with Spicer and his assuming the full-time role of company president. According to one newspaper account, “He had a cold logical eye which could look at a situation, determine what had to be done, what it would cost to do it, what it would return in dollars and cents, and whether it represented a good investment.”

Charles’ recipe for success was determination, close attention to details, “plus hard work and then more hard work.” While he was a firm believer in organization, he wouldn’t let routine policies and procedures stand in the way of progress. “It’s a great thing,” he once said, “to do all the work you want to do, and do it simply and easily, without regard for conventions.” Charles reputedly purchased a production facility during a train ride. With a notation in the margin of the day’s newspaper reading, “I hereby purchase plant from you for \$3 million,” and the seller and buyer’s signatures, the deal was closed.

Charles made it a point to know every department in the Spicer business inside and out. He never purchased a permanent residence in Toledo, preferring to commute from New York via the “upper berth” cars of the Pennsylvania Railroad’s Red Arrow train. An employee in a 1917 issue of *The Drive Shaft* newsletter wrote, “The only way to keep up with Mr. Dana when he asks questions is to rely on instinct; and the only time instinct will serve you is when you know what you are doing and why.”

Despite his success and wealth, Charles was notoriously frugal. He was known to walk around the company’s five-acre Bennett Road operation turning off lights in empty rooms. He spent hours in barber shops reading magazines to avoid subscription costs, and he wrote on used envelopes instead of new notepads (and encouraged others to do the same).

Charles Dana was, according to Ralph Carpenter, a trusted colleague of more than 30 years, “unconventional.”



Since Charles Dana’s formal training was in law, his father strongly advised him to stay away from business affairs. Charles was too ambitious to listen and proved to be an exceptional business leader and financier.



From the beginning, Spicer universal joints met the needs of light and heavy vehicle manufacturers alike. Early commercial vehicle customers included J.I. Case, Mack, and International Harvester, whose 1915 truck appears here.

CARS, TRUCKS, AND TRACTORS

The number of passenger vehicles continued to climb despite the material and personnel demands of World War I. Registrations of cars and trucks topped five million in the United States by 1918 and hit nearly a million in Europe. The war showcased the utility of commercial trucks on a grand scale, and production soared. Since the U. S. Army relied more on horses than internal combustion engines at the start of the conflict, thousands of farmers across the country were forced to convert to motor-propelled tractors.

Like cars, commercial and off-highway vehicles needed effective power transmission, and Spicer universal joints met the needs of many of the early manufacturers. Some of them included Grabowski (a predecessor of GMC), Kelly-Springfield, J.I. Case, Morton, American LaFrance, International Harvester, Indiana Truck, and Sullivan.

ZISS-BOOM-BAH!

Both Clarence Spicer and Charles Dana must have felt a profound sense of accomplishment in 1919. The product Clarence had invented and the company Charles had revived played an important part in the Great War and were incredibly successful in the motor vehicle industry. Spicer's annual sales topped \$30 million in 1918 and 1919.

The optimism of the time certainly carried over to employee Thomas Brennan, who won the Spicer Yell contest with this entry: "Ziss-boom-bah, here we are. 'Universal Joint Boys,' Ha-Ha-Ha. We make 'em in peace, we make 'em in war. Spicers, Spicers, Rah-Rah-Rah!" In addition to securing his place in Dana history, Brennan was awarded a \$2.50 gold coin.

Later that year, a good fellowship clam bake, vaudeville show, and dance were organized for Spicer employees and families at the company's new roller bearing

On June 5, 1925, Spicer hosted guests from Motor Trucks Industries. "The Spicer Band, resplendent in their new uniforms and smiling faces, rendered an

appropriate musical program," reported the company newsletter, "and their presence on the lawn added considerable zest to the reception."



plant in South Plainfield. Nearly 3,000 attended. "The entertainment which followed was unusually good and the dancing added greatly to the enjoyment of the occasion," reported the company newsletter, *The Drive Shaft*.

While Charles Dana wholeheartedly supported the company's social activities, he was always out in the shop, looking for ways to cut waste and boost output.

Spicer acquired a minority stake in the E.J. Hardy & Company of Birmingham, England, in 1925. Hardy-Spicer Ltd. produced driveshafts for nearly all English-built automobiles by the 1950s.



Spicer
UNIVERSAL JOINTS
PROPELLER SHAFTS

UNIVERSAL joints in the propeller shaft drive from engine to rear axle through an axle changing with every movement of the springs. The entire driving load falls on the universal joints—stresses wrench and rack them—stresses that come only by the strongest of steel worked to the precision.

Since 1904 SPICER UNIVERSAL JOINTS and SHAFTS have met every requirement.

Give the SPICER UNIVERSAL JOINTS the SPICER SHAFTS

SPICER MFG. CORPORATION
SOUTH PLAINFIELD, N. J.

The Passenger Car: Number Four of a series of SPICER advertisements.

Spicer Propeller Shaft

By the time this advertisement ran in 1919, Charles Dana was taking Spicer Manufacturing Corporation into the production of axles and frames – still core products today.

The founder of Cadillac, Henry Leland, started Lincoln Motor Company in 1917 to build aircraft engines for World War I. At its 1920 debut, the Lincoln car came equipped with Spicer u-joints. Two years later, the luxury car maker was acquired by Ford.



From the Collections of The Henry Ford (G3405)



To celebrate a plant addition in Pottstown, Pennsylvania, Spicer employees and family members gathered for a day of food and festivities on May 5, 1923. On eight tables, running the full length of the building, 1,800 people enjoyed a feast that included 640 chickens.

PRODUCT AND BUSINESS ACQUISITIONS

In 1919, Charles was also eyeing opportunities for more business growth. With sales and profits at record levels, by year's end he acquired Chadwick Engine Works, Parish Pressed Steel, Sheldon Axle & Spring, and Salisbury Axle. Beyond the initial purchases, Charles invested heavily in each of these, as he had done with Spicer five years earlier.

Chadwick Engine Works consisted of four buildings and a three-story mansion on an old farm in Pottstown, Pennsylvania. Renovated and equipped, the operation produced 200,000 universal joints per month. After three years and more capital investment, Pottstown's output tripled.

The construction of a tube mill in Pottstown was planned in 1925. Employee Gerald Burden later recalled: "I received a telephone call asking me to report to the

manager's office the next day. There I was introduced to Mr. Spicer who informed me we were going to start manufacturing our own tubing. After lengthy questioning about my character – whether I drank, whether I went to church, whether I knew anything about making tubing – I was told to report the next morning and he would go into further detail of what he expected of me. He readily admitted he knew nothing about the manufacture of tubing and that was one of the reasons I was given a job, because I didn't either. He wanted a fresh start."

Likewise, Salisbury and Parish operations were expanded. Although the war had stretched the capacity of both companies, Charles foresaw even greater demand for axles and frames. In 1926, Parish opened a new plant in Reading, Pennsylvania, which was expected to produce 95 percent of the bus and truck frames in the U.S. The

PRODUCT EXPANSION

Clarance Spicer received his first patent on the encased universal joint in 1903, but his contemporaries, Neff Parish, Clark Salisbury, Alexander Brown, and Charles Lipe already had 67 patents among them. Their earliest inventions advanced products that predated the motor vehicle – guns, bicycles, shearing machines, typewriters, brooms, and horse-drawn carriages. Each, like Clarence, started a business to produce and sell the product he invented.

PARISH

In 1901, Neff Parish – with the Parish and Bingham Company in Cleveland, Ohio – had manufactured, on a production basis, the first pressed-steel frames, which replaced wooden frames and metal frames shaped with forms, blocks, and hand-held hammers. To answer the urgent need for automobile frames that could withstand the abuse of unpaved roads, Neff Parish and John Sullivan co-founded Parish Manufacturing Company in Reading, Pennsylvania, in 1905. Equipped with one 1600-ton press and two 400-ton hydraulic presses, they produced their first vehicle frame for Stevens-Duryea of Chicopee Falls, Massachusetts.

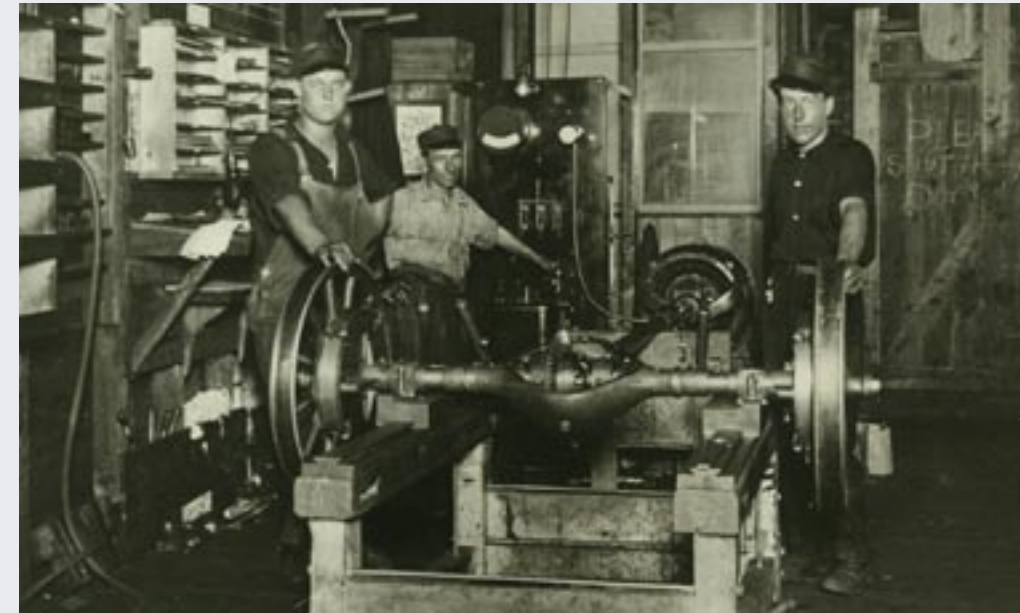
In 1910, the company began making heavy-duty frames for Mack, Autocar, White, and others. Bus frames were added to the product mix after World War I.

Parish's new plant in Reading, Pennsylvania, opened in 1926 with a hydraulic press that formed structural components with an incredible 4,000 tons of pressure. Dana's Robo Clamp® hydro-forming presses, developed in Reading 70 years later, apply up to 14,000 tons of clamping force in Dana's frame plants today.



SALISBURY

Clark Salisbury, a key-maker and mender of umbrellas, founded the Salisbury Wheel Company in Jamestown, New York, in 1901 and began manufacturing automobile wheels. His first two patents related to wheels for the horseless carriage. He partnered with S.H. Penfield, a veteran of the carpet cleaning business, and E.D. Sherman, a bill collector for an ice company, for their business experience.

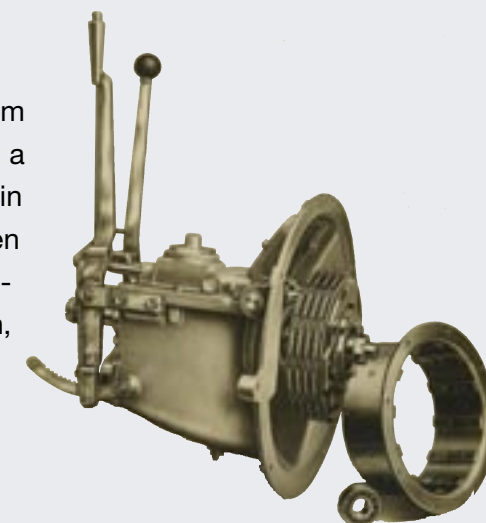


Early customers for Salisbury Axle included E.R. Thomas, Willys-Overland, American-Underslung, Crow-Elkhart, and Auburn. In 1930, Salisbury operations were moved from Jamestown, New York, to Toledo, Ohio. They moved again in 1946 to Fort Wayne, Indiana.

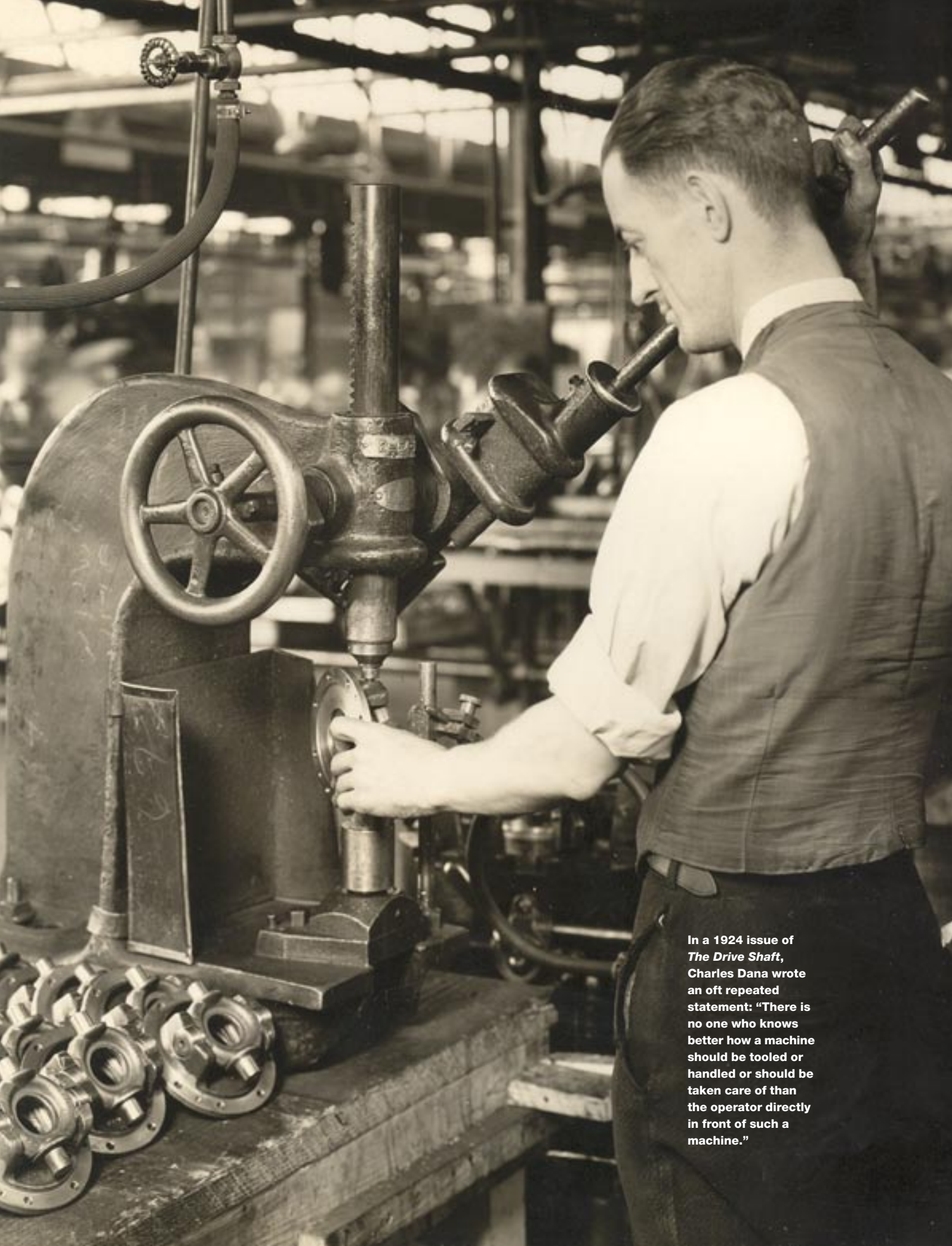
With their pooled life savings, the three men set up shop in 1902; production quickly shifted from Salisbury's patented wheel to standard hubs and wheels and then to axles.

BROWN-LIPE

With a mechanical engineering degree from Cornell University, Charles Lipe started a machine shop in Syracuse, New York, in the 1880s that eventually became a haven for inventors. Lipe leased space to like-minded men, including Alexander Brown, who over the course of 50 years was issued 145 U.S. patents. The two collaborated on a variety of products, including a two-speed bicycle gear, and formed the Brown-Lipe Gear Company in 1895. Upon Charles Lipe's death, his brother Willard joined Brown in the business. The company soon began producing transmissions and differentials for cars and trucks.



The Brown-Lipe Gear Company sold the first practical automotive transmission to H.H. Franklin in 1904. Other early products included axles, differentials, power take-offs, and clutches. The first clutch was shipped to Grabowsky Power Wagon, a predecessor of GMC, in 1911.



In a 1924 issue of *The Drive Shaft*, Charles Dana wrote an oft repeated statement: "There is no one who knows better how a machine should be tooled or handled or should be taken care of than the operator directly in front of such a machine."



Around 1920, Spicer engineers developed universal joints lubricated with grease instead of oil - "G" type joints. Clarence Spicer alone filed 16 patent applications related to joints, couplings, and shafts in the '20s.

"G" type universal joints and shafts (below) were made in Pottstown for 1926 Franklin sedans. Other new Spicer customers of this period included: Ford, Willys-Overland, Maxwell (a predecessor of Chrysler), Dodge Brothers, Duesenberg, and Indian Motorcycle.

modern facility was so advanced that production required only 24 hours of heat soaking and five days of cooling.

Charles' acquisition strategy was put on hold in 1920 and 1921 as the aftereffects of the war, labor strikes, material shortages, and high interest rates set off a major slump in the industry. In the U.S., vehicle output dropped more than 30 percent from 1920 to 1921. Spicer's sales in the same period dropped from \$18 million to \$5 million. Recovery for the company and broader industry began the very next year, which was also Spicer's first on the New York Stock Exchange.

During the 1920s, millions of Americans embraced the freedom of four motor-propelled wheels. At the insistence of automobile owners, Uncle Sam threw his weight and resources into building new roads.

Inventors in the Spicer organization were backed by the services of the Engineering and Experimental Department and the Patent Department to develop and protect their ideas.

As the automotive market grew and matured, it also became more competitive. Automakers and suppliers alike went under. The survivors, including Spicer, emerged stronger. Again and again, Spicer, under Charles' leadership, purchased the assets of failing competitors at bargain prices. Despite the acquisitions, Spicer still competed against more than 100 other universal joint, axle, and frame manufacturers. Additionally, European companies were entering the U.S. market. Charles saw opportunity across the Atlantic as well and bought interests in E.J. Hardy & Company in Birmingham, England, and Soci t  Spicer-Glaenzer, which was already producing Spicer joints under license in Paris, France.

In 1929, Spicer also acquired interests in Hayes Wheels and Forgings, Ltd., in Ontario, Canada. The last major acquisition of the decade was the Brown-Lipe Gear Company of Syracuse, New York, a manufacturer of transmissions and clutches.

A NEW HOME IN TOLEDO

By 1929, General Motors, Ford, and Chrysler accounted for more than 80 percent of all new car sales in the U.S., the world's largest vehicle market. And Detroit had clearly become the center of automotive production. To be closer to its customers, Spicer moved that year from New Jersey to a company-built complex on Bennett Road in Toledo, Ohio, just 60 miles south of Detroit. Toledo was preferred to Detroit partly



because an overnight train service would allow Charles Dana to continue living on the East Coast and still visit the company on a regular basis.

With its broadening product portfolio, expanding international business, and modern operations hub in Toledo, Spicer sales climbed back up to \$17 million in 1929, well short of war levels but up 70 percent from 1922.

For the first three quarters of 1929, Spicer posted net income of \$2.4 million, its best ever for a nine-month period. But for the company, the industry, and the American economy, calamity lay just around the corner. It began with a massive sell-off on U.S. stock exchanges on October 24, which would come to be known as "Black Thursday." By the end of November, investors lost \$100 billion in assets in what was quickly dubbed the Great Stock Market Crash. ◆

NEW PARTS FOR USED CARS

Used car sales surpassed new car sales for the first time in the U.S. in 1927. As with the motor vehicle itself, the replacement-parts market arrived with its share of inventors and entrepreneurs. Among them were many names that would eventually become part of Dana – Ben Hopkins and James

Myers of Cleveland Graphite Bronze Company (later Clevite); Earl and Jack Echlin of Echlin & Echlin; the Teetors of Perfect Circle; the Victors of Victor Manufacturing and Gasket; and Jack Wicks and Paul Crawshaw of Accessories Corporation (later Wix).

Hugo Reinz and the Brown brothers served the European aftermarket and would also eventually join the Dana organization. Many of these companies first concentrated on vehicle makers, but soon saw profitable opportunities in the replacement-parts business.

Joseph Gorey placed his first order for Spicer parts in 1911. By 1923, his company was one of the largest distributors in the Northeast with genuine replacement parts for Spicer universal joints, clutches, transmissions, axles, and gears.





1930-1945

SPICER MANUFACTURING SURVIVES THE GREAT DEPRESSION AND
JOINS THE "INDUSTRIAL ARMY" IN WORLD WAR II

"Nothing endures but change."

- HERACLITUS, GREEK PHILOSOPHER

"**F**or sale. 760,000 square feet of production floor space. Attractively priced!" So read the flyer printed in 1930 to stir up interest in Spicer's three vacant plants in South Plainfield, New Jersey, and Jamestown and Syracuse, New York. The proceeds from this sale and the dollar savings from Spicer's consolidated manufacturing in Toledo, Ohio, couldn't come soon enough, as the still-unfolding effects of the 1929 stock market crash were devastating the U.S. economy. In 1930, 26,000 American businesses went bankrupt; in 1931, 28,000 more closed their doors. In that same year, Spicer operated at just 25 percent of its production capacity.

By 1932, automobile production in the United States sank 75 percent to 1.4 million vehicles, and Spicer's sales dropped nearly 90 percent to \$2 million. Almost a third of American workers were unemployed. Spicer too was forced to lay off employees; those who remained endured pay cuts averaging 40 percent.

Depressed wages and the growing strength of organized labor unions came together at Spicer and three other Toledo-based auto suppliers on February 23, 1934, when 4,000 workers – half of them Spicer employees – went on strike. According to the *Toledo News Bee*, good news came just days later, before the strike affected



Four thousand employees of four Toledo auto parts suppliers walked off their jobs on February 23, 1934. In addition to playing a lead role in labor negotiations, Charles Dana took coal and coffee to the strikers, half of whom worked for Spicer.

Detroit, when Everett Weaver, head of the Spicer strikers, declared, "No strike in this country was ever cleaner than this one. I think this thing can be ironed out tonight."

That night, in a mass meeting of 2,000 people, an agreement was announced between the suppliers and the United Auto Workers' federal labor union. A high point was reached when Charles Dana, the focal figure among employers in the strike, spoke of his happiness with the settlement. He had been "spotted in the

gallery when a photographer flashed a picture of him," according to the *News Bee*. "Spontaneously a cheer arose throughout the house. The ovation accorded Dana was second only to that given to Thomas Ramsey," the union's business manager when he presented the agreement and recommended its approval. Charles had not only spearheaded the negotiations, but with the strike coinciding with the winter's lowest temperatures, he also frequented the picket lines with cups of coffee and buckets of coal.

Standing in front of the Bennett Road plant in 1936 are Spicer people with implemented ideas. *The Drive Line* recognized their efforts in improving quality and safety, cutting waste, and making the company more than "just a place to work." Ideas and leaner operations helped Spicer survive the Great Depression.





To meet the unusually tough requirements of the New York Fire Department, Mack engineers specified

Brown-Lipe Model 7440 Transmissions and Spicer® 1700 Series Needle Bearing Joints in 1936.

Information technology has replaced bins and buildings of inventory. But even in the Great Depression, big inventories were maintained to keep production lines rolling and to quickly fulfill orders for replacement parts.

The agreement ended the strike and gave workers pay increases between 5 percent and 12 percent, a permanent pay scale, and the right to collective bargaining through unions of their choice. This right became law the following year in the National Labor Relations Act. Two years after organizing Spicer's workers, the UAW organized General Motors and Chrysler, and then Ford in 1941.

NEW PRODUCTS WIN NEW BUSINESS

Despite the aggressive cost cutting of the time, Spicer Manufacturing kept minds and ample resources focused on new product development. Patents issued to the

company and products introduced to market in turn helped to attract new business. Spicer's "IG" (Improved Grease) joint was a huge success with its customers and quickly became the industry standard. In the fall of 1933, Charles Dana reported a number of other product successes to the board of directors. Spicer had just won a contract with Hudson to supply shock absorbers. Continental selected its new Powerflo Clutch. Studebaker and Nash Motors awarded contracts for Spicer's light axles.

Transmission engineers at the Bennett Road laboratory in Toledo introduced a number of industry firsts in the 1930s. Among them were: helical gears for heavy-duty truck transmissions; a manual-shift, three-speed bus transmission; aluminum housings for bus and truck transmissions; gear hopping guards; equalized shifts for helical gear transmissions; a multiple-speed transmission (five, eight, or 12 speeds)



from a basic four-speed unit; a splitter-type auxiliary transmission; and a torque converter for buses. These products proved successful in both civilian and military vehicles.

For years, vehicle driving axles were of the "banjo" design – a stamped, load-bearing housing with a separate gear carrier bolted in place. In the late '30s, Spicer engineers developed the carrier-type axle in which the gear carrier – with tubes pressed in place to enclose the axle shafts – supported the vehicle's weight. Its advantages were immediately recognized, and it too became the industry standard.

Another new product attracting new customers was the Spicer Positive Railway Generator Drive, designed by Clarence Spicer himself and launched by engineers Robert Lewis and J.A. Lindberg. A 1936 inspection of the first unit – installed on Erie Railroad's combination car No. 885 – showed its gears and bearings in perfect condition after four years and 300,000 miles of service. Nearly a hundred railroads eventually adopted the product.

Clarence Spicer's Positive Railway Car Generator Drive, was adopted by nearly 100 railroads. An inspection of the first unit after 300,000 miles of service showed it in perfect condition (although the car's steel wheels were worn out). This was to be Clarence's final invention.



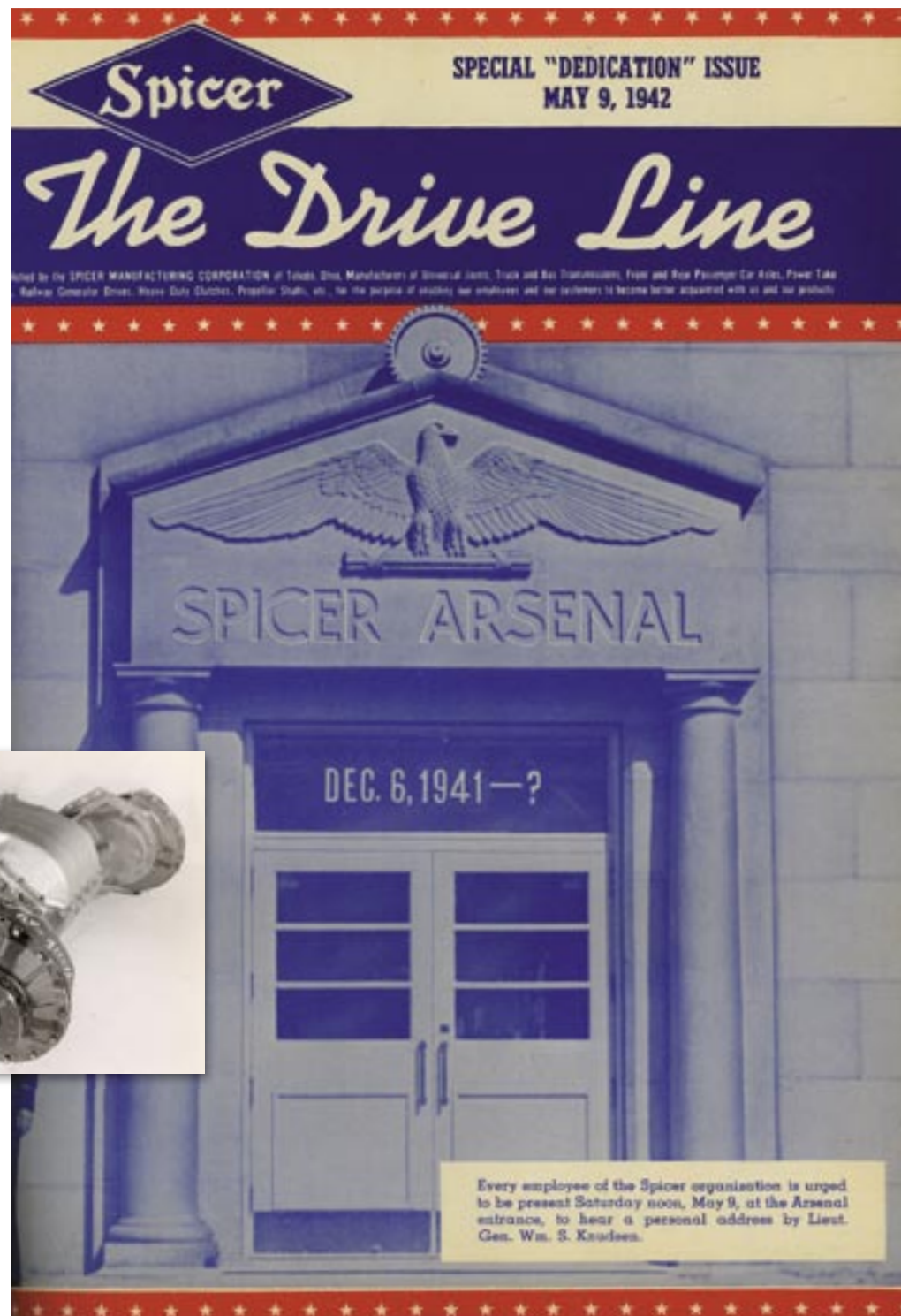
“In this day and age, automobile axles can be sold only if the gears are absolutely quiet,” read a 1935 article in *The Drive Line*. Nearly 70 years later, gear manufacturing and development remain vital to the success of the Dana Corporation.

TREATING GEARS LIKE GLASS

The Great Depression made every program with the vehicle manufacturers vitally important, which in turn reinforced the importance of quality in every product made. *The Drive Line* stories in 1935 pointed to the interdependence of Spicer’s reputation, its financial performance, and its product quality. “Everyone that handles a gear should think of it as glass ... if we do this we’ll eliminate ‘hickeys’ and go to town,” pointed out the editors.

The focus on gears extended to greater scrutiny of Spicer’s entire product range, which at the time included universal joints, propeller shafts, shock absorbers, passenger car axles, frames, truck and bus transmissions, power take-offs, and heavy-duty clutches. Extra steps were put in place at the steel mills and in Spicer’s chemical laboratories to ensure the quality of incoming steel shipments. “Due to the improved method of steel making these variations are becoming less,” reported *The Drive Line*. “However, they still have a decided effect” on Spicer’s final products.

During World War II, more than 2,000 Spicer people left their machines, laboratories, and offices for the battlefronts. Military orders drove the company's workforce above 10,000 for the first time.



Spicer products were used on a wide variety of military vehicles. Pictured here is a Spicer transmission for a Landing Vehicle Tracked (LVT) "Water Buffalo" used by the U.S. Marines.

JEEP AXLES AND FIELD KITCHENS

Coming out of the Great Depression, Spicer's sales fluctuated wildly. By 1937, they had nearly recovered to pre-depression levels, only to drop by a third to \$10 million in 1938. Then, production began to pick up again, led by Hardy-Spicer in England, whose plants were running at capacity for war purposes.

TRIBUTE TO CLARENCE SPICER

A horse-drawn carriage in which the horse can't stay connected to the wagon isn't an acceptable way to travel. A horseless carriage in which the engine's power can't reliably be transmitted to the wheels isn't either. Early cars and trucks fitfully channeled power the same crude way bicycles did – via two sprockets and a chain.

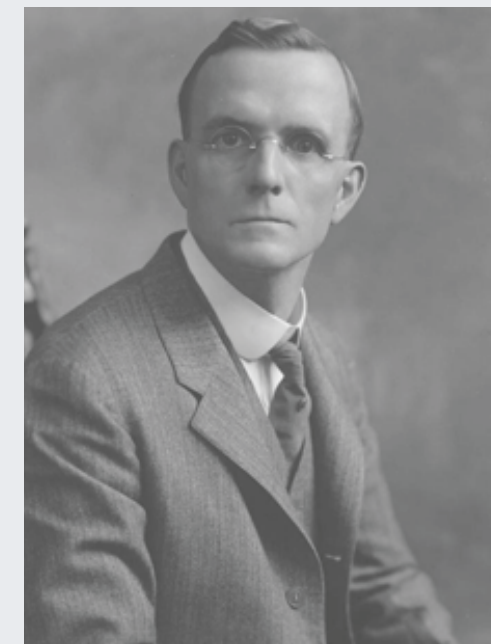
More than a century after he conceived the encased universal joint, Clarence Spicer's better way to transmit engine torque still helps drive vehicles of every size, shape, and purpose around the world. His patented idea also gave birth to one of the automotive industry's oldest, largest, and most successful companies, the Dana Corporation.

Though Clarence ran the Spicer Manufacturing Corporation for just 10 years, his inventive abilities kept Spicer® u-joints the best in the world long afterward and contributed immeasurably to the company's success.

Clarence's creativity and quiet determination also took him to the very top of his profession, the presidency of the Society of Automotive Engineers (SAE). From SAE after his death: "The unostentatious yet creative life of Clarence Spicer exists as a beacon of example and inspiration in the engineering profession ... We shall miss his quiet conviction, his direct application and his winning simplicity."

Dr. Clarence Spicer – Alfred University presented him with the honorary degree of Doctor of Science – died in 1939. In spite of his failing health, Clarence spent weeks that fall traveling on railroad trains equipped with his drive mechanisms, often working through the night in railroad yards to study the performance of his products. His gifted mind, untiring drive for perfection, and love of tinkering were obvious to the very end.

Clarence Spicer's father won fame at the 1893 World's Fair in Chicago with top honors in the butter competition. Ten years later, Clarence received a patent on his u-joint design that would take the Spicer name across the globe.





The famous Jeep® was equipped with Spicer transfer cases, universal joints, propeller shafts, and front and rear axles. In April 1945, the company produced its 350,000th axle set for the military Jeep. Millions of women once again moved into industrial jobs during World War II. Pictured here are workers from Auburn Clutch, which later became the Spicer Clutch Division.



The U.S. Congress began approving immense sums of money in 1940 for rearmament. On March 11, 1941, lawmakers passed President Franklin D. Roosevelt's Lend-Lease program, giving him the authority to transfer, lease, and lend arms and equipment to nations (notably Great Britain, the Soviet Union, and China) deemed vital to the defense of the United States. Spicer operations quickly ramped up production for big orders from the War Department. America's "Industrial Army" once again shifted into battle mode. In World War I, the bulk of supplies for the

fighting forces consisted first of ammunition and second of forage for the horses. In World War II, two-thirds of the supplies were gasoline-powered armored cars, trucks, tanks, and airplanes. Only a third was ammunition, food, and general supplies.

Two months after the attack on Pearl Harbor, the last car rolled off U.S. production lines until 1945. Despite the suspension of civilian vehicles, American automobile makers doubled their production capacity during World War II by helping to satisfy the Allies' immense appetite for shells, bombs, guns, tanks, and military trucks.

On December 15, 1942, Charles Dana and thousands of Spicer employees in Toledo accepted the coveted Army-Navy "E" award for excellence in engineering, communications, and production. By war's end, every Dana plant flew the "E" pennant, and every employee proudly wore the "E" pin.

Most Spicer products required few if any changes for military specifications. In addition to frames, however, Parish workers produced field kitchens, gun carriages and mounts, ammunition bundling accessories, and housings for fighter planes. Spicer's sales grew from \$10 million in 1939 to \$109 million in 1945. For additional capacity, the company acquired General Drop Forge of Buffalo, New York, and Atlas Drop Forge of Lansing, Michigan. In 1945, Spicer also began building a new facility in Fort Wayne, Indiana, for its Salisbury Axle division.

Employment in the U.S. auto industry overall swelled more than 50 percent between December 1941 and May 1943 – one million men and women on the payroll of nearly 800 companies. Spicer's Reading plant was expanded five times to

keep up with military orders. By 1944, the company's overall employment had grown to 10,000.

Every Dana plant received the Army-Navy "E" award for production excellence during World War II. "Keep 'em rolling" was the slogan at Spicer's operation in Hillsdale, Michigan, acquired in 1936. The Hillsdale newsletter stressed the importance of each man's – and woman's – daily effort and the need for 14 hard-working industrial employees behind every individual in the U.S. Armed Forces.

As in World War I, Spicer's involvement far exceeded meeting production orders. Between 1942 and 1945, employees in Toledo alone purchased \$6 million worth of war bonds, consistently beating the quotas assigned to them. In the summer



YOUR BACK ORDER

Under the weight of wartime production needs, a Spicer employee wrote the following poem, "Your Back Order," for *The Drive Line* newsletter.

Herewith apologies to all
 Our customers both large and small.
 Though your goods are overdue
 For a month or maybe two,
 We can't help it. Please don't swear.
 Labor's scarce and metal's rare.
 Can't get steel, can't get dies.
 These are facts, we tell no lies.

Fred is drafted. So is Bill.
 All our work is now uphill,
 So your order we're afraid,
 May be just a bit delayed.
 Pictures on this page will show
 Where Spicer products have to go,
 Until our forces have sufficient
 Trucks and tanks to be efficient.



R. Boers explained the gear-shaving process to Brigadier General Burton Lewis in Toledo in 1941. During the plant tour,

General Lewis thanked the Spicer team for its outstanding support and performance.

Among the 16,000 “gaily dressed” people at Spicer’s 40th anniversary celebration in Toledo were Mrs. Eric Pearson and Miss Ruetta Zimmerman of the company’s industrial relations department. The open house included a one-mile tour through the Bennett Road plant.



of 1943, Spicer made five acres of plowed land available to Toledo employees for Victory Gardens to help alleviate the nation’s food supply problem. By the end of the conflict, more than 2,100 Spicer employees had left their lathes, presses, laboratories, and offices for the battlefronts; 50 lost their lives.

PREPARING FOR PEACE

Spicer advertisements in 1944 and 1945 highlighted the role of its products in the varied military vehicles deployed in the war. Additionally, the ads included a brief but important post-war promise – “Spicer’s adaptability assures quick conversion to peacetime need when the war is won.”

A letter to customers from William Fairhurst, Spicer’s vice president of sales, indicated that vehicle manufacturers were also looking ahead. Fairhurst wrote: “... inasmuch as Spicer is still fighting the war with all the loyalty and energy at our command, we are not as yet in a position to do much about the many requests we are getting for post war samples, drawings, and layouts.”

Ralph Carpenter, executive vice president and Charles Dana’s day-to-day operations chief, reported wholesale military-related order cancellations in August 1945, which immediately eliminated 80 percent of the company’s business. He added that post-war production of civilian vehicles was expected very soon, but the volume wouldn’t require war-level employment. “Competition will be keen and we will have

Advertisements at the end of World War II highlighted Spicer’s contributions to the war effort and, perhaps more importantly, told vehicle makers that the company would be ready to meet their needs when peace returned.

Peterbilt

Hauling America's Most Critical Jobs . . . Spicer Transmissions, Auxiliaries and Universal Joints

Hauling massive logs from mountainside forests, and moving great hull sections in busy shipyards . . . these are a few of the jobs which Spicer-equipped trucks are doing to meet America's urgent wartime material and construction needs. Wherever men, materials and motions must be moved . . . on the battle front and home front . . . Spicer Transmissions, Auxiliaries, Universal Joints and Axles deliver power that will help us reach the goal of peace. Then Spicer again will be ready to serve immediately the tremendous needs of America's automotive industry. Spicer Manufacturing Corporation, Toledo, Ohio.

41 YEARS OF Spicer SERVICE

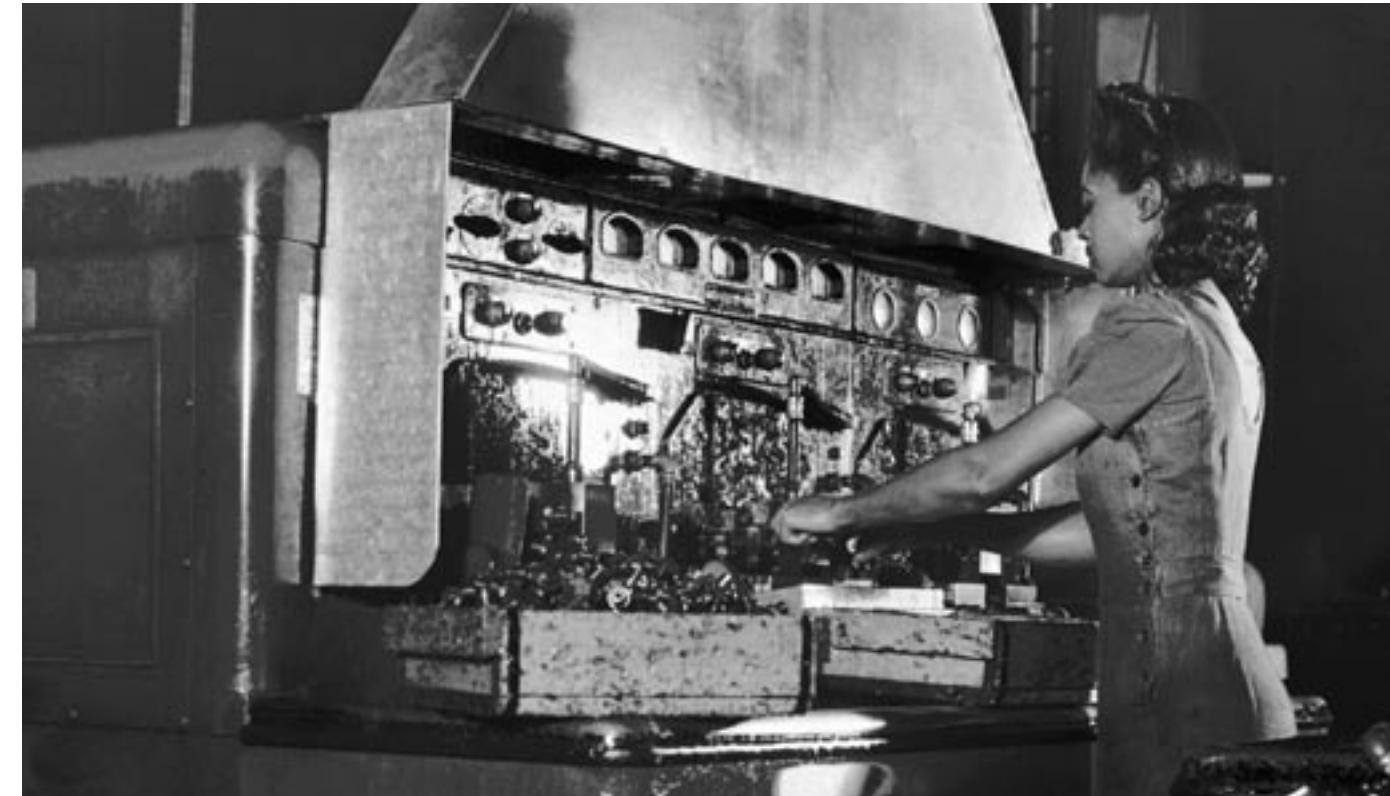
SPICER TRANSMISSIONS • AUXILIARIES • UNIVERSAL JOINTS • AXLES • DRIVE SHAFTS • DRIVE SHAFTS • DRIVE SHAFTS • DRIVE SHAFTS



Spicer workers, including Charles Garber, time and time again met the challenges for more u-joints, more axles, more transmissions, and more frames during World War II. Demands were so great, because so many Spicer products had become the industry standard.

After nearly five years, Pottstown's Dell Scott finally had the opportunity in 1945 to produce components for

civilian vehicles. After the Great Depression and World War II, people longed for some sense of normalcy in their lives.



to be increasingly efficient in order to meet it and to get our proper share of the business available.”

Once again, the world was at peace. Yet the daily lives of millions of people and thousands of companies around the world would be challenged in different ways by disarmament and the shift back to normality. The difficulties though paled in comparison to the Great Depression and the war itself. The people of Spicer – who now included 30- and 40-year company veterans – had learned well how to deal with adversity and were ready for whatever changes lay ahead. ♦



1946-1966

THE RENAMED, REORGANIZED DANA CORPORATION
REINVESTS, REBUILDS, AND RESUMES ITS GROWTH STRATEGY –
WITH RECORD RESULTS

“I’m a great believer in luck, and I find the harder I work
the more I have of it.”

– THOMAS JEFFERSON, U.S. PRESIDENT

Purchased before the Great Depression and World War II, millions of cars and trucks being driven in 1946 were held together by ingenuity and prayer. Demand was set to explode. It didn’t happen immediately. While veterans returned to civilian life, people held onto their money. Car makers used the lull wisely by retooling their factories and designing more stylish and powerful vehicles.

In addition to retooling, officials at Spicer Manufacturing decided to rename the company. Numerous acquisitions made Spicer’s product lineup formidable, but confusing. On one hand, Spicer was a respected brand. On the other, it was a corporation that owned other familiar names like Parish, Salisbury, and Brown-Lipe.

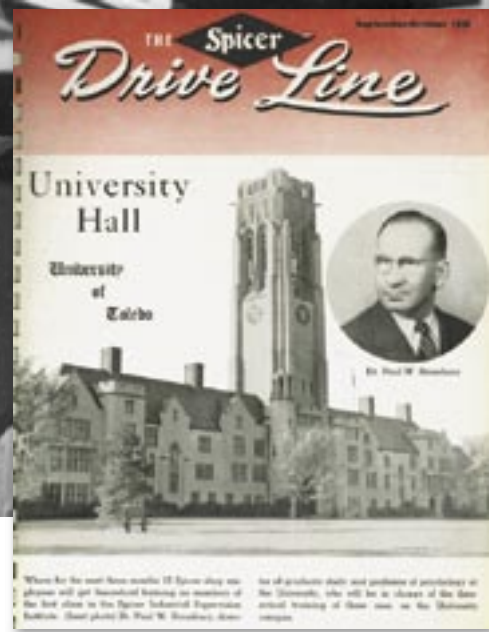
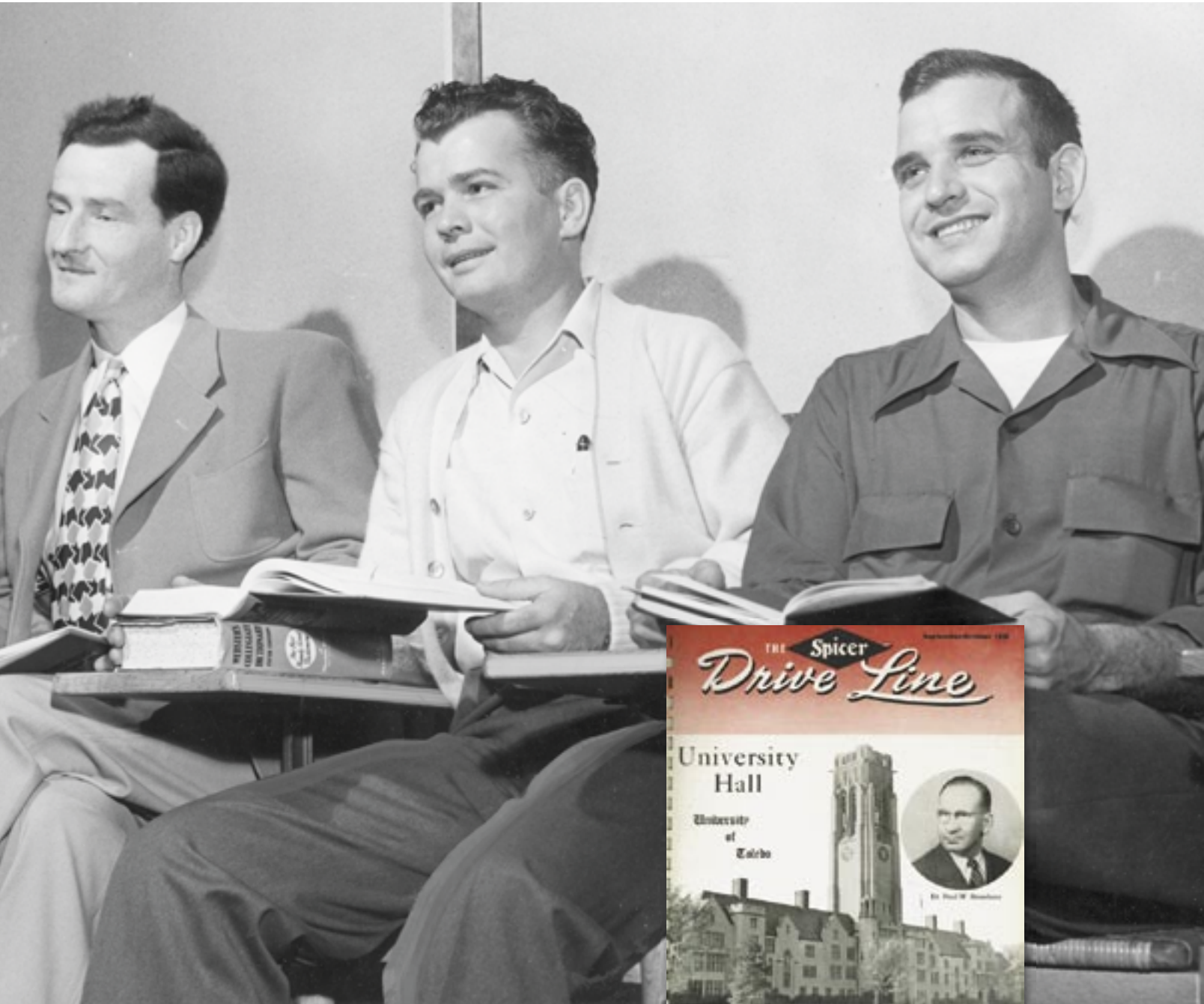
In recognition of his 32 years of leadership, Charles Dana’s family name was chosen as the new corporate name. Spicer remained on the product Clarence Spicer himself had designed, universal joints, and was eventually applied to other core products including axles and transmissions.

U.S. aid to war-damaged countries and the ongoing food scarcity prompted this Victory Garden parade at the Dana Corporation in 1946. On company grounds, 300 plots were plowed, fertilized, and watered at no cost for employees interested in planting.



Dana production employees John Gleason, Robert Wiggins, and Ray Lenix traded their tools for textbooks

at the University of Toledo in 1948 as the Spicer Industrial Supervision Institute got underway.



The addition of Auburn® clutches (below right) and Chelsea® PTOs (below) to Dana's under-the-vehicle

offering strengthened its position in the commercial and off-highway vehicle markets.

NEW PRODUCT LINES

Charles, as always, searched for growth opportunities outside the company. New companies (and new names) were added to the Dana Corporation. Auburn Clutch, a well-known manufacturer of light- and heavy-duty clutches; Chelsea Products, a leading designer and producer of power take-offs (PTOs); and Convel, which owned exclusive U.S. rights to the Rzeppa constant velocity u-joints, were acquired in the late 1940s and 1950s to broaden Dana's "under-the-vehicle" product offering.

To sell more product, Dana opened a showcase facility in Fort Wayne, Indiana, for the Salisbury Axle Division, which in turn freed up space in Toledo to produce more transmissions. The company also acquired a new frame plant in Detroit, and purchased a small outfit in Marion, Indiana, in 1950 to increase production of its u-joints. Though small, Marion Tool and Engineering had great potential in the eyes of Charles Dana and Ralph Carpenter. Within months of acquiring the shop, they moved work from the Hillsdale Division and broke ground on a new plant. By 1960, Dana's Marion Division produced 20 percent of all driveshafts in the United States.



In the early 1950s, Ralph Carpenter (left) began selling Charles Dana on the idea of succession. Years later, Jack Martin (right) joined the company, succeeding Carpenter as company president and eventually Charles as chairman of the board.

JACK MARTIN JOINS DANA

In the early 1950s, company president Ralph Carpenter began selling Charles Dana on a different type of addition to the company – a successor. Carpenter even had the person in mind, Jack Martin, a group president at Firestone Tire & Rubber in Akron, Ohio. Charles reluctantly agreed to talk to the young man. Years later, Martin recalled his first meeting with Charles as “the most unpleasant half hour in my life – he just chewed me out.” After Martin replied to a question about compensation, the company namesake retorted, “I don’t think you’re worth half that.” Carpenter kept pushing. Finally, in 1952 Martin joined the company as executive vice president and upon Carpenter’s retirement in 1953 was promoted to president.

Charles remained chairman of the board (and continued his monthly trips from New York to Toledo via train). Martin took over the day-to-day operations and brought a fresh perspective to the company. The following year, he wrote to Dana

PERFECT CIRCLE

Charles Teetor began his career outside of the automotive industry by designing and manufacturing a pedal-powered quadricycle for use on railroads by track inspectors and linemen. The Railway Cycle Manufacturing Company was started in 1895 in Hagerstown, Indiana. The entrepreneurial Teetor family soon realized the advantage of engine power over pedal power and developed a new engine for the vehicle. The motor-driven quadricycle was eventually exported to more than 40 countries. The Teetors were also a creative bunch, particularly Charles and his blind nephew Ralph, who designed and built his own automobile at the age of 12.

The company name changed to the Light Inspection Car Company and then to the Teetor-Hartley Motor Company, after which the engine business was sold in 1918. Based on the importance of piston rings in engine performance, that part of the original business was retained and became the focus of its research and development. The new company became known as the Indiana Piston Ring Company, and its trademark was Perfect Circle®. The company moved into the aftermarket piston ring business in 1921 with just one salesman and one



The Teetors of Hagerstown, Indiana, originally designed and produced railway cars. They branched into engines for the cars, and then piston rings for the engines. When the engine business was sold to focus on rings, Macy Teetor described the new company as “rather puny.”

Among Perfect Circle’s early inventions were “slotted” oil-regulating rings, expander-type rings, and chrome-plated rings. The company produced 330 million piston and sealing rings during World War II. It was acquired by Dana in 1963.





“There is only one thing really worthwhile about an organization,” said Charles Dana. “And this is its men and women.” This belief would later become a cornerstone of the Dana Style. Pictured are second-shift forklift drivers and maintenance men from the Bennett Road plant in Toledo in 1946, and Nancy Baylor from Pottstown in the 1950s.

people and customers: “There is a strong temptation on an occasion as important as a 50th anniversary to indulge in self-praise; to talk about one’s own accomplishments. Instead, we would rather engage in self appraisal.”

At the half-century mark, Dana employed 10,000 people in Toledo, Ohio; Pottstown and Reading, Pennsylvania; Auburn, Marion, and Fort Wayne, Indiana; Hillsdale and Lansing, Michigan; and Buffalo, New York. The company also had interests in Société Glaenzer-Spicer, Hardy-Spicer, and Hayes Steel Products.

WORKING TOGETHER

In 1954, Jack Martin began preaching about the “day of competition” and the need for change in the industry and at Dana. World War II, the pent-up demand that followed it, and then the Korean War had all contributed to overcapacity in the industry. Despite the increasing competitiveness and need for change, industrial management and union labor changed little at that time and cooperated even less. The root cause of this, as Dana’s new president saw it, was a lack of faith and

With both parents gone, the young Victor brothers bonded together and then staked a future in the auto industry on an idea for a better engine seal – the beginning of the world’s largest gasket manufacturer. Circa 1920.

VICTOR GASKET

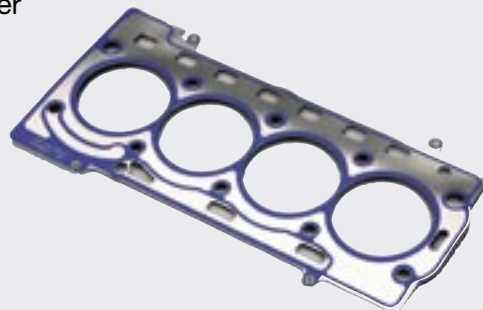
T heir mother’s premature death and father’s desertion deepened the brotherhood of John, Joseph, Paul, Anthony, and Benjamin Victor in the early 1900s. To get a tighter grip on their fate, older brothers John and Joseph decided to start their own business. Joseph, an experienced tool and die maker, suggested gaskets, and production soon began in the basement of a Chicago apartment building in 1909. Brother Paul became the company bookkeeper, and the two youngest, Anthony and Benjamin, were the first press operators. The pioneer automotive builders of the time liked what they saw in the construction of the new Victor gasket. It delivered tighter engine sealing, longer life, and greater protection against the common problem of gasket blowout.



John Victor visited California in 1921 to gauge the company’s opportunities on the West Coast. He found Victor gaskets commanding nearly 90 percent of the market there. The company was acquired by Dana in 1966, and Victor® Reinz® gaskets today can be found in vehicles around the world.

As the automobile industry grew, the Victor Manufacturing and Gasket Company grew with it. The Victor brothers continued to improve their product – collectively earning more than 50 patents on gaskets and oil seals. When the Great Depression hit in 1929, the company promptly hired its first patent attorney, believing “good counsel is just as important as inventive ability.” The company built the industry’s first sealing research laboratory in the ‘30s and pioneered the development of synthetic rubber in oil seals. Like the rest of the auto industry, the Victors scaled back their operations to cope with the Depression, but they also relied on a steady stream of product advancements to keep the orders coming in.

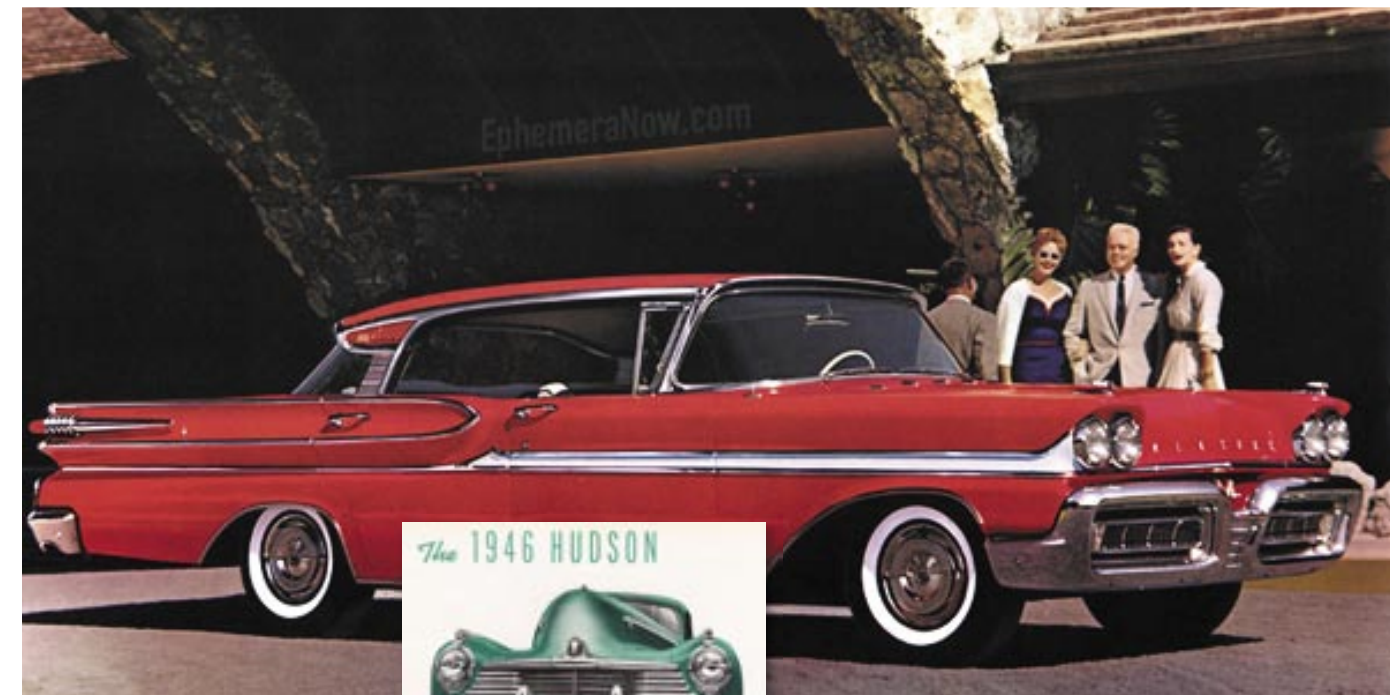
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trust. Martin’s team and union stewards met on common ground – fairness, job security, good pay, and profitable company performance.

Plant staffs and union representatives began rewriting work standards, tightening cost and quality controls, instituting preventive maintenance, and attacking every kind of waste – from leaky faucets to excessive paperwork. Cooperation paid off. The results for just one plant included the demise of 80 forms, millions in savings, and 40 percent less scrap. The Pottstown plant, literally slated to be closed (and partly replaced by the new facility in Marion), completely revamped its operations and subsequently underwent a four-year, \$5 million renovation.

Among the 1958 models riding on Parish frames were the Mercury Park Lane (below), Buick Roadmaster 75, Oldsmobile Super “88,” and Pontiac Star Chief.



Spicer® universal joints and propeller shafts were standard equipment on this 1946 Hudson, as well as every Hudson model dating back to 1909.

REVOLUTIONARY PRODUCTS

In addition to the belt-tightening measures, Dana continued to modernize its plants, investing \$100 million within one six-year period, and develop new products. Charles Dana told a *Business Week* writer, "When the size of the pie is reduced (car production dropped 20 percent between 1950 and 1954), the only way to help yourself is to fight for a bigger slice." The company's offensive started with what Charles called "highly specialized products." New products, lean manufacturing, and reinvestment kept the Dana Corporation profitable throughout the '50s. It also outperformed its rivals, who were diversifying into new businesses, by sticking to the automotive market.

One of Dana's most successful products ever was launched in 1956, the Powr-Lok® limited-slip differential. On slippery surfaces, Powr-Lok directed the engine's power to the rear wheel with the better traction. On turns, it also allowed the outer rear wheel to rotate faster than the inner one for better stability. Just two years later, the product was being marketed as the Chevrolet Positraction, Chrysler Sure-Grip,

BEHIND CHARLES DANA

Charles Dana didn't run the company alone. In managing finances, he relied a great deal on John and Louis Melick. In sales, William Fairhurst accompanied Charles on customer calls for 30 years. And in the daily operation of the company, Charles was backed by the very able Ralph Carpenter.

Carpenter's diverse experiences before joining Spicer Manufacturing in 1922 included: helping to prepare the machinery to produce the first Cadillac car, running one of the first research laboratories in the country, and liquidating and selling the assets of a bankrupt universal joint company to Charles Dana. Carpenter was cheerful, diplomatic, and always impeccably dressed. Charles was aggressive, brash, and at times a bit unkempt. They were a perfect complement.

When Spicer Manufacturing relocated to Toledo in 1929, Charles Dana commuted monthly from New York to keep tabs on the company. Beyond moving his family, Carpenter became part of the community through such groups as the chamber of commerce, YMCA, Rotary Club, and Junior Achievement.



The *New York Times* declared Dana's Powr-Lok® differential to be "among the more significant engineering improvements" in automotive history. In 1959, it was available on many GM, Chrysler, Lincoln, and Studebaker car models.

Ruan Transport maintenance chief Mel Lusman reaffirmed that Spicer and Chelsea products, selected for 100 new rigs in 1963, delivered under the toughest conditions — steep grades, bad weather, and big loads. Also shown is Dana's Ray Denkhoff (left).



Lincoln Directed Power Differential, Pontiac Safe-T-Track, Buick Positive-Traction, and Oldsmobile Anti-Spin. Auto dealers pushed the safety and utility of the new Dana differential, and consumers everywhere drove home with greater peace of mind.

Another product hit for Dana was the Synchro-Verter automatic transmission for heavy trucks, which reduced fuel consumption, truck maintenance, and driver fatigue. Still other introductions included 4-, 6-, and 12-speed transmissions, a tractor transaxle, a clutch pedal assistor, and an improved Road Speed Regulator. The latter was developed by Perfect Circle, which Dana acquired in 1963.

Perfect Circle and Victor Manufacturing and Gasket, acquired in 1966, were both world-leading manufacturers of engine components; they sold to vehicle makers and to the replacement parts market. Perfect Circle's primary product was piston rings; Victor's, engine gaskets and oil seals. Together, the companies added nearly \$100 million in annual sales to Dana.

DANA CORPORATION FOUNDATION

The Dana Corporation Foundation was established by Charles Dana in 1956 for charitable purposes. Today, the foundation provides financial support through grants to communities in the United States where Dana people live and work and to the causes to which they are committed. It is run exclusively by Dana people on seven regional boards.

Grants are made to nonprofit organizations in four areas: education, neighborhood revitalization, arts and culture, and physical and mental well-being. Dana people's gifts to educational institutions are also matched dollar-for-dollar by the foundation.

Specific groups the Dana Foundation has supported include: United Way, Red Cross, Junior Achievement, Habitat for Humanity, Big Brothers Big Sisters, and various museums and symphonies.



Dana Foundation grants often support the same organizations and causes to which U.S. employees devote their time. Dana's Paul Steeley met with his group of young YMCA Indian guides in 1977.

THE MULTINATIONAL COMPANY

Despite the advancements into new product and market segments, the Dana Corporation reversed course geographically in 1954 by selling Hardy-Spicer. Charles Dana had grown disenchanted by what he saw in Europe. The decision proved ill-timed though. In 1950, the United States produced some 80 percent of the world's trucks, cars, and buses. Over the following two decades, that share slipped to 35 percent. Dana needed to go abroad, or lose out.

International expansion did continue, especially to the South. In the rapidly growing Brazilian market, Dana purchased a minority stake in Albarus, a universal joint manufacturer. Dana products were soon being made in Argentina and Venezuela as well. Spicer Perfect Circle, S.A. of Mexico built a new plant in 1966. In Europe, Dana reestablished its presence in the early 1960s by taking an interest in agricultural driveshaft manufacturer Bogense Jernstoeberi og Maskinfabrik (BJM).

"Always ask for No. 1," read this advertisement (below left). "Dana products are No. 1 for quality, coverage, and reliability." During the '50s and '60s, Dana's manufacturing operations expanded to Brazil, Argentina, Venezuela, and Mexico.



Dana began exporting driveline products to Volvo in Sweden in 1936. Pictured here is the 1963 Volvo P1800 sports sedan — with 108 horses under the hood.

By 1966, Dana had licensing agreements with 34 companies, accounting for \$100 million of its sales, and partial ownership of 10 other firms internationally.

Sales in 1963 exceeded \$300 million. Concerned with Dana's size, Jack Martin split the company into seven autonomous units, each responsible for the processes closest to its customers – engineering, manufacturing, and sales. Additionally, the company invested more and more in employee education and training. As early as 1919, Charles Dana had shared his vision of a formal school within the company. In the 1920s, professional trainers from New York City visited South Plainfield to lecture on Modern Production Methods. Years later, the Industrial Supervision Institute was developed with Toledo University. By the '60s, the company had programs with Hillsdale College, Earlham College, and Harvard University's business school.

The Dana Corporation in 1966 was an altogether different organization than what it had been in 1946. Behind a new president, a slew of new products, new customers in new markets, a new divisional structure, and modernized plants and equipment, sales and

profits reached record levels. Employment hit 19,000. The one constant had been the leadership of Charles Dana himself. There, too, change was on the way. ♦

Due to their durability and ease of maintenance, Spicer® spring-loaded clutches were used on John Deere's full line of combines.



Originally designed for the 1939 Crosley sedan, which had an 80-inch-wheelbase, Model 11 axles were resurrected and mass produced in Fort Wayne in the 1950s for Cushman and E-Z-Go® three-wheel vehicles. For a short time, Dana even had its own brand of golf carts called DanaMite.



E-Z-Go is a registered trademark of Textron Inc.

HAYES

Clarance Hayes started making wheels for horse-drawn carriages in 1889. His early career also included running a wheel company organized by Dallas Dort, William Durant, and Charles Nash. (Durant later formed General Motors; Nash became president of GM in 1912.) In 1908, Hayes struck out on his own for a second time by founding Hayes Wheel. When the company's Canadian operation was hit by financial troubles in 1929, Charles Dana got involved and Hayes was soon making Spicer u-joints.

The company was struggling again in the 1950s. Hayes people figured there was nothing to do but wait out another cyclical downturn. Then Dana's Ren McPherson arrived with the order to revive the business or shut its doors. He charged his new colleagues with saving their own business – and jobs. McPherson reshuffled top managers, closed or sold non-automotive assets, and overhauled remaining operations through the ideas of the people working there.

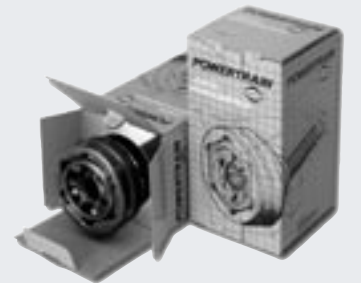
Hayes people met Saturday afternoons at a local spaghetti house to trade cost-cutting ideas. Work shifts began competing with each other to see who could produce the best and the most. Demand surged and profits returned. Hayes eventually became Hayes-Dana and then Dana Canada Inc.

ALBARUS

Ricardo Bruno Albarus emigrated from Germany to Brazil and started a tooling shop in Puerto Alegre in 1947. Noting the scarcity of replacement parts for motor vehicles, Ricardo saw an opportunity to increase his business by producing universal joints.

When American automakers established manufacturing operations in Brazil in the early 1950s and were required to use locally made parts, Ricardo again saw opportunity. This time, he needed far more capital, technical expertise, and equipment. In 1954, he and Zeca Bohrer flew to Toledo and met with Charles Dana and Jack Martin. As a result of this first meeting, Dana granted Albarus a technical assistance license. Three years later, Dana traded refurbished equipment for a 30-percent stake in Albarus. This grew to majority ownership in 1967.

Ricardo Bruno Albarus started making u-joint replacement parts in 1947. When GM and Ford started making vehicles in Brazil in the 1950s, he partnered with Dana to meet their original-equipment needs.





1967-1979

**JACK MARTIN'S CHANGES SET THE STAGE
FOR REN MCPHERSON'S REVOLUTION**

“Learning is not compulsory ... neither is survival.”

– DR. W. EDWARDS DEMING, QUALITY CONSULTANT

In 1967, the Spicer Power Train, a custom-built tractor and 40-foot classroom-in-a-trailer, hit the highway to provide product training to Dana customers and truck fleet owners across the United States. In 1915, a handful of used buses owned by Spicer Manufacturing maneuvered the unpaved roads of Plainfield, New Jersey, to pick up and carry employees to its plant in rural South Plainfield.

The link between these two events was Charles Dana as he journeyed through more than five decades of the motor vehicle industry. He transformed a struggling u-joint company into one of the largest independent producers of vehicle components in the world. Part of Charles' success was a keen eye for good opportunities – and good people. He clearly saw leadership abilities in Jack Martin, who began 1967 as the company's new chairman of the board.

The Spicer Power Train truck was just one example that the Dana Corporation had become a major force in the vehicular industry. This classroom-on-wheels traveled across the United States to educate customers on Dana's growing array of products.



3 out of 4

When 3 of the nation's 4 largest fleets specify Spicer transmissions, there must be a reason!

For more information, write Spicer Transmission Division, Dana Corporation, P.O. Box 988, Toledo, O. 43606

Spicer

To keep three out of four truck fleet owners specifying Spicer® transmissions, Dana kept reinvesting in its product development resources and laboratories, including the truck test center and track in south-eastern Michigan.

Martin continued Charles' legacy of investing in new and old plants alike. Dana built or expanded six manufacturing facilities in 1967 alone, including a frame plant in Thorold, Ontario, Canada. About half of Dana's sales at the time came from the light- and heavy-duty truck markets where its products had earned impressive shares. To service these customers, Dana also opened the J.R. Miller Truck Test Center in Ottawa Lake, Michigan. (Miller served as Dana's president in 1967 and vice chairman in 1968.)

THE MOVE TO DORR STREET

Dana's sales doubled in the 1960s, and with its growing size and international reach, many felt the company needed a new home base. For 40 years, the central office had been located within the Bennett Road complex in Toledo. Eighty-four acres were purchased across the street from Inverness, a private golf club in town, and a Georgian Colonial-style world headquarters building opened in the fall of 1970. Along with the new building came a flattening of Dana's management structure. Jack Martin and Ren McPherson, who had become company president in 1967, were changing far more than organizational policies and structure; they were remaking Dana's culture, which for so long had been molded by one central figure, Charles Dana. Martin himself was being challenged by McPherson. By the time he was appointed president in 1968, McPherson's revolutionary leadership style had been proven time and time again, characterized by his turnaround of Hayes-Dana in the late '50s.

Just as he had streamlined and simplified operations at the Canadian affiliate, McPherson pressed for the same changes to all of Dana. He visited the chairman's office one day in 1968 with volumes of corporate policies and procedures. One by one, he took a manual from the stack, placed it in front of Martin, and asked, "Do we need this to run the company?" Two feet of paper and a lot of "no's" later, McPherson had dealt Dana's bureaucracy a serious blow. He kept pushing decision-making and accountability all the way to the shop floor.



Dana's headquarters moved from the Bennett Road production complex in Toledo to 4500 Dorr Street in 1970. At the same time the building was going up, Chairman Jack Martin and President Ren McPherson were flattening Dana's management structure to strengthen the company's competitiveness.



Dana people's productivity nearly tripled during the 1970s. New phrases were introduced to Dana's vernacular: "What do you think?" "Expert in your 25 square feet," and "Talk back to the boss."

Ren McPherson (inset) borrowed the best leadership traits from those he followed – Clarence Spicer, Charles Dana, and **Jack Martin** – added his own unique approach to business and people, and called the result the Dana Style.

THE DANA STYLE

To help Dana people rise to the challenge of more decisions, higher expectations, and more accountability, McPherson established Dana University in 1969, an in-house school that initially taught first-line supervisors and managers the basics of cost control and asset management. This was crucial as Martin and McPherson were also pursuing leaner operations and greater productivity, goals they knew

depended most on the people in the plants. Other core courses for "Dana U" focused on the fundamentals of supervision, so leaders throughout the company could follow the Dana Style of Management.

Bringing supervisor education and training in-house from Hillsdale College was a huge success. Four hundred students completed classes in the first year. Working with two Toledo-area universities, graduate-level engineering and business

Marina Meyersohn of Dana Equipmentos, Ltd. attended a Dana University class in Sao Paulo, Brazil, in 1979.



Dana University had some 400 students in its first year, 1969. Early courses were designed to educate Dana people on the fundamentals of cost control, supervision, and the new Dana Style of Management.



programs were launched. The Certified Dana Supervisor curriculum was introduced in 1978, the same year Dana U moved into the new McPherson Hall adjoining the Dorr Street headquarters.

To help articulate the Dana Style, McPherson introduced a one-page policy sheet that effectively replaced the manuals he had already tossed. The better way of managing Dana – with empowered people at all levels – worked. The annual return to Dana investors averaged 18 percent from 1967 to 1976. Dana people’s productivity nearly tripled in the 1970s. Perhaps more importantly, Dana people believed in the company’s future; more than 70 percent bought shares of Dana stock through the Employees’ Stock Purchase Plan.

TRIBUTE TO CHARLES DANA

In 1910, Charles Dana asked his wife if he should continue in politics, claiming that one day he could have a shot at the New York governorship. Agnes suggested he find out how much money the governor made. Charles checked and came back to sheepishly admit the governor made \$15,000 per year. “Well, Charlie, if that’s the best you can do as the chief executive of the state, it’s not your bag,” replied Agnes. “You get yourself an honest job in business somewhere.”

Charles did even better. He built a global automotive supplier with sales at the time of his death in 1975 exceeding \$1 billion. His earliest acquisitions remain cornerstones of the Dana Corporation today. His disciplined approach to spending money is still evident within the company’s 240 facilities around the world.

Charles Dana was cautious, but not afraid to take risks. He gambled the company’s future by building its first big facility in South Plainfield, New Jersey, and its second in Toledo. His risks sometimes back-fired. He nearly lost the company during the Great Depression, convincing bankers to extend more loans solely on the value of his reputation.

Worn shoes and wrinkled suits added to Charles’ frugal reputation. What they disguised though was a man of simplicity and focus. Beyond his reluctance to spend money, Charles simply did not care to spend time on such frivolities. The pursuit of opportunities for the Dana Corporation, and later for the Charles A. Dana Foundation, was an all-consuming passion.



Charles Dana's wife, Agnes, told him early in his career to find “an honest job in business.” No one could have predicted how successful he would become.

MARTIN AND MCPHERSON

The future for John E. “Jack” Martin, who was elected Dana’s second chairman in 1966, wasn’t always so bright. In fact, he once said it looked rather gloomy when, as an 18-year-old, he married his 16-year-old high school sweetheart. Without a diploma, he enrolled in college, but was expelled for unruly behavior. He then joined a manufacturing concern in Atlanta and quickly moved from stenographer to foundryman to general manager. Years later, Martin became president of Firestone Steel Products in Akron, Ohio.

Despite joining Dana from the outside, Martin vowed that future leaders would be promoted from within. When Martin tapped René C. “Ren” McPherson to be company president in 1968, he promoted another no-nonsense, team-oriented veteran, Gerry Mitchell, to executive vice president. Through McPherson and Mitchell, who both eventually became Dana chairmen, Martin delivered on his vow to promote from within.

With degrees from the Case Institute of Technology and Harvard University, McPherson moved rapidly through a number of jobs at Dana, running Hayes-Dana and the powertrain divisions along the way. McPherson’s charisma, intensity, curiosity, and interest in other people earned him the affection of Dana people around the world. He asked the now famous question, “What do you think?,” thousands of times and was totally absorbed in each person’s answer.

Despite the company’s phenomenal success during his leadership, McPherson always claimed his greatest accomplishment was the founding of Dana University. He believed passionately in the potential of people at all levels of the organization. He retired from Dana in 1979 to become dean of Stanford University’s Graduate School of Business.



Though Jack Martin was an outsider who succeeded president Ralph Carpenter and then chairman Charles Dana, he vowed his successor would be promoted from within.

According to the people who worked for Ren McPherson in the '70s, the shock of his changes at Dana registered 7.5 on the Richter scale.

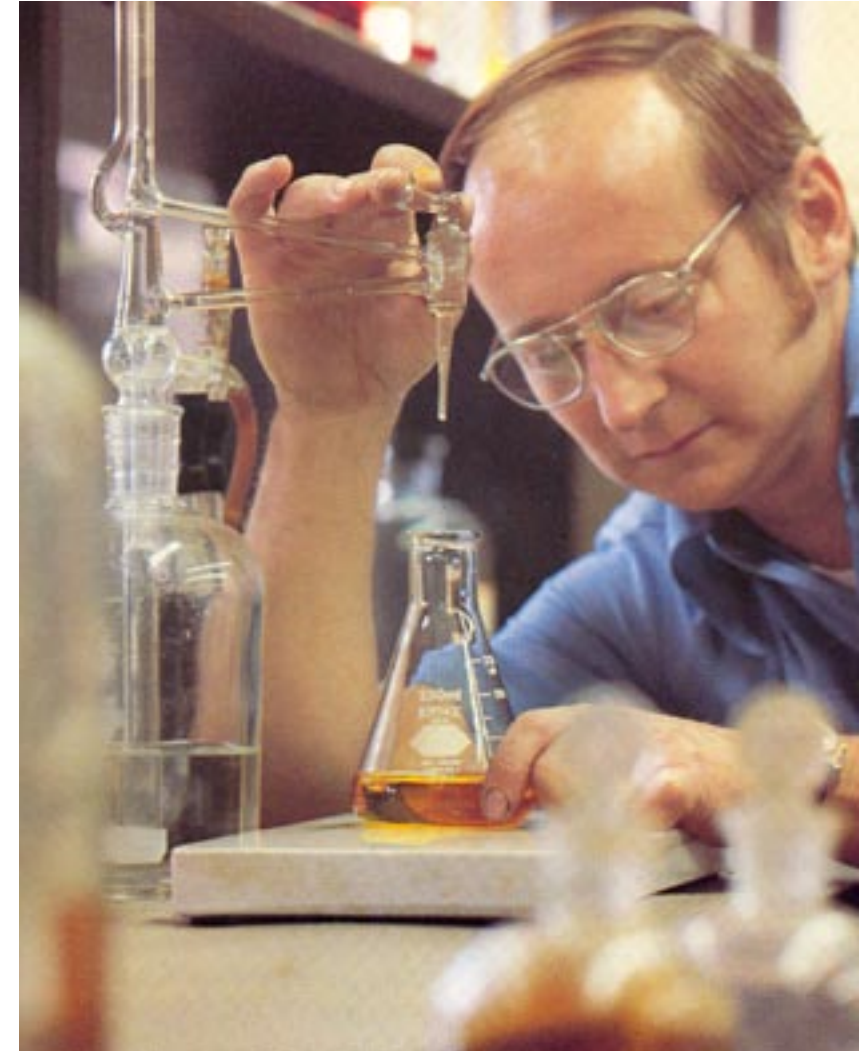


BEYOND VEHICLES

When Jack Martin joined Dana, American companies produced three-quarters of the world’s automobiles. In just 25 years, their share fell to 25 percent. Japan in particular was producing and selling more and more cars. Fuel-efficient imports ate into Detroit’s share of its home market and won wider acceptance during the oil crisis of the mid ’70s. Sales of car components fell dramatically for Dana. Equally challenging, a competitor was beating Dana in its largest business, heavy-duty truck transmissions.

Dana needed to rethink its approach to the market and tap new revenue streams. From 1966 to 1979, Dana’s sales grew from just over \$450 million to just under \$3 billion. While the company kept developing new car and truck parts, it also entered altogether new markets, largely industrial equipment, and continued expanding abroad.

Much of Dana’s industrial sales, including components for construction, mining, and agricultural equipment, were derived from existing product lines. Other mechanical, electric-electronic, fluid power, and turbo products were added through acquisitions that included: Michigan Wheel, Seco Electronics, Coolidge Propeller, Formsprag, Rapidsyn, and Weatherhead. By 1979, industrial products accounted for 20 percent of Dana’s sales, comparable to that of replacement parts. Though vehicular sales still accounted for 60 percent, Dana had clearly become less dependent on car and truck manufacturers.



Though Dana entered the industrial market in the '70s, it remained committed to vehicle makers. Company engineers, including Hardy McDaniel in Marion, Indiana (above), kept pushing for advancements in materials, processes, and products.

A team of Parish engineers led by Rod Moyer (right) developed the industry's first computerized frame inspection equipment in the

1970s. Neff Parish founded Parish Manufacturing in 1905, contrary to what this advertisement (below) indicated.



Over the years, we have been privileged to work with confidential information from all of the major vehicle manufacturers concerning chassis, frames and related components. We have always treated this information with utmost respect, and as a result we have an enviable reputation for keeping engineering secrets secret. Parish's secret service is yours for the asking. Here's what we can do:

- We can help you with basic research and development of new frames—in secret.
- Supply prototype builds and production proposals—in secret.
- Test frames—in secret.
- Maybe even help you off road.

It's no secret that since 1925, Parish has produced millions of the strongest, safest, most dependable frames on the road. For more information, write Parish Sales, Engineering & Research Division, Dana Corporation, P.O. Box 200, Taylor, Michigan 48180.

Parish

Your design secrets are safe with Parish frame engineers.

“TURNING POWER INTO PROGRESS”

“If it moves under its own power, Dana will have a piece of the action.” This tagline was used for years in promotional materials to describe Dana’s many vehicle products. In the early ’70s, Dana people were invited to sum up their role in the industry in better (and fewer) words. From 9,000 entries, “Turning Power Into Progress Around the World,” submitted by William Shingledecker of the Spicer Transmission Division, became the new slogan for the company’s industrial and vehicular products.

Though the domestic car market was down, light and heavy trucks and off-highway vehicles still represented enormous opportunities. Spicer axles for four-



Parish frames were used for the Cadillac Eldorado (left), Ford Thunderbird, and the Oldsmobile Toronado in 1967.

Great products and great people pushed Dana's annual sales above \$1 billion for the first time in 1974.

AH, YES!

DANA JOINS THE \$1,000,000,000 CLUB

| | 1974 | 1973 |
|--------------------------|-----------------|---------------|
| Sales | \$1,680,000,000 | \$999,000,000 |
| Net Income | \$61,100,000 | \$55,100,000 |
| Earnings Per Share | \$4.20 | \$3.95 |
| Dividends Paid | \$1.50 | \$1.34 |

For a copy of our 1974 annual report, write Corporate Relations, Dept. 88, Toledo, Ohio 43697

Turning Power Into Progress Around the World

wheel-drive pickup trucks, which leveraged the company’s know-how from the World War II Jeep, sold briskly. Clean air regulations created new opportunities for Dana’s under-the-hood operations. Perfect Circle’s retrofit emissions control system, called Retronox, reduced exhaust gases on old and new vehicles. Victor’s Victocor® 3000 sealing system also met the stricter standards for gasoline engines. Other successful introductions included: Spicer Angle Link and Angle Spring clutches, which reduced pedal effort by 40 percent; a family of SST semi-automatic and automatic transmissions; longer-life driveshafts; Ag-Master® driveshafts; and new Perfect Circle® cruise controls for cars and trucks.

Equipped with Dana's new "44" front axle, the Ford Bronco took first place at the 1970 Baja 500 in the production 4x4 class. Soon after,

Ford decided to make the axle standard on all Broncos. Dana's leadership in light-truck axles started with the military Jeep.



Now standard...the heavy-duty front axle that helped BRONCO win at Baja!

How good is Bronco with the new Dana 44 heavy-duty front axle? Good enough to take first place in the production 4x4 class in the 1970 Baja 500. Which is pretty darn good. In fact, the Bronco-Dana 44 combination is just too good to be an extra-cost option—so, beginning with production September 27, we made it standard.

Bronco's other goodies are so good we wouldn't want to change them. That 33.6-ft. turning diameter, for

instance . . . tightest of any 4-wheeler. Or that 11.3-inch ground clearance. Or that approach angle of 40.2 degrees and departure angle of 26.9 degrees. Or that 28.6-degree ramp breakover angle. Or those identical front and rear tracks of 57.4 inches. These are the kinds of numbers that make you a winner in the desert and the hills. That's what Broncos are all about. Give one a try. Your Ford Dealer will be happy to put you in the saddle.

A better idea for safety: Buckle up

FORD BRONCO

Not every Dana product has been a smash hit in the marketplace. Among the flops from the '50s, '60s, and '70s were the Perfect Circle Puffy air

compressor, Danair hydraulic air-craft jacks, a bike transmission, the Hull-Gard boat trailer, and the DanaMite golf cart.

PUFFY
AIR COMPRESSOR

\$79.00

DANAIR
AIRCRAFT GROUND SUPPORT EQUIPMENT

HYDRAULIC AIRCRAFT JACKS TRIPOD

features

- LIGHTWEIGHT
- HIGHLY MANEUVERABLE
- BUILT-IN SAFETY VALVES
- TYPED-RAM WITH LOCK-NUT

Perfect Circle

At a Dana International seminar, Arturo Cuervo (center) translated a discussion about engine components. Dana completed 25 international acquisitions between 1966 and 1979.



T.W. Kim machines shafts for GM cars at the Korea Spicer facility in Seoul, a market Dana entered in 1975.

Acquisitions also added to Dana's automotive offering. Weatherhead brought a variety of hoses, tubing, and valves for braking, steering, fuel, lubricating, and other systems. Dana purchased interests in many of its international licensees. Its axle operation expanded beyond the Fort Wayne plant to include Spicer, S.A. in Mexico, C.A. Danaven in Venezuela, Albarus in Brazil, Transejes in Colombia, Korea Spicer, ROC Spicer in Taiwan, and Spicer Philippines.

Dana World Trade, formed in 1969, provided the company with a network of 200 sales agents in 130 countries to market and sell its products. While exports boomed, Dana added more production facilities internationally. In 1972, it acquired stakes in Turner Manufacturing in England and SOMA in France, transmission and axle manufacturers. It bought BJM of Denmark, which made agricultural PTO shafts, in 1973, the same year Dana-Asia, Ltd. was formed in Japan.

Two acquisitions also strengthened Dana's hold in the replacement parts market. The first was Brown Brothers, one of the largest automotive aftermarket distributors in Europe. The second was Wix, a filter manufacturer in Gastonia, North Carolina, with yearly sales of more than \$100 million.

Dana's sales outside the U.S. in 1979 were up 71 percent over the previous year, industrial sales 34 percent, and replacement parts 31 percent. The company's growth in no small way resulted from more than 50 acquisitions in just 14 years. Topping that off were the initiative and ideas of Dana people. Ren McPherson summed it up best, "If our people are allowed to put their creativity and ability to work, we can beat the socks off anybody in the world." ♦

WIX CORPORATION

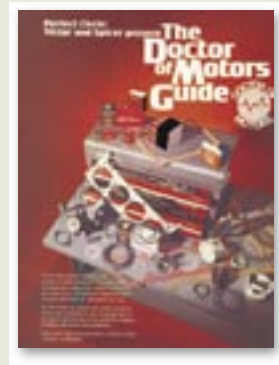


Working for a filter manufacturer in the early 1930s left Jack Wicks feeling discontented. He and friend Paul Crawshaw decided to start their own business – making and selling candy, an unsuccessful venture. The restless and creative Jack then turned his energy back to filters. With patents protecting his own filter design, he set up shop in Gastonia, North Carolina, a cotton mill community. Cotton waste was the key filtering element in Jack's product. A few entrepreneurial bankers, led by Allen Sims, bought into the idea, and Wix Corporation began producing filters in 1939.

Founded by Jack Wicks in Gastonia, North Carolina, in 1939, Wix today produces oil, air, cabin, fuel, coolant, transmission, and hydraulic filters.

Jack Wicks also invented a revolutionary spin-on oil filter that he called "twist of the wrist." It was perfected in the 1950s by Kingsley Humbert and Paul Francois and remains the standard to this day.





1979-1990

**GERRY MITCHELL KEEPS THE FOCUS ON PEOPLE —
AND DANA ON THE GROWTH TRACK**

“Life affords no greater pleasure than
overcoming obstacles.”

— SOURCE UNKNOWN

As in 1974, another oil-induced recession hit the U.S. economy at the end of the decade. This time, Americans realized the value of compact, fuel-efficient cars. Demand for Detroit’s large automobiles dropped, and Japanese manufacturers made big, lasting gains in the U.S. market. Worse, the light-truck market collapsed almost overnight – a \$600 million sales hit for Dana. In 1980, for the first time in several years, Dana did not set new profit or sales records. And the downturn was not short-lived. The car and truck markets stayed in a slump; interest rates remained high; and the recession lasted for more than two years.

The downturn inevitably led to layoffs and plant closures. “Of all the damned things you have to do, laying people off is the toughest,” said Gerry Mitchell. Almost a third of Dana’s people lost their jobs. The company’s worldwide employment dropped from 44,000 in 1979 to 29,000 just three years later. The recession also made it clear that Dana needed to reduce its dependence on the cyclical light-vehicle market and diversify its business.

Dana’s leadership had changed when, at the end of 1979, Ren McPherson announced he was leaving to become a graduate school dean at Stanford University. Mitchell became chairman and chief executive officer, and in 1980, Stan Gustafson was elected president. (Gustafson died just three years later.) Working in the economic cycles of the late 1970s and early 1980s, Mitchell later recalled, was like riding on a roller coaster. However, the difficulties he and the company faced were beneficial in the long run: “When you hammer your way through something like that, what you get is something better.”



Rocky Coile and Ed McNeal reviewed layout plans for Dana's fourth U.S. service parts depot in 1980. Sales of light-vehicle replacement parts grew 30 percent that year to nearly \$800 million and helped to offset slumping original-equipment sales.



Dana Chairman Gerry Mitchell insisted on two-way communication. He visited dozens of plants each year to share his thoughts as well as to listen to what others had to say. The “Talk Back to the Boss” program also provided an easy way for people to share their comments directly with Mitchell.

TALK BACK TO THE BOSS.

The name of Dana is synonymous with productivity. Because we have all the elements. The workers who drive the job, the management who lead it, the tools that make it possible, and the capital that makes it all work. At Dana, we know that it's a part of what we call "Total Quality Management" getting people the freedom to work well, to grow and to share the rewards. You can see the results in our productivity. It's more than doubled in the last 7 years. Productivity alone doesn't produce profits. But we're increasing our output of parts for the automotive industry and industrial equipment markets and manufacturing for us, we need to increase productivity, we've equipped our workforce with the best. And there's still time for a handful of people who talk back to their bosses. Dana Corporation, Toledo.

PRODUCTIVE PEOPLE 

THE DANA STYLE

To help weather the tough times, the company relied more than ever on the Dana Style. Hayes-Dana people's commitment to quality, for example, was key in winning a driveshaft contract from Volvo. During a factory visit to Hayes-Dana, before the contract was awarded, Volvo officials received a polite but firm lecture from a Volvo-owning machinist on how the car's quality could be improved.

Communication within the company, as emphasized by the Dana Style, remained a top priority. Mitchell and Gustafson visited upwards of 50 facilities each year to keep people apprised of the company's performance and to listen to their ideas and concerns. Above all else, Mitchell looked to generate loyalty while touring the plants. Working his way down production line after production line, Mitchell

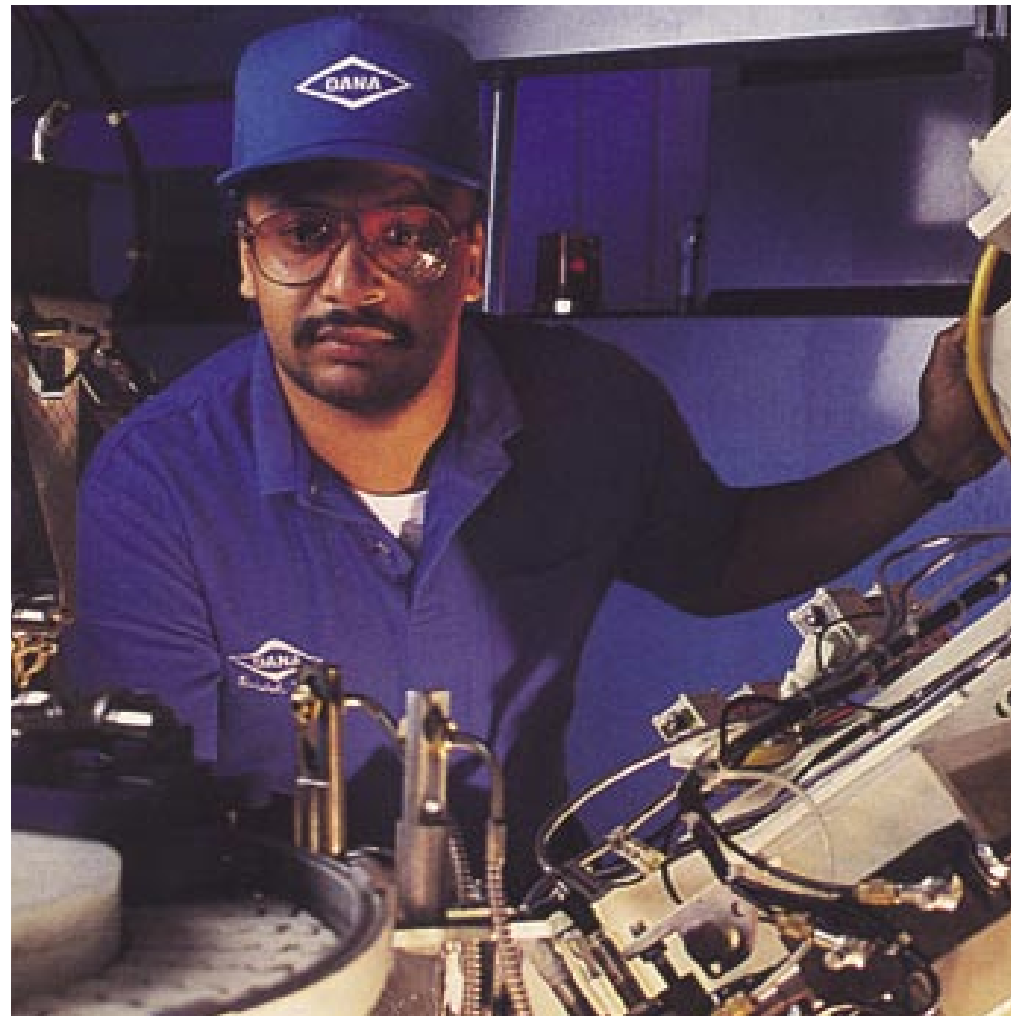
repeated his simple message to thousands of Dana people: “You help me, you help Dana, and I'll help you.” In one 36-hour stretch, Mitchell personally talked to 1,800 people in Gastonia, North Carolina. Feedback was also solicited through the formalized “Talk Back to the Boss” campaign, which was launched in 1982. Posters and attached notepads made it easy for everyone to send their comments directly to Mitchell. This practice continues today through the “What Do You Think?” posters.

In 1981, the company created an employee stock award plan to reward full-time employees “who have contributed to the success of Dana by their invention, ability, industry, loyalty, or exceptional service.” Stan Gustafson noted, “The purpose of the Dana Corporation is to earn money for its shareholders. Our people know this, because they are our shareholders.”

QUALITY CIRCLES

Education and training continued, as did participation in various types of “quality circles.” One quality circle, the “Dana Thick Skins” in Auburn, Indiana, made improvements in the roto-finish area of its heat-treat department. The redesigned work flow cost \$14,000 to implement, but saved an estimated \$300,000 while increasing safety and efficiency. The “Trouble Shooters” in the Ashland, Ohio, plant implemented 27 suggestions. The “Roberts Renegades” team in Hagerstown, Indiana, invested long hours over the course of two years solving a thorny packaging problem.

Charles Bradley's journal-cross cell in the Bristol, Virginia, driveshaft plant cut machine setup time from four hours to 10 minutes in 1989. Similar teams produced similar results in Dana facilities around the world.



Teamwork continued to drive improvement. Another Hagerstown group, the “Solution Seekers,” cut order-fulfillment time by more than 60 percent and created a computer program to reduce inventory and checking errors. Lew Farber, Jon Sallot, Scott Norris, and Jim Hart in Columbia City, Indiana, developed a crimping machine that cost one-third the price of machines available on the market. The Wix facility in Gastonia, North Carolina, organized a “Bright Idea” program that resulted in more than 9,000 suggestions and big savings. Boston Industrial in Hohenwald, Tennessee, implemented 86 percent of its people’s “Paperclip Program” ideas, saving \$500,000 in 1988 alone.

GERALD B. MITCHELL

Gerald B. “Gerry” Mitchell’s career began at the age of 16 as a third-shift machine operator with Hayes-Dana in Canada. By 39, he was president of the subsidiary. At 52, he became Dana’s fourth chairman, succeeding one of his closest friends, Ren McPherson.

On one hand, Mitchell was big, tough, and aggressive. On the other, unpretentious, genuine, and friendly. He made a lot of tough calls in the up-and-down ’80s, yet hated to dictate orders. Decrees, in his opinion, “tore at the fabric” of the team. He firmly believed in the Dana Style of Management, and in the talents, skills, and know-how of every person in the company. Acting on this belief, he spent much of his time on the basic duties of communicating, recognizing, and teaching.

“You’re winning if people can say, ‘It’s a good place to work.’ You’re losing if they can’t,” explained Mitchell.



The Dana Style of Management in Gerry Mitchell's opinion committed company leaders to developing and growing people within the ranks to run the company. While facing one challenge after another in the 1980s, he gave his full, unwavering support to Dana University.



Dana's shift in the 1980s to a more market-based company meant its traditional vehicular products were supplemented with new industrial businesses and brands such as Tyrone®, Lantex®, Gresen®, Boston®, and Warner®.



To promote the corporate name and its automotive brands, Dana began its official sponsorship of Dana Motorsports in 1983. Johnny Rutherford claimed the Dana Cup in 1986 with his victory at the Michigan 500.

PRODUCT FOCUS TO MARKET FOCUS

In 1982, Dana's three basic product groups – vehicular, service, and industrial – were reorganized to get them closer to the markets they served. The new market-focused divisions were: automotive distribution, direct distribution, highway vehicle, trucks parts distribution, trailer equipment, mobile off-highway, industrial equipment, and shelter and security. This last division represented a decidedly new direction for Dana. Created to handle the company's insurance and financial needs, this group grew into a full profit-and-loss operation that sold housing, insurance, financing, and leasing services. Its purpose was to help offset the cyclical nature of the

vehicular market. Although segments of the shelter and security division such as construction services didn't pan out, others such as leasing clearly found a profitable market niche.

During this period, the company made a number of other acquisitions to bolster its bottom line. In 1981, Dana acquired Tyrone Hydraulics, Lantex Hydraulics, Gresen Manufacturing, and Boston Industrial Products (the latter was combined with Weatherhead to form a single division). That year also marked the completion of Dana's acquisition of the Brown Brothers in the United Kingdom. By 1983, the economy and Dana both were turning around. The company's employment was

Drivetrain Service Division employees gathered at Dorr Street for their 1981 sales conference. Heavy-vehicle service parts became a bigger part of Dana's growth strategy in the '80s.

rising slowly, with 35,000 people on the payroll. Profits doubled those of 1982, and sales reached a new record, just shy of \$3 billion. Sales to the car and truck markets increased 45 percent over 1982.

In 1985, Dana made its largest acquisition to date with the purchase of Warner Electric Brake & Clutch. With annual sales of \$200 million, Warner greatly strengthened Dana's position in the industrial sector. Its product mix included industrial clutches and brakes, compressor clutches, ball bearing screws, and step motors for production machinery, defense and aerospace equipment, and commercial and off-highway vehicles. Chairman Gerry Mitchell and other members of Dana's corporate staff negotiated the deal without the aid of an investment banker, saving an estimated \$1 million in fees.



We asked 10 Dana Divisions, **“What’s new for trucking?”**



1. Spicer Drivetrain
 Spicer drivetrain components are designed for maximum durability and performance. The new Spicer drivetrain features a new design for the front axle housing, which provides increased strength and resistance to bending. The new design also allows for easier maintenance and repair.

2. Dana Axles
 Dana axles are designed for maximum strength and performance. The new Dana axle features a new design for the axle housing, which provides increased strength and resistance to bending. The new design also allows for easier maintenance and repair.

3. Dana Brakes
 Dana brakes are designed for maximum performance and safety. The new Dana brake features a new design for the brake pads, which provides increased friction and resistance to fading. The new design also allows for easier maintenance and repair.

4. Dana Clutches
 Dana clutches are designed for maximum performance and durability. The new Dana clutch features a new design for the clutch plates, which provides increased friction and resistance to slipping. The new design also allows for easier maintenance and repair.

5. Dana Compressor Clutches
 Dana compressor clutches are designed for maximum performance and durability. The new Dana compressor clutch features a new design for the clutch plates, which provides increased friction and resistance to slipping. The new design also allows for easier maintenance and repair.

6. Dana Ball Bearing Screws
 Dana ball bearing screws are designed for maximum performance and durability. The new Dana ball bearing screw features a new design for the ball bearings, which provides increased strength and resistance to wear. The new design also allows for easier maintenance and repair.

7. Dana Step Motors
 Dana step motors are designed for maximum performance and durability. The new Dana step motor features a new design for the motor housing, which provides increased strength and resistance to wear. The new design also allows for easier maintenance and repair.

8. Dana Industrial Clutches and Brakes
 Dana industrial clutches and brakes are designed for maximum performance and durability. The new Dana industrial clutch and brake features a new design for the clutch and brake plates, which provides increased friction and resistance to slipping. The new design also allows for easier maintenance and repair.

9. Dana Defense and Aerospace Equipment
 Dana defense and aerospace equipment are designed for maximum performance and durability. The new Dana defense and aerospace equipment features a new design for the motor housing, which provides increased strength and resistance to wear. The new design also allows for easier maintenance and repair.

10. Dana Commercial and Off-Highway Vehicles
 Dana commercial and off-highway vehicles are designed for maximum performance and durability. The new Dana commercial and off-highway vehicle features a new design for the motor housing, which provides increased strength and resistance to wear. The new design also allows for easier maintenance and repair.

New components and systems fueled the 30-percent jump in Dana's original-equipment sales to commercial vehicle manufacturers in 1984. Three years later, Dana began shipping complete chassis assemblies to Mack on a just-in-time basis.

In Ottawa Lake, Michigan, Neil Zeigler tested the performance of a complete Spicer drivetrain on a Hino medium-duty truck from Japan. Such technical services supported Dana's growing export business.

1980s ACQUISITIONS

Arthur Warner was a clever engineer and publicist. He adapted an early industrial invention to the automobile, creating the first speedometer. He then built a giant, gold-plated speedometer and toured the country to stir up demand.

Dana Chairman Gerry Mitchell was looking for balance in the 1980s. He had seen too many swings in car and truck demand in his 30-plus years in the industry. Acquisitions took Dana further into the industrial equipment and automotive distribution markets, as well as into the leasing business.

INDUSTRIAL

Boston Industrial Products, Weatherhead, and Warner Electric each began with an inventor and a novel idea. James Gillespie founded the Boston Hose and Rubber Company in 1870; its early success was based on a loom he invented that wove multiple tubular fabrics. Among Albert Weatherhead's dozens of inventions was a radiator drain valve that car-makers widely adopted in the 1920s. Combined, Boston Weatherhead was a leading industrial hose and fitting manufacturer.

In 1903, Arthur Warner invented an instrument to measure the speed of industrial machinery. Realizing the technology could be adapted to the automobile, he created the speedometer, which proved enormously popular

among motorists anxious to record their exploits or just stay within the limits of the law. Warner's firm grew to produce electric clutches and brakes, industrial products, and motors and controls.



When a winter freeze triggered a rush for car batteries in the U.K. in 1992 and supplies were exhausted, Dana's Milton Keynes distribu-

tion center came to the rescue – delivering the goods to 110 Brown Brothers branches and 600 jobbers within 24 hours of the shortage.

DISTRIBUTION

In 1889, three Brown brothers – Albert, Ernest, and John – rented No. 7, Great Eastern Street in London to sell bicycles, spare parts, and tools. They were joined a year later by brother Fredric. From a single storefront, the business grew into what would become Dana Distribution Europe. With great foresight, the brothers added a separate department to supply parts to the expanding automotive industry. Eventually, the small parts stores formed the core of the business. By the mid-1990s, Dana Distribution Europe operated 140 Brown Brothers branches throughout the U.K.

LEASING

Dana's acquisition of General Ohio Saving & Loan in 1981 ultimately led to the creation of Dana Credit Corporation. DCC engaged in large- and small-ticket lease financing as well as asset management and real estate services. As the business grew, DCC's reputation for solid customer service and outstanding quality won widespread recognition. By the mid-1990s, DCC was one of the largest leasing companies in the United States, and in 1996, it received the prestigious Malcolm Baldrige National Quality Award.

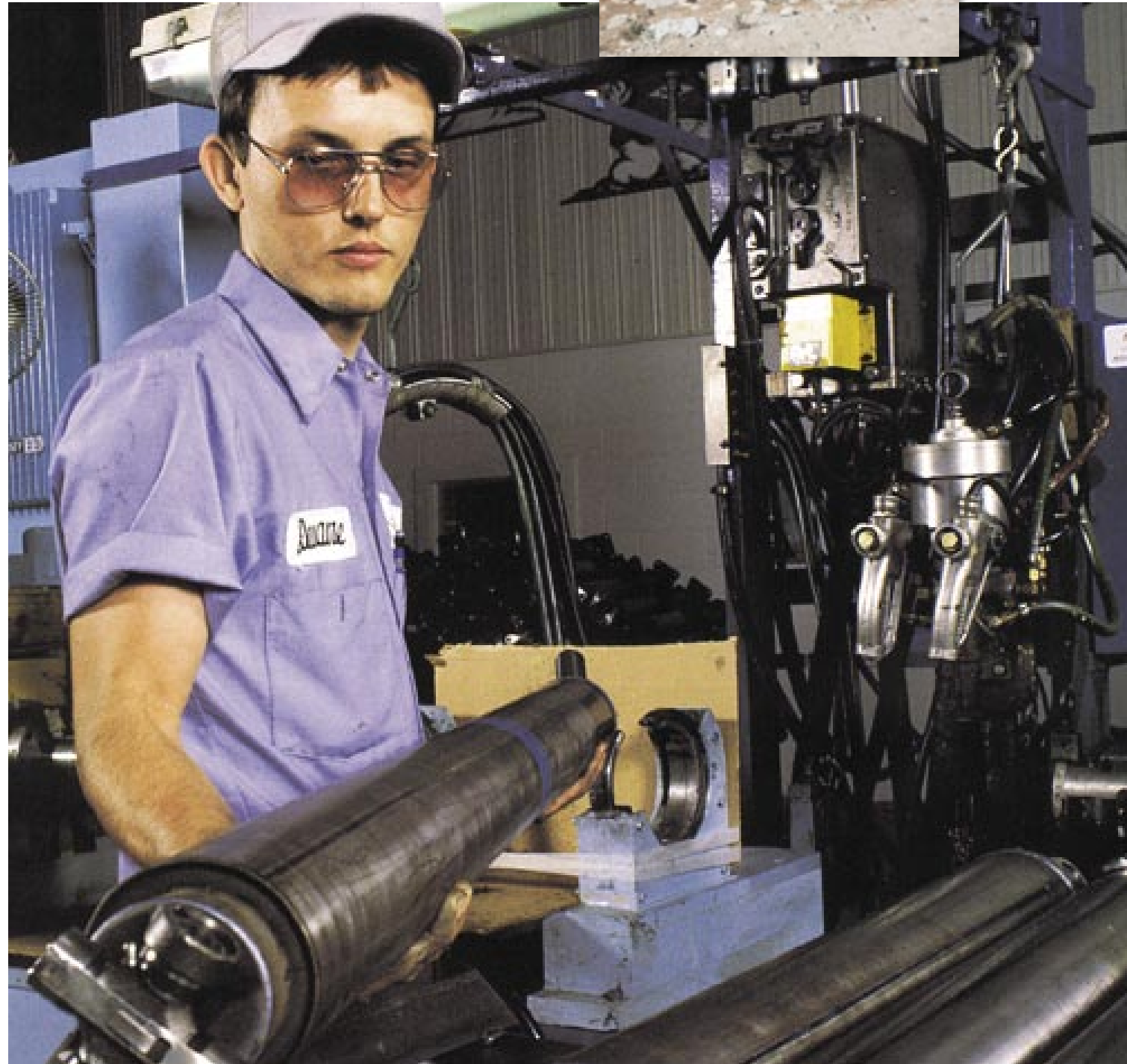


During its 20 years of business, DCC's broad range of expertise helped Dana divisions and facilities manage leases, acquire property, and save money. Dana's restructuring plan in 2001 included the sale of most DCC businesses. In the late 1990s, as Dana renewed its focus on the vehicular markets, its industrial and distribution operations were also divested.

DCC financed a lighting and HVAC retrofit for the Statue of Liberty/Ellis Island that saved \$160,000 annually. The leasing unit also helped its customers, including Dana production facilities, reduce their material-handling expenses.

Duane Apple and his coworkers in Gordonsville, Tennessee, began supplying drive-shafts to Nissan's light-truck operation

in Smyrna, Tennessee, in 1985. The program was Dana's first with a Japanese manufacturer building vehicles in the United States.



Relationships with Detroit's "Big Three" span Dana's history. The Spicer® all-aluminum driveshaft, an industry first, debuted on the 1983 Chevrolet Corvette. Dana

engineers used the same technology to create the first carrier-design axle with an aluminum housing, which was used on the '83 Ford Ranger.

CHANGING PRODUCTS AND CUSTOMERS

Dana acquired International Harvester's heavy-axle operations in 1982, adding \$120 million in annual sales and 14 new models to the Spicer Axle Division. The same year, Dana introduced the complete Spicer® powertrain package to the medium-duty truck market, marking a shift in how Dana sold to its customers. The package included three new components: the CM-55 Spicer transmission, the Angle-Ring Spicer clutch, and a Model 220 2-speed Spicer axle. Combining a system of multiple components with Dana's design expertise would become an increasingly important concept for the company.

In 1984, Mack Trucks awarded Dana all wheel-end business (hubs, drums and brakes) for front and rear axles. This led to a 10-year agreement where Dana supplied complete front and rear axles, driveshafts, clutches, and frame assemblies to Mack. Other notable business wins included a seven-year contract to supply all front driving and non-driving axles for Jeep vehicles; front-frame cradle assemblies for GM's new Saturn line of cars; universal joints for Caterpillar and Kato Crane; and Spicer 1310 driveshafts for Nissan' 720 four-wheel-drive trucks, built in Smyrna, Tennessee. This program was Dana's first with a "transplant," a European or Asian vehicle manufacturer with a production facility in the U.S. Dana also secured supply agreements with Isuzu Motors and Mitsubishi for universal joints and with Hyundai for Weatherhead® brake hose assemblies.



REMAKING DANA'S PLANTS

In the mid-1980s, Dana undertook a major restructuring of its production facilities. The company shifted its approach from fewer, larger plants to smaller regional facilities designed to run with a few hundred employees each. By 1988, Dana had closed or sold 45 facilities worldwide, while opening or acquiring 65. A 1984 capital improvement initiative called "Project 90" complemented the shift in facility scale. The goals of Project 90, which was lead by Borge Reimer, were to price Dana products at 90 percent of competitors' costs and make its facilities number one in quality and technology by 1990. Dana invested \$120 million in 1985 alone to revamp operations and improve computer technology across the company. Project 90 also included additional investments in training, particularly in engineering skills and advanced technology training. By this time, Dana University courses were more likely to be taught in regional locations rather than at the central campus in Toledo.

INDUSTRY LEADERSHIP AND RECOGNITION

Three Dana engineers served as president of one of the Society of Automotive Engineers. Ralph Teetor served in 1936, Clarence Spicer in 1938, and Philip Mazziotti in 1981. Teetor, the engineering prodigy who built a working vehicle at the age of 12, also rose to the top of his family's business, the Perfect Circle Corporation. Mazziotti followed the footsteps of his father, who had worked for Brown-Lipe and then Spicer Manufacturing, by joining the company in 1941. He became president of the driveshaft division and later vice president of product development for all of Dana.

For their "creativity, toil, and genius" in the industry, four Dana pioneers have been inducted into the Automotive Hall of Fame in Dearborn, Michigan. They were: Charles Dana in 1978; Ralph Teetor, 1988; Ren McPherson, 1991; and Clarence Spicer, 1995.



Despite being blind, Ralph Teetor (right) was issued more than 40 patents. His best known invention was the cruise-control device in the 1950s.

Philip Mazziotti (far right) received 36 patents by the time he retired from Dana. Since then, he has earned nearly 20 more. Among his inventions is the 8-degree CV joint.

Project 90 led to the creation of manufacturing cells in many Dana facilities. These flexible manufacturing systems moved the full range of assembly tools into one shortened line, allowing a complete manufacturing operation to take place in one area. One cell in Minneapolis, Minnesota, reduced production time from 29 days to three. The extensive use of machining cells in Columbia, South Carolina, required only 55 people for the two-shift operation, one-third the number of people usually needed for a plant of its size.

Training Dana people to work with new technology was an important part of the Project 90 initiative. Before being hired in Columbia, employees took three months of training followed by Dana U courses during their first two weeks of employment. The Lima, Ohio, driveshaft plant selected a team of five people (four hourly and one first-line supervisor) to study manufacturing technology in Japan. To be considered for the assignment, more than 123 volunteers wrote essays explaining why they wanted to participate; the five members chosen were then required to share their experience with coworkers upon their return.

By 1989, Dana sales reached \$4.9 billion, double the 1980 figure. Profits were almost one and a half times greater than those at the start of the decade. As Dana approached a new decade, it did so under new leadership. In February 1990, Gerald Mitchell retired after 45 years of service to Dana, and Woody Morcott became the new chairman and CEO. ♦



Dana invested heavily in new computer technologies in the 1980s as part of Project 90, an aggressive effort to further reduce operating costs, improve quality, and leverage new computer technologies. In Fort Wayne, Indiana, Gary Davis used finite element analysis software to design lighter axles.



In 1985, Katherine Boyd inspected graphite gaskets for Buick V-6 engines on Victor's new and completely automated stamping line in Chicago. Manufacturing innovations as well as product advancements have made Dana a world leading vehicle supplier.



1990-1999

A BOOMING ECONOMY, BIG ACQUISITIONS, AND A FLOOD OF IDEAS DRIVE PHENOMENAL GROWTH AT DANA

“Individual commitment to a group effort – that is what makes a team work, a company work, a society work, a civilization work.”

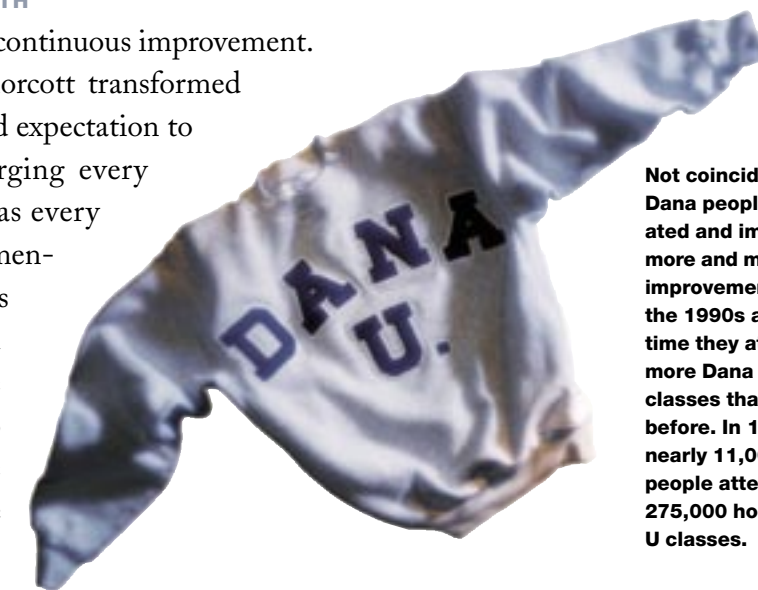
– VINCE LOMBARDI, FOOTBALL COACH

In 1990, hundreds of Dana plants were working toward goals once considered impossible – zero inventory, zero scrap, and zero machine set-up time among them. In facilities around the world, Dana people shipped components and systems to customers not monthly or weekly, but daily, and sometimes even hourly. Lean manufacturing supported the company’s broader push for total quality management, which became a structured pursuit through the Dana Quality Leadership Process (DQLP). Patterned after the Malcolm Baldrige National Quality Award, DQLP provided every Dana operation with the framework for assessing and measuring its performance. After winning DQLP Gold Awards, two Dana units later received the prestigious Baldrige award.

Along with the sharper focus on quality came the expanded Dana University curricula, which included courses on DQLP, Excellence in Manufacturing, Kaizen blitzes, and more. In 1993, 4,000 Dana people attended Dana U classes, a figure that tripled by the end of the decade. Training often took place outside the company as well. At the request of its people, one facility in Minnesota started classes on basic math skills. Employee Jerry Anderson went on to get his high school diploma and sign up for additional instruction in blueprint reading.

TWO IDEAS PER PERSON PER MONTH

Dana’s ideas program also drove continuous improvement. Company Chairman Woody Morcott transformed “ideas” from a sometimes implied expectation to a measurable objective by charging every Dana person to submit two ideas every month with an 80-percent implementation rate. Even before Morcott’s challenge, Dana’s heavy-axle team in Hilliard, Ohio, had taken the principle of people involvement to heart. The team submitted more than 8,000 suggestions in the three years ending in 1991, boosting productivity by 65 percent.



Not coincidentally, Dana people generated and implemented more and more quality-improvement ideas in the 1990s at the same time they attended more Dana University classes than ever before. In 1998 alone, nearly 11,000 Dana people attended some 275,000 hours of Dana U classes.

In its first three years of operation, the Parish frame plant in Hopkinsville, Kentucky, devoured 163,000 hours of training and produced more than 20,000 ideas.

More than two-thirds of “Hop’town” workers participated in Excellence in Manufacturing teams – teams that raised the bar for manufacturing excellence. They slashed machine set-up times, drove lost-time accidents down to just one in 1992, and hit equipment uptime levels of nearly 100 percent. Later, the axle group in Fort Wayne, Indiana, used individual initiative and teamwork to make 70 improvements to its painting process. Among the benefits were increased productivity and a 90-percent drop in emissions.

The flood of ideas from around the world proved invaluable when another recession hit the U.S. vehicle market in the early 1990s. Segments of the North American truck market dropped by 40

percent, and automobile sales hit an eight-year low. Weak economies in Europe and turmoil in Venezuela and Brazil exacerbated the slump – and Dana’s challenges. Through involved people and continuous improvement, the company was able to ride out the recession while continuing to post operating profits and pay dividends to its shareholders.

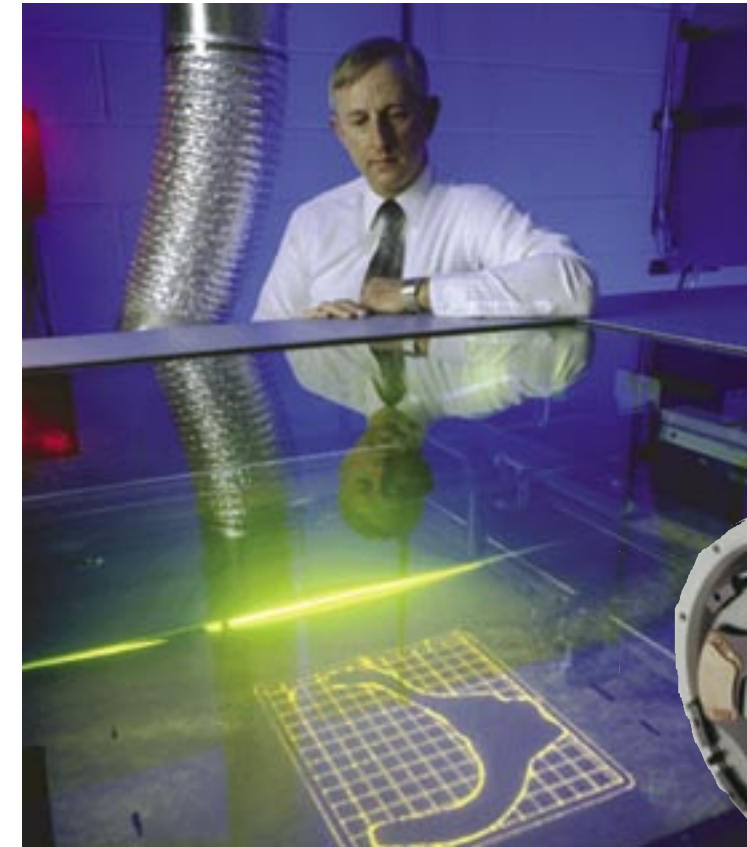
The time was perfect in 1992 to roll out a new slogan – *People Finding a Better Way*® – which recognized the millions of ideas and contributions of Dana people to making the company a world leader in one of the world’s biggest and toughest industries. By 1994, Dana posted record sales of \$6.6 billion, up 20 percent from the previous year. Another contributor to Dana’s recovery was the rising popularity of pickup trucks, vans, and sport utility vehicles. “Light trucks,” as they were called, accounted for more than 40 percent of the North American industry’s sales by 1995.



“Just-in-time” (JIT) delivery was one of many lean-production practices that Dana adopted in the ‘80s and ‘90s to meet customer needs. Hayes-Dana’s Stan Berry (left) discussed production issues with Gord Lee, Ford’s JIT coordinator in Oakville, Ontario.

Spicer Axle chief engineer John Hickey observes a rapid prototype system, which reduced lead time for prototype tooling from six weeks

to four days. Lean design processes and technologies have made Dana more responsive to customers’ needs.



AWARD-WINNING PRODUCTS

Dana people’s suggestions not only improved production processes, but also advanced the company’s product lines and created altogether new solutions for customers. In 1993, more than 50 Dana engineers were granted patents for their product-related ideas. Kenneth Knip and Margot Hoffman developed a better way to balance coupling shafts. At Perfect Circle, Ed LaFever and John Spoonamoor devised a better system for measuring engine oil consumption. And Paul Pollock, Anil Bansal, Richard Ryan, and Dennis Mahoney developed a better self-steering axle assembly that increased payload capacity and improved vehicle handling.

New products fueled new-business wins, company growth, and more innovation. Dana introduced the Spicer Lite 1760, the first aluminum driveshaft for Class 8 trucks. For another driveshaft design introduced in 1995, Dana received the coveted

Two products were recognized with the coveted PACE Award from *Automotive News* in the ‘90s. The first was a new driveshaft; the second was Automate-2, the first electronically automated transmission for linehaul trucks.



Introduced in 1999, the High Performance-40® axle (left) helped to answer heavy-truck manufacturers' needs for better performance and durability at reduced cost and weight.



Dana's Hydra-Lok® limited-slip differential provided the 1999 Jeep Grand Cherokee with the world's first true four-wheel-drive system. The 2004 Dodge Viper SRT-10 roadster also utilized the Hydra-Lok axle differential.

PACE Award from *Automotive News*. The award was a fitting achievement that year as months later, Clarence Spicer was inducted into the Automotive Hall of Fame, nearly a century after receiving his first driveshaft-related patent.

Dana won its second PACE Award just two years later for Automate-2, the first electronically automated transmission for linehaul trucks. Not to be outdone, a development team from Dana's axle group, led by John Hickey and Jun Yoshioka, introduced the Hydra-Lok® limited-slip differential in 1998. It provided the Jeep Grand Cherokee with the world's first true four-wheel-drive system. In Reading, Pennsylvania, the Parish division received a \$2 million grant from the U.S. Department of Commerce to develop a process for joining dissimilar metals, such as aluminum and steel. And engineers in Dana's sealing group carried the phenomenal success of their multi-layered steel cylinder-head gaskets from Europe into the Americas.



Launched in 1998, Dana's Rolling Chassis® module represented a quarter of the Brazilian Dodge Dakota truck and included more than 200 components from 66 Dana-managed suppliers.

THE ROLLING CHASSIS™ MODULE

In 1998, a truly unique product rolled out of Dana's facility in Campo Largo, Brazil, bound for a nearby Chrysler assembly plant. There, 11 variations of Dana's Rolling Chassis module were quickly mated with the matching Dodge Dakota engine, transmission, and truck body. The module accounted for a quarter of the Dakota's content and included more than 200 components from 66 Dana-managed suppliers. "Dana assembles the truck's frame, axles, brakes, and wheels, all within 108 minutes of getting the order by computer ... The Holy Grail in the global auto industry is (this) idea of modularity," said *The Wall Street Journal*. Key to the program's success was the cooperation and coordination with Chrysler. Paulo Nunes, Raul Germany, and Leslie Clark led the Dana team.

While the Rolling Chassis module was the biggest light-vehicle program of its kind, it was hardly the only one. Dana also built suspension modules for Volkswagen



In 1991, Dana customers received more than 15,000 hours of engine training from in-house instructors including Bill McKnight (left). This training led to the creation of Dana U's Customer & Industrial School, which in turn evolved into training programs at customers' facilities.



Between 1998 and 2003, three of Dana's frame operations earned *IndustryWeek* magazine's "Best Plants" award. They were located in Hopkinsville and Owensboro, Kentucky, and Stockton, California.

Dana's Elizabethtown, Kentucky, plant opened in 1995 with the most advanced technologies and equipment, including 59 robots, to produce frames for Ford trucks. That same year, the Parish division was awarded a \$2 million research grant from the U.S. Department of Commerce.



For more than a decade before the Rolling Chassis module, Dana supplied chassis and modules to commercial vehicle customers such as Mack. Along with the modules, Dana provided engineering, program management, supply chain management, and logistics services.



Golfs in Brazil and Chrysler Neons in Venezuela. For more than a decade, it had also supplied modules to Mack and other commercial vehicle manufacturers. All of these successful programs, including the Rolling Chassis business, helped Dana secure additional modules contracts with Fiat in Argentina and GM Holden and Ford in Australia.

GROWING WITH THE "TRANSPLANTS"

Throughout the 1980s and 1990s, transplants, or Asian and European carmakers with production facilities in the United States, continued winning market share in Dana's home market. By the end of the 1980s, the Japanese had built more than one million cars in the United States. By 1995, transplants produced that number of vehicles in just the first six months of the year.

To maintain its leadership in the light-vehicle market, Dana expanded its sales and engineering teams to pursue business with the automobile manufacturers in North America, Europe, and Asia. Worldwide sales to Japanese companies doubled between 1987 and 1992. In 1992, Dana became the first U.S. company to supply full frames to a Japanese manufacturer when it was selected to supply the Toyota Tacoma truck. By 1995, Dana's business with Japanese manufacturers alone had grown to \$240 million. Other Japanese and European customers included: Peugeot, Renault, Rover, Volkswagen, BMW, Nissan, Isuzu, Suzuki, and Honda. Dana's double-digit sales growth with non-U.S.-headquartered manufacturers has continued through today.



The Toyota Tundra, introduced in 1999, featured Dana frames and driveshafts. The same products were

supplied to Toyota for its Tacoma pickup truck and Sequoia sport utility vehicle.



In 1995, Dana built or purchased more than 30 facilities in Brazil, the U.S., Italy, Spain, Austria, Poland, China, Taiwan, and India.

WORLD-CLASS FACILITIES

Dana continued to invest heavily in its plants in the 1990s, opening some of the most advanced manufacturing facilities in the vehicle industry and beyond. The Structures group opened three state-of-the-art facilities in the 1990s: Stockton, California, to produce Toyota Tacoma frames; Elizabethtown, Kentucky, to produce Ford F-150 and Expedition frames; and Owensboro, Kentucky, to make Toyota Tundra and Sequoia frames. Dana's off-highway group built an impressive axle facility in Rovereto, Italy, and Plumley opened a Composite Sealing Center in Paris, Tennessee.

Dana facilities earned a long list of awards and honors for their outstanding performance in the areas of quality, productivity, employee involvement, customer satisfaction, the environment, health, and safety. During the 1990s, *IndustryWeek* magazine recognized Dana facilities in Minneapolis, Hopkinsville, and Owensboro with its "Best Plants" award. In 1997, Dana's Danville, Kentucky, gasket



By mid-decade, Dana employed more than 9,000 people in Europe, including Vania Haubler at the Victor Reinz plant in Neu-Ulm, Germany. Chairman Woody Morcott set the company's sights at the start of the '90s on aggressive international growth.

Quality inspector Paulo Henrique Santos de Oliveira measured the roundness of a constant-velocity joint in the dimensional laboratory in Porto Alegre, Brazil, one of 25 production facilities in Brazil. Dana employed just under 9,000 people in South America in 1995.

facility won the inaugural Kentucky Governor's Gold Quality Award, which used the same judging criteria as the Malcolm Baldrige award. Over the next three years, 19 Dana plants won similar state quality awards. Long Manufacturing facilities in Ontario, Canada, were recognized for their voluntary pollution prevention and waste reduction programs. Dana's off-highway products facility in Statesville, North Carolina, completed 2.4 million hours without a lost-time accident in 1999, underscoring its commitment to people and quality.

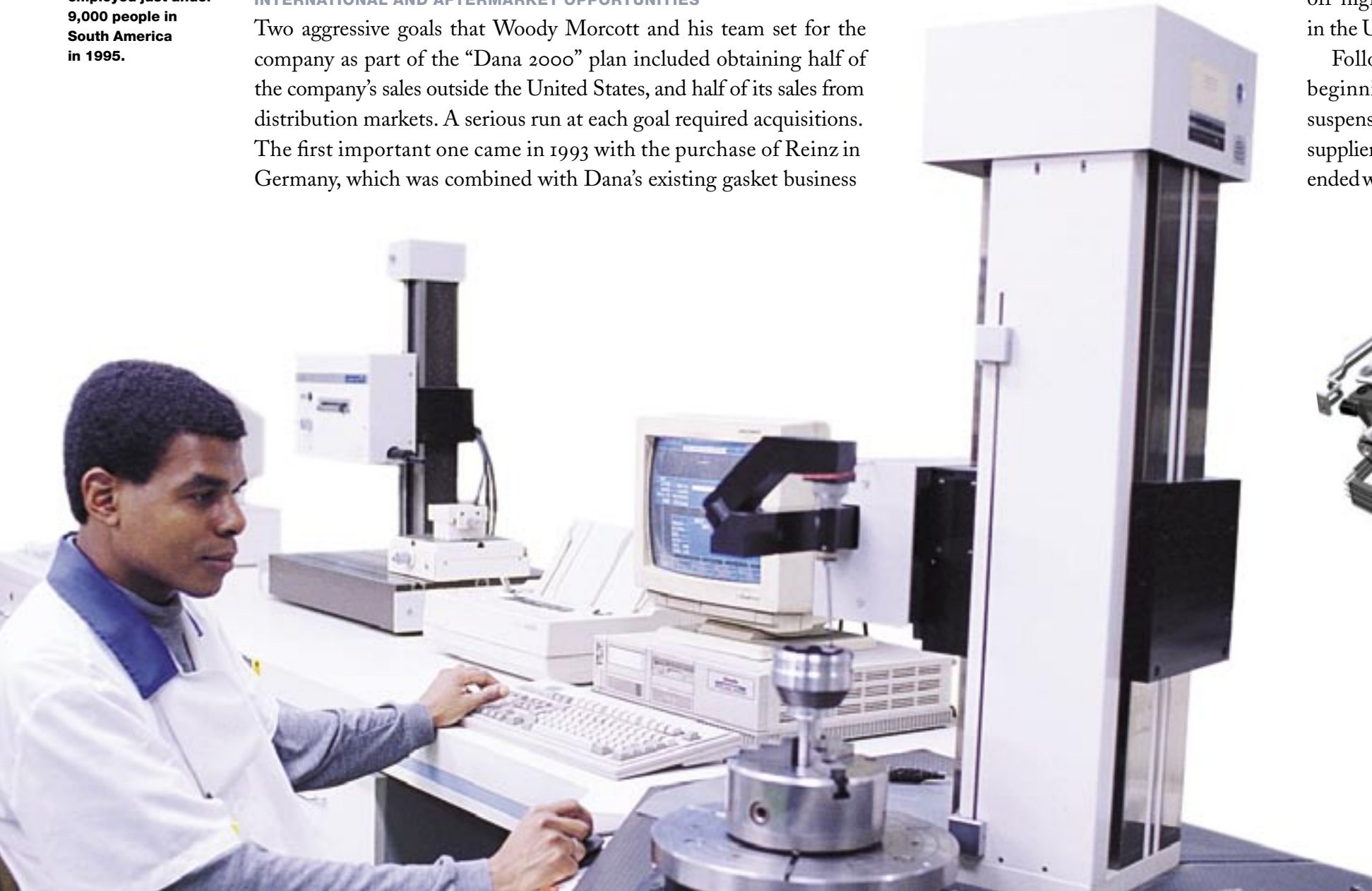
INTERNATIONAL AND AFTERMARKET OPPORTUNITIES

Two aggressive goals that Woody Morcott and his team set for the company as part of the "Dana 2000" plan included obtaining half of the company's sales outside the United States, and half of its sales from distribution markets. A serious run at each goal required acquisitions. The first important one came in 1993 with the purchase of Reinz in Germany, which was combined with Dana's existing gasket business

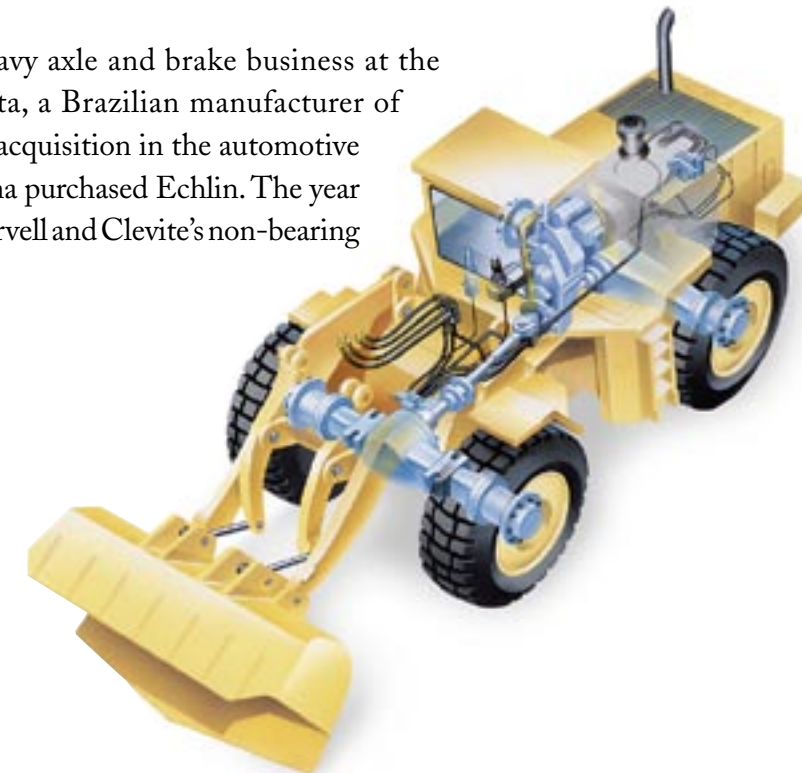
to form Victor Reinz. In 1995, Dana built or purchased more than 30 facilities in nine countries, including new axle and driveshaft operations in Brazil, the U.S., Italy, Spain, Austria, Poland, China, Taiwan, and India.

Domestic acquisitions continued as well with Plumley of Paris, Tennessee, which increased Dana's share of the sealing market. In 1997, Dana acquired the piston ring and cylinder liner business of SPX Corporation. Within days, Dana announced its largest acquisition to date, Clark-Hurth Components, 60 percent of whose sales were outside the U.S. This capped off a series of European-based, off-highway acquisitions, which included Comaxle and Sige in Italy and Kirkstall in the United Kingdom.

Following the purchase of Eaton's heavy axle and brake business at the beginning of 1998, Dana acquired Nakata, a Brazilian manufacturer of suspension components. Then the largest acquisition in the automotive supplier industry was completed when Dana purchased Echlin. The year ended with the acquisition of Glacier Vandervell and Clevite's non-bearing



Acquisitions in the 1990s broadened Dana's collection of engine and fluid-management products - Reinz, Plumley, Sealed Power, Long Manufacturing, Clevite, Glacier Vandervell, Nobel Plastiques, and more.



Likewise, the acquisitions of Clark-Hurth Components, Comaxle, Sige, and Kirkstall strengthened Dana's leadership in the off-highway vehicle market.

ENGINE BUILDERS

Hugo Reinz frequented the testing labs of German, Austrian, Czech, and French engine builders to help solve their sealing problems. Since he founded the business in Berlin in 1920, Reinz-Dichtungs GmbH had become the leading gasket supplier for nearly every vehicle and engine manufacturer in Europe.



After devastating bombings during World War II, Reinz was rebuilt by a small group of employees led by Rudolf Rzehulka, another brilliant engineer who was later awarded the golden Diesel Medal from the German Inventors Association. By the 1950s, ongoing advancements had taken Reinz gaskets into industrial equipment, 50 export markets, and the replacement parts market. In 1966, Reinz opened a new laboratory in Neu-Ulm, Germany. The following year, Nippon Reinz was founded in Japan. Dana’s Sealing Products group, which produces Victor Reinz gaskets, remains a world leader in gasket and sealing technology.

By using sealing materials less permeable to hydrocarbons, the recyclable cylinder-head cover module from Dana’s Sealing Products group, which included the Plumley operation in Tennessee, helps reduce vehicle emissions.



PLUMLEY

Like many entrepreneurs, Harold Plumley risked everything when he bought a small manufacturing concern in rural West Tennessee in 1967. On day one, the Plumley Rubber Company had but one automotive order on its books – radiator hoses for Oldsmobile. That business was lost less than a year later.

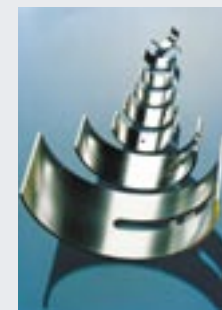
Harold and his people turned the business around with determination, hard work, and continuous improvement. Though the designs of Plumley’s early hose and tubing products were not unique, the quality attracted customers’ attention – and orders. By 1992, Harold’s venture had grown to a seven-plant operation with 1,200 people (including his four sons) and annual sales of \$80 million. With Dana’s purchase in 1995, Plumley’s products expanded to include cam covers, sealing systems, and fuel-cell components.

CLEVITE AND GLACIER VANDERVELL

In the early years of the motor vehicle, alloys were cast, bored, and hand-scraped to produce engine bearings. The limitations of this process became apparent by the late 1920s when engine building was reaching incredible volumes to meet the ever-growing demand. A mass-produced bearing was needed in order to develop a truly mass-produced engine.

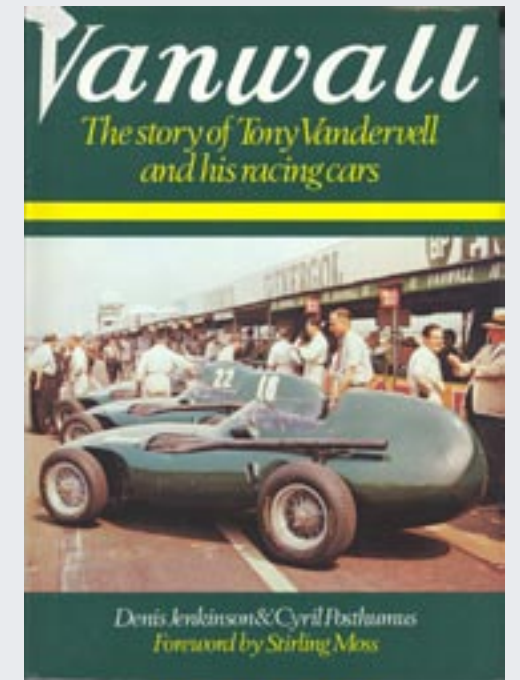
In 1929, the thin-wall bimetal bearing from the Cleveland Graphite Bronze Company (later Clevite) answered the need. Not long after John Palm and Ben Hopkins received the patents on this breakthrough invention, a gentleman by the name of Tony Vandervell arrived from the U.K. to secure a manufacturing license. According to the book *Vanwall*, a scornful Hopkins explained that although the end product was cheaper to make with the patented technology, the special equipment required cost hundreds of thousands of dollars. “A two-and-half-bit company like yours couldn’t find that sort of money.” The Brit pressed on. The American wouldn’t budge. Vandervell then walked out to Hopkins’ outer office, stretched out on a settee. For six days, he waited, asking Hopkins every morning if he had changed his mind. At last the Cleveland engineer (and owner) barked to his secretary, “Fetch that darned Englishman,” and granted Vandervell the exclusive U.K. license.

Glacier and Vandervell Products were merged into one operation in 1988, and together they joined Clevite in 1998. Glacier Vandervell today is part of Dana’s Bearing Products division and remains a world leader in automotive engine bearings. Clevite-branded bearings, bushings, and thrust washers are sold to the aftermarket.



In 2002, Glacier Vandervell Europe received Dana’s second Spirit of Innovation Award for its patented bearing overlay for diesel

engines. The development team was led by Dr. Carl Perrin, and included Ian Laing, Andrew Bacon, Jeff Stevens, and Raphaelle Francois.



In the 1950s, Tony Vandervell set out to prove – and improve – his engine bearings on the race track. His Vanwall team became the first British winner of the Formula 1 World Manufacturers’ Championship in 1958, and the focus of this book.

aftermarket business. In all, the 1998 acquisitions added more than \$4.5 billion to Dana's annual sales. Employment climbed from 50,000 to 80,000 in just 12 months.

As Dana grew, it also began restructuring to simplify operations and keep

its focus on its primary customers. Operations that no longer fit were divested. In 1997, Dana restructured operations in Canada, France, Italy, the United Kingdom and the United States, and announced the divestiture of nine operations with sales of \$900 million. In 1998, Dana announced its largest divestiture to date, the sale of the Warner Electric Industrial Products Group and part of its Warner Electric Industrial Motors and Controls Group. Selling most of its CV joint operations, Gresen, and clutch operations were also part of Dana's efforts to reduce non-strategic and underperforming businesses.

SIX GLOBAL BUSINESSES

By the close of the 1990s, Dana was reorganized into six global business units: automotive components, engine components, heavy truck components, off-highway components, industrial components, and leasing services. According to Dana's president and CEO, Joe Magliochetti, the reorganization reflected a customer-driven, rather than product-driven, focus for

the company. "In the past, an automotive customer would confront different Dana organizations in each of Dana's four global regions," said Magliochetti. "Today, those customers have something more akin to one-stop shopping."

Ciagli Paolo inspected off-highway axles prior to shipping from Dana's Rovereto, Italy, plant.



Driver Joe Ruttman joined the Dana-sponsored Bobby Hamilton Racing Team in mid-1999. In 16 starts that season, he posted three top-five and nine top-10 finishes in the NASCAR® Crafts-

man Truck Series. Racing vehicles provided several Dana divisions with an ideal advertising medium, as well as an opportunity to test the strength and durability of their products.

2001 NASCAR Craftsman Truck Series



SOUTHWOOD J. MORCOTT

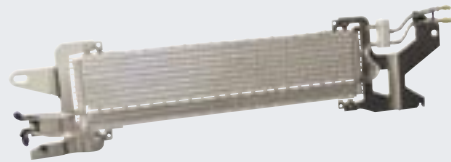
Ambitious, hard-working and charismatic, Southwood J. "Woody" Morcott's vision drove Dana's remarkable growth in the 1990s. Named CEO in 1989 and chairman in 1990, Morcott was a champion of continuous improvement and quality – and the importance of always looking forward to the next goal. As he once said, "There's no resting on your laurels. There's no finish line. Once you achieve one milestone, you have to think about how to improve even further."

A true internationalist, Morcott realized the importance of overseas growth, particularly in Asia. During his tenure as chairman, Dana expanded into 10 new countries. Morcott also initiated efforts to measure the application of the Dana Style, including formalizing the ideas program, with the benchmark of two ideas per person per month, and the introduction of the Dana Quality Leadership Process in 1992.

As a student at Davidson College, Woody Morcott was asked to give a benefactor by the name of Charles Dana a tour of the campus. Thirty years later, Morcott followed in Charles Dana's footsteps in being elected chairman of Dana Corporation.



Among the many product innovations from Brake Parts Inc. is the Vehicle Specific Metallurgy, or VSM™, brake rotor. It is quieter than conventional rotors and helps vehicles stop in shorter distances.



Long Manufacturing, founded by J.B. Long in 1903, produced radiators for the early motor vehicles. Renamed Thermal Products, the operation today is still a leading manufacturer of heat exchangers, oil coolers (above), and related products.

ECHLIN

When Jack Echlin’s parents bought their first automobile in 1903, he and his two brothers became fascinated with the new horseless carriage. Brother Earl was the first to enter the automotive world, opening a small repair shop in San Francisco to handle the constant maintenance required by early vehicles. Within three months, the shop was filled with cars needing repair, but Earl had little time for collecting the money owed him.

On leave from his job as a telegraph operator, Jack helped collect the payments, and in the process became absorbed in the business. He joined his brother full time in 1915, and the company was renamed Echlin & Echlin. Blessed with great business acumen and an aptitude for sales and marketing, it was primarily Jack who built Echlin & Echlin into a widely known and respected replacement-parts distributor. It was also Jack who forged the beginnings of a long relationship with the fledgling National Automotive Parts Association (NAPA) in 1928.

By the time Dana acquired Echlin in 1998, it had become an aftermarket giant with annual sales of \$3.5 billion. Like Dana, it, too, had a stable of established businesses and products. Among them were: Brake Parts Inc.; FTE, a German producer of brake, clutch, and hydraulic products; Long Manufacturing, which made its first cooling product, a radiator, in 1903; and Nobel Plastiques, whose roots could be traced back to Swedish scientist and industrialist Alfred Nobel.



Yasutaka Ohmori checked the glide coat operation at Dana’s Najico Spicer Takahagi, Japan, plant. Each morning at the facility began with the entire work force exercising together. In 1995, Dana had 3,500 people in Asia and 10 production facilities.

By the end of the 1990s, thanks in part to its aggressive goals, big acquisitions, excellence in manufacturing, and the booming light truck market, Dana continued to experience record growth and sales. According to Morcott in a 1999 *Automotive News* article: “We built a frame plant in [Kentucky] with a design capacity of 650,000 frames. [That] was absolutely at the top end of our expectations. We’re running 900,000 frames through there right now ... We love it.” ♦



2000-2004

**DANA RETURNS TO ITS ROOTS WITH A RENEWED FOCUS
ON VEHICLE MAKERS AND AN ENGINEER IN THE LEAD**

“Always bear in mind that your
own resolution to succeed is more important
than any one thing.”

– ABRAHAM LINCOLN, U.S. PRESIDENT

Joe Magliochetti took the helm at Dana in 2000, just as the vehicle industry was headed toward another cyclical downturn. In his annual letter to shareholders a year later, Chairman and CEO Magliochetti referred to 2001 as a year “many of us in the automotive industry might prefer to forget.”

Broad economic troubles, deteriorating markets, and erratic customer production levels took a heavy toll on Dana’s performance. The company reported a net loss of \$298 million on 2001 sales of just over \$10 billion. The loss included charges associated with a \$442 million restructuring program that led to the closure or consolidation of 39 facilities; the divestment of 10 businesses; and the reduction of about 20,000 people. (This came on the heels of 10,000 layoffs in the preceding 18 months.) Dana’s board of directors also made the tough decision that fall to reduce Dana’s quarterly dividend, which ended a 65-year run of paying dividends without a reduced or missed payment.

Despite the tough conditions inside and outside the company, Dana people stayed focused on meeting their customer commitments. “These restructuring actions affected not only those who left the company, but also those who remained – as many of our people have been asked to take on new or additional responsibilities,” said Magliochetti. “Clearly, the progress Dana has made amid these difficult circumstances is due to the ongoing efforts of our exceptional people.”

“Many of our people have been asked to take on new or additional responsibilities,” said Dana Chairman Joe Magliochetti after the company’s restructuring was announced in October 2001. This was true of the driveshaft team in Louisville, Kentucky (below), as well as Dana people around the world.



Dana's Driveshaft
Louisville, KY

The Spicer Driveshaft Division became the second Dana operation to earn the prestigious Malcolm Baldrige National Quality Award.



QUALITY ROLL

Among the exceptional people were the 3,500 employees of the Spicer Driveshaft Division, which in 2000 became the second Dana operation to earn the Malcolm Baldrige National Quality Award. Division Manager Joe Sober attributed the award first and foremost to “the hard work and commitment of our people.” As part of the Baldrige Award process, the Spicer Driveshaft Division, the world’s leading independent supplier of cardan driveshafts, underwent a rigorous evaluation that included an exhaustive review of its application and a week-long site visit by eight examiners.

In '01 and '02, Dana’s driveshaft and frame operations in Thorold, Ontario, and Magog, Quebec, earned the Canada Award for Excellence, a quality honor based

on the Baldrige criteria. The team in Magog averaged 20 ideas per person with 90 percent implementation. Then, in '03 the driveshaft plant in Gravatai, Brazil, received that country’s National Quality Award.

The push for continuous improvement was not new, nor was it limited to Dana’s driveshaft group. Dana people in Henderson, Kentucky, put into place error-proofing processes and an electronic Kanban system. Frame operations in Owensboro, Kentucky, and Stockton, California, implemented the Toyota Production System and earned Dana two more *IndustryWeek* “Best Plants” awards. The operation in Rayong, Thailand, used lean processes to assemble and deliver axles every 30 minutes to its customers. In Brugge, Belgium, a team of Dana people cut time, paper, and errors out of its daily communications with suppliers by creating its own Web-based tool.

Six Sigma Black Belts rely on statistical tools and teamwork to improve business and production processes. They have already saved Dana more than \$70 million. Pictured here, left to right, are Black Belts Tom Bosler, Jeffrey Periat, and Amanda Nelson in Maumee, Ohio.



SIX SIGMA BLACK BELTS

Dana’s exceptional people also included its Black Belts, experts in the Six Sigma business-improvement process. Trained by Dana University, nearly 500 Black Belts today rely heavily on statistics and old-fashioned teamwork to revamp core processes to virtually eliminate variations and defects. Between mid-2001 and the close of 2003, Black Belt-led teams saved the company more than \$70 million.

A fundamental principle of Six Sigma, explained Black Belt Paul Mackalski, is that the people closest to the process are best qualified to improve it. His team in Rochester Hills, Michigan, tackled a plating process used in Dana’s Coupled Products division. Defects dropped to zero parts per million; costs were reduced by \$200,000; and, as a result of the improvements, the group was awarded new business.

JOSEPH M. MAGLIOCHETTI

Joe Magliochetti was a company leader, an industry leader, and a community leader.

Joseph M. Magliochetti, known by many as “Joe Mag,” began his career in 1966 as a management trainee at Victor Manufacturing and Gasket in Chicago, Illinois. Later that year, Dana acquired Victor, and 34 years later, Magliochetti was elected Dana’s sixth chairman.

His Dana service included a variety of sales, engineering, and manufacturing positions at several divisions and, later, leading both the European and North American operations. Tragically, he died in 2003 following a brief illness. People throughout the industry knew Magliochetti for his quick smile, his unflinching generosity, and his staunch commitment to humility and integrity.

In addition to his Dana responsibilities, Magliochetti served as a board member for several other corporations, including BellSouth and CIGNA, led various automotive industry groups, and shared his time and talents with many community and non-profit organizations.





Dana's Spicer Drive-shaft Division earned the 2000 Malcolm Baldrige National Quality Award. The premier quality award in the U.S., the Baldrige criteria form the foundation of the Dana Quality Leadership Process. Pictured here are driveshaft team members from Bristol, Virginia.



The Nissan Titan truck features several Dana technologies, including multi-layered gaskets with the Wave-stopper™ seal (top) and advanced ring and pinion gears (bottom). New driveline and engine technologies have continued to help Dana secure business with vehicle makers across the globe.



GROWTH THROUGH INNOVATION

Just as Six Sigma and other quality-improvement teams pursued better processes inside Dana, engineering teams continued to tackle under-the-hood and under-the-vehicle problems for customers. Magliochetti's five-year plan for Dana, called "Transformation 2005," could be summed up in just three words – growth through innovation.

Advanced driveline products helped Dana secure business on new BMW, Infiniti, and Jeep sport utility vehicles, as well as the Nissan Titan pickup truck. A patented hydroforming process not only solidified Dana's position as the frame supplier for the world's best-selling vehicle, the Ford F-150 truck, it helped win additional structures business with Land Rover in Europe. New cooling and steering modules were specified for GM's first hybrid pickup truck. Innovative engine



The success of Victor Reinz thermal-acoustical protective shields in North America earned Mark Boogemans (*right*) and Ernest Oxenknecht Dana's 2003 Engineering Achievement Award and the division Volvo's Award of Excellence.

Despite tough market conditions, Dana has continued to invest in its engineering centers. Pictured above is the noise lab in Farmington Hills, Michigan. In response to customers' growing need for systems- versus component-based solutions, a new technology center

that brought together Dana's axle and drive-shaft engineering groups opened near its headquarters in Toledo, Ohio, in 2003. Additionally, alliances were also formed with Getrag, HyRadix, Permo-Drive, Emerson, GKN, and others to develop new driveline and engine technologies.

Leading heavy-vehicle manufacturers, including Ford and John Deere, have specified Dana products for nearly a century. Other customers include: DaimlerChrysler, International, PACCAR, AGCO, CNH, Manitou, and Ingersoll-Rand.

and fluid-management technologies were developed and produced for General Motors, Ford, DaimlerChrysler, PSA Peugeot Citroën, Toyota, Nissan, Cummins, and Polaris. Likewise, Dana's heavy-vehicle group landed several programs with such manufacturers as PACCAR, International, Blue Diamond, John Deere, and Ingersoll-Rand.

In 2003, nearly 300 patents were granted to Dana engineers, and twice as many patent applications were filed. All individuals granted a patent are recognized for their achievement. Technical people and teams have also been recognized in recent years through special awards. The annual Outstanding Engineering Achievement Award has been presented to Bob Durand of Structural Products, Bill Stamey of

Wix, Dr. Chas Johal of Glacier Vandervell, Mark Boogemans and Ernest Oxenknecht of Victor Reinz, and Jeff Dutkiewicz of Torque Traction Technologies.

Established in 2001, the Spirit of Innovation Award recognizes Dana's most promising new products and the development teams behind them. Winners have included the electro-hydraulic power-assist steering module from the AMTL group, a high-performance bearing overlay from Glacier Vandervell, and the Wave-stopper™ seal from Sealing Products. The primary inventors of these innovations, respectively, were Mike Werson, Dr. Carl Perrin, and Dr. Juergen Schneider, Guenther Unseld, and Kurt Hoehe.

Dana also continued its commitment to meeting customers' needs for modules and systems. Engineers from around the world worked together to design the entire sealing system for the Tritec engine. Cylinder-head cover modules for Jaguar cars, fuel-line systems for PSA Peugeot Citroën diesel engines, and hub systems for Peterbilt and Kenworth Class 8

trucks all strengthened Dana's systems-integration expertise. For the Ford Falcon car in Australia, Dana's services included design, development, program management, and supplier sourcing and management. Seventy-nine components make up the Dana-assembled independent rear suspension, and nearly half the content is produced by Dana people. The program mirrored the suspension module for another Australian passenger car, the Holden Commodore.



Four Dana divisions came together in 2000 to produce the entire sealing system for the Tritec engine, which powers Chrysler PT Cruisers, Dodge Neons, and Mini Coopers from BMW.



Matthew Kelly (left) and Vlado Kova assembled suspension modules for the Ford Falcon car in Dana's Campbellfield, Australia,

facility in 2003. The scoreboard (top) displays the status of Dana's module builds relative to the customer's needs.



Markus Lemm helps develop fuel-cell components in the Neu-Ulm, Germany, Fuel Cell Support Center, one of five such Dana facilities. The company closed 2003 with more than 50 active fuel cell-related development projects.

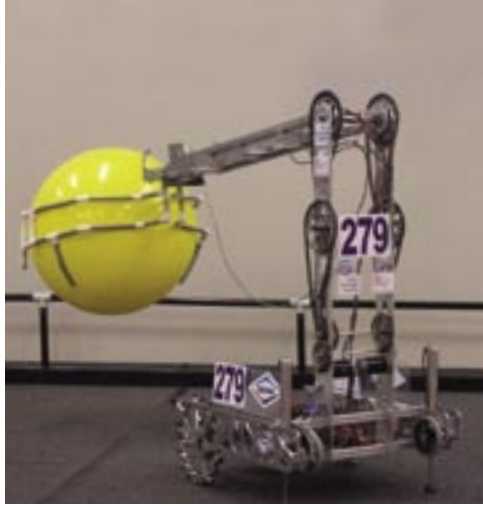
Dana engineers in fuel-cell support centers in the U.S., Canada, Germany, England, and Japan have continued to develop new technologies and high-volume production methods for fuel-cell components and sub-systems. Similarly, the Intelligent Cooling™ and Rolling Spaceframe™ systems, electronic differentials and active drivelines, and microwave plasma technology are all being refined, tested, and readied for future vehicles.

FOCUSED OPERATIONS, IMPROVED PERFORMANCE

In all cases, Dana's product development efforts supported the growth of its core businesses, which included axles, driveshafts, frames, brake and chassis products, fluid systems, filters, and bearings and sealing products. These businesses served the production and service sectors of Dana's three basic markets: automotive, commercial vehicle, and off-highway. At the close of 2003, after \$2 billion worth of

Led by Brenda Moyer-Kochan, Dana engineers in Ottawa Lake, Michigan, and local students participate annually in the FIRST Robotics Competition, which exposes teenagers to

science and engineering. For its minority supplier development, environmental, and community initiatives, Dana received Ford's 2001 Citizenship Award.



Edson Cavalheiro and his son Ciao participated in a Solidara-Dana event in Brazil in 2003. For 15 years, the SolidaraDana program has channeled volunteer time and money to community needs and organizations.

Management Group into a single business unit, citing the need to better serve Dana's oldest customers, the vehicle manufacturers. Just 10 days later, in marking the official founding of Dana on April 1, 1904, Burns, who soon assumed the additional post of chairman, followed his predecessors' lead in attributing the company's success to the staying power, initiative, and dedication of Dana people. ♦

divestitures, Dana narrowed its focus even further with the decision to sell its \$2 billion automotive aftermarket business.

Dana's focus and strategic direction were put to the test in the summer and fall of 2003 when a competitor launched an unsolicited tender offer for the company. Dana's board of directors reviewed and rejected the offer. By that time, Dana's restructuring and transformation efforts were clearly producing results, and the board reaffirmed its belief that the company's ongoing strategy was a better way to satisfy its shareholders.

The offer was revised and again rejected in November. Dana's board of directors by this time was led by Glen Hiner, who played a key role in the company's response to the takeover attempt. When Joe Magliochetti died suddenly in September, Hiner became the acting chairman of the board, and Bill Carroll, a 34-year Dana veteran, was named acting president and chief operating officer.

In February 2004, a 34-year veteran of General Motors, Mike Burns, was named president and CEO of Dana. That same month, Dana also announced its 2003 net income, \$220 million, which represented a \$500 million swing from the earnings loss just two years prior. "As we embark on our rooth year," said Hiner, "Dana is back on track."

In one of his first moves as Dana's CEO, Burns combined Dana's Automotive Systems Group and its Engine and Fluid

GLEN H. HINER AND MICHAEL J. BURNS

Following a 35-year career with the General Electric Company, Glen H. Hiner served as chairman and CEO at Toledo-based Owens Corning from 1992 to 2002. He joined Dana's board of directors in 1993, serving on and leading a number of the board's committees. With Joe Magliochetti's untimely death in 2003 – in the midst of a hostile takeover attempt by a competitor – Hiner stepped in to help fill the leadership void.

As acting chairman of the board, Hiner, along with Dana's management team, ensured that the company's focus stayed on its customers and shareholders. In February 2004, Hiner was elected chairman of the board of Dana, and Michael J. Burns was named president and CEO. Shortly thereafter, Burns assumed the additional post of chairman.

Burns earned a bachelor's degree in mechanical engineering from Kettering University and a master's degree in business administration from the Wharton School of Finance at the University of Pennsylvania. He began his career with GM as a co-op student in 1970, holding various positions on the component side of the automaker.

In 1998, Burns became president of GM Europe and led the turnaround of the \$25 billion division that resulted in market share gains through product development, quality improvements, and significant cost reductions. He was also a member of the GM Automotive Strategy Board and was responsible for GM's worldwide quality process.



Never one to shy away from a challenge, Glen Hiner (top) played critical roles in Dana's response to a hostile takeover attempt in 2003 and in filling the void left by Joe Magliochetti's untimely death.

A native of Monticello, Indiana, Mike Burns' (left) career with GM took him around the world before he joined Dana and returned to the midwestern United States. He is the first engineer since Clarence Spicer to lead the company.



Looking Ahead

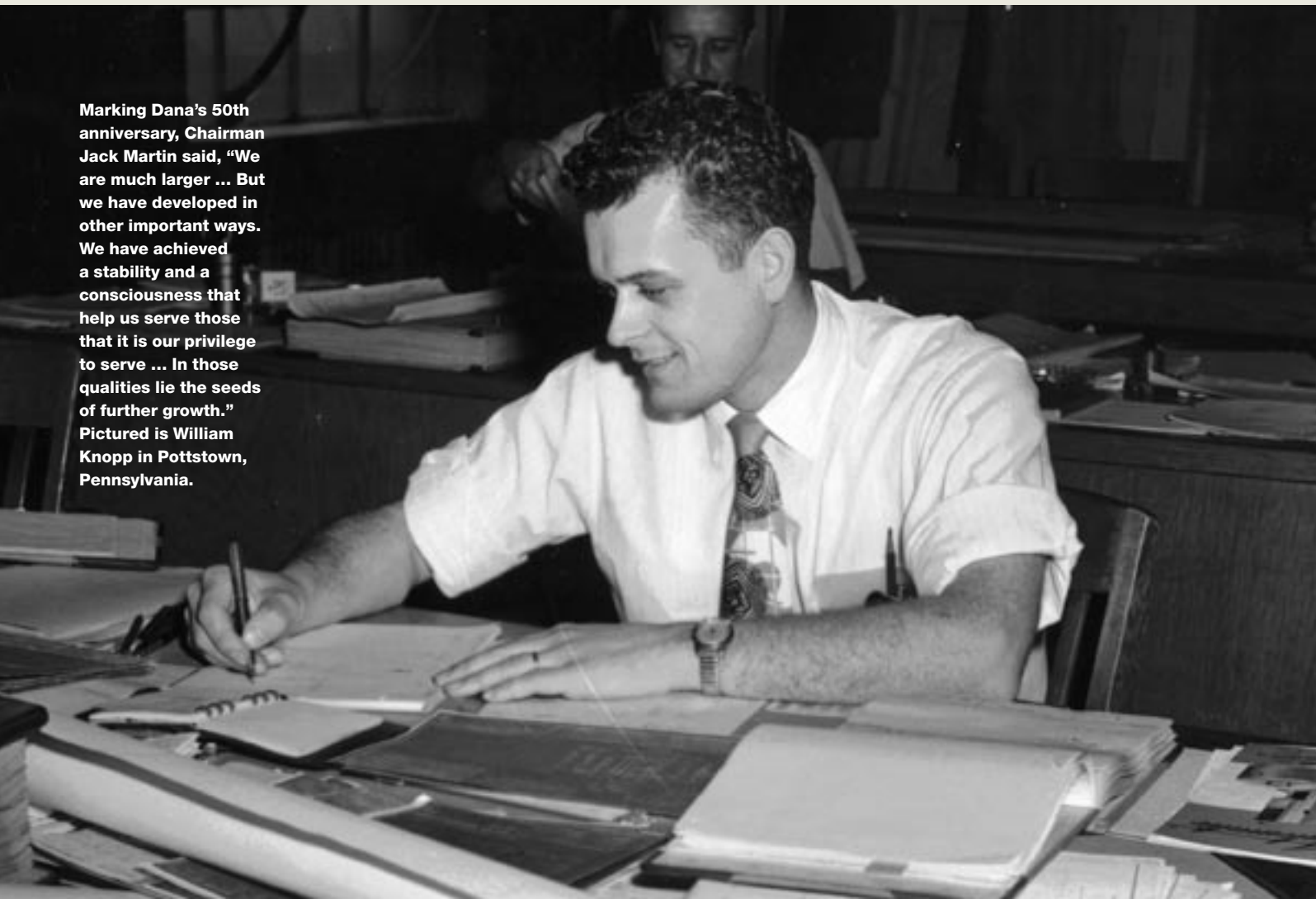
Dana's success always has been – and always will be – driven by Dana people. The vehicular industry of the future will likely be more consolidated, more competitive, and more globally based. With fewer but more widely shared vehicle platforms, fewer manufacturers and suppliers will compete in an increasingly global marketplace – within increasingly fragmented niches. Manufacturers' requirements for lower cost, better quality, faster design and testing, and more systems-based solutions will require smarter, faster, more flexible suppliers.

Stringent customer requirements are hardly new. Clarence Spicer and Charles Dana faced many of the same challenges nearly a century ago. Clarence had a unique product, the encased universal joint, that solved the vehicle makers' power-

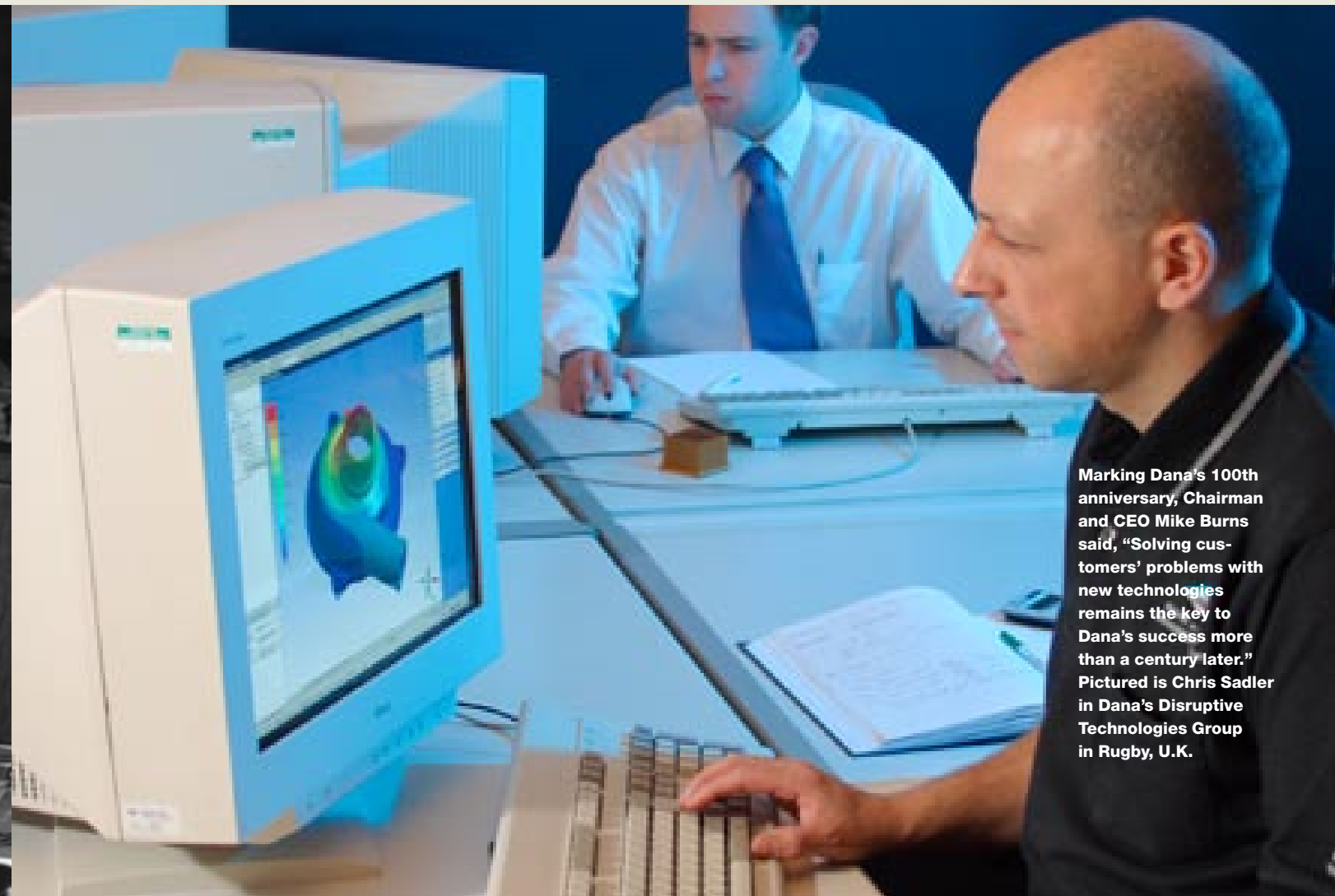
transmission problem; it practically replaced the sprocket-and-chain drive overnight. As important as his patented product was to the company's early success, Clarence also had hard-working, creative people whose ideas sustained the business. He personally credited the company's growth and success to his employees. Charles Dana echoed the same sentiment after joining the company years later: "Stone and mortar, bricks and machinery can be duplicated, but the workers cannot," he once said.

In addition to meeting customers' needs, the future of Dana rests on Dana people's ability to anticipate and respond to the needs and preferences of vehicle consumers – the buyers and drivers. Basic consumer demands for better fuel economy and emission controls, improved ride and handling, and enhanced safety and predictive

Marking Dana's 50th anniversary, Chairman Jack Martin said, "We are much larger ... But we have developed in other important ways. We have achieved a stability and a consciousness that help us serve those that it is our privilege to serve ... In those qualities lie the seeds of further growth." Pictured is William Knopp in Pottstown, Pennsylvania.



Marking Dana's 100th anniversary, Chairman and CEO Mike Burns said, "Solving customers' problems with new technologies remains the key to Dana's success more than a century later." Pictured is Chris Sadler in Dana's Disruptive Technologies Group in Rugby, U.K.



As advertisements (below) highlighted in its 100th year, Dana remains committed to anticipating and responding to its customers' needs.

Among those needs are reducing noise, vibration, and harshness. Among the testing tools used by Dana engineers are four-wheel

chassis dynamometers, finite element analysis software, and hemi-anechoic sound chambers.

In 1954, Dana looked forward to another 50 years “working together hand in hand with designers and engineers on the vehicles of the future.” (above) The company’s celebration of its 100th anniversary is now part of its proud heritage as well.

performance represent enormous opportunities for Dana both today and well into the future.

To capitalize on these needs, Dana engineering teams are already pursuing a host of new, promising technologies: several fuel-cell sub-systems, electric drivetrains, brake- and steer-by-wire solutions, intelligent chassis, composite space frames, and more. In fact, Dana engineers have already been issued several patents that may lead to the next generation of many of Dana’s current best-selling products.

As important as these and other new technologies will be to the company’s future, however, Dana values and Dana people will continue to provide the foundation for growth and success. Translating customer needs into new products, systems, and services, as always, will happen only through Dana people. Dana’s first century has clearly shown that challenged, trusted, and involved employees will produce practical, but innovative solutions – products and systems that have historically set the benchmark for the industry.

The Difference Between Dollars and Ideas
 You have a dollar.
 I have a dollar.
 We swap.
 Now you have my dollar.
 And I have yours.
 We are no better off.
 * * *
 You have an idea.
 I have an idea.
 We swap.
 Now you have two ideas.
 And I have two ideas.
 * * *
 That's the difference.

The author of this verse (left), which ran in *The Drive Shaft* in 1923, was likely encouraging his co-workers within the South Plainfield, New Jersey, plant to share ideas. With more than

200 major facilities serving a global customer base, the exchange of ideas has never been more important as Dana embarks on its second century.



The core values of honesty and integrity will continue to guide Dana in its second century. Little has been said, even in this historical account, of the honesty and integrity of Clarence Spicer and Charles Dana. They simply considered these principles to be essential ingredients in running the business. Generations of Dana people since have quietly and resolutely embraced the same high ethical standards.

Teamwork, too, will continue to provide an indispensable building block for the future. Competing in the vehicular industry – with many of the world’s largest companies – demands joint efforts and solid relationships. Dana people working closely with customers, suppliers, partners, and most importantly with each other, is a necessity.

With Dana’s future, as well as its heritage, securely grounded in *People Finding A Better Way*®, the story continues. Given its history, its products, and its people, the next century at the Dana Corporation promises to be equally exciting. ♦

One of Dana’s biggest challenges in its second century of business will be living up to the proud heritage from its first. Customer-focused product innovation will undoubtedly be a key to ongoing growth and success.

Sales History

(millions of U.S. dollars)

| | | | | | | | |
|------|-------|------|-------|------|--------|------|----------|
| 1914 | \$ 14 | 1937 | \$ 15 | 1960 | \$ 230 | 1983 | \$ 2,870 |
| 1915 | 15 | 1938 | 10 | 1961 | 191 | 1984 | 3,600 |
| 1916 | 16 | 1939 | 10 | 1962 | 289 | 1985 | 3,800 |
| 1917 | 21 | 1940 | 19 | 1963 | 312 | 1986 | 3,695 |
| 1918 | 35 | 1941 | 35 | 1964 | 364 | 1987 | 4,142 |
| 1919 | 32 | 1942 | 70 | 1965 | 394 | 1988 | 4,936 |
| 1920 | 18 | 1943 | 85 | 1966 | 453 | 1989 | 4,865 |
| 1921 | 5 | 1944 | 104 | 1967 | 513 | 1990 | 4,952 |
| 1922 | 10 | 1945 | 109 | 1968 | 536 | 1991 | 4,398 |
| 1923 | 13 | 1946 | 48 | 1969 | 659 | 1992 | 4,870 |
| 1924 | 12 | 1947 | 91 | 1970 | 668 | 1993 | 5,460 |
| 1925 | 14 | 1948 | 126 | 1971 | 636 | 1994 | 6,610 |
| 1926 | 14 | 1949 | 106 | 1972 | 822 | 1995 | 7,600 |
| 1927 | 11 | 1950 | 119 | 1973 | 989 | 1996 | 7,700 |
| 1928 | 14 | 1951 | 172 | 1974 | 1,080 | 1997 | 8,300 |
| 1929 | 17 | 1952 | 163 | 1975 | 1,140 | 1998 | 12,500 |
| 1930 | 6 | 1953 | 203 | 1976 | 1,440 | 1999 | 13,200 |
| 1931 | 3 | 1954 | 154 | 1977 | 1,790 | 2000 | 12,317 |
| 1932 | 2 | 1955 | 187 | 1978 | 2,250 | 2001 | 10,271 |
| 1933 | 5 | 1956 | 229 | 1979 | 2,760 | 2002 | 9,504 |
| 1934 | 9 | 1957 | 201 | 1980 | 2,520 | 2003 | 7,918 |
| 1935 | 11 | 1958 | 169 | 1981 | 2,710 | | |
| 1936 | 14 | 1959 | 220 | 1982 | 2,420 | | |

Note: Sales as originally reported in Dana's annual reports are shown in this table. These figures do not reflect restatements for acquisitions accounted for as pooling-of-interest transactions, certain divestitures and planned divestitures accounted for as discontinued operations, or the adoption of SFAS No. 94 – Consolidation of All Majority-Owned Subsidiaries.

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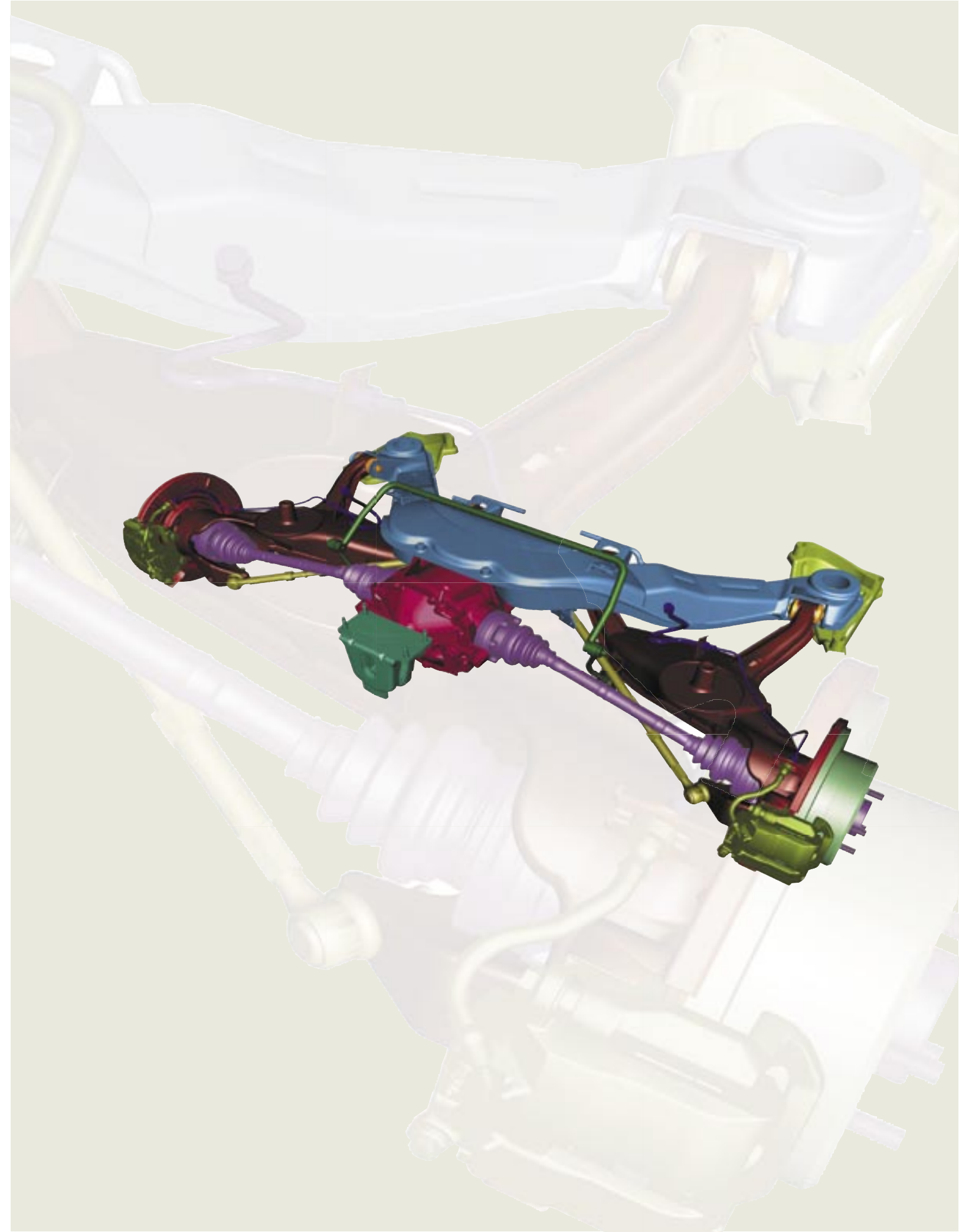
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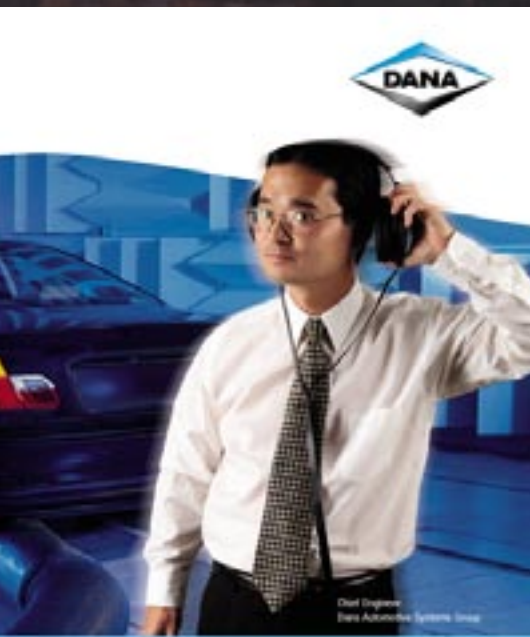
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