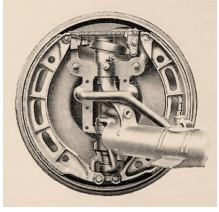
THE DUESENBERG HYDRAULIC BRAKING SYSTEM

A Historic Mechanical Engineering Landmark

ASME
SETTING THE STANDARD



Duesenberg 4-Wheel Hydraulic Braking System

Frederick S. Duesenberg was the first to use four-wheel hydraulic brakes on a production automobile. He also invented and employed internal expanding-shoe hydraulic brakes on his vehicles. These braking innovations were first featured on the Duesenberg Model 'A,' which was introduced in 1921. Duesenberg Automobile and Motors Company had been established only the year previously.

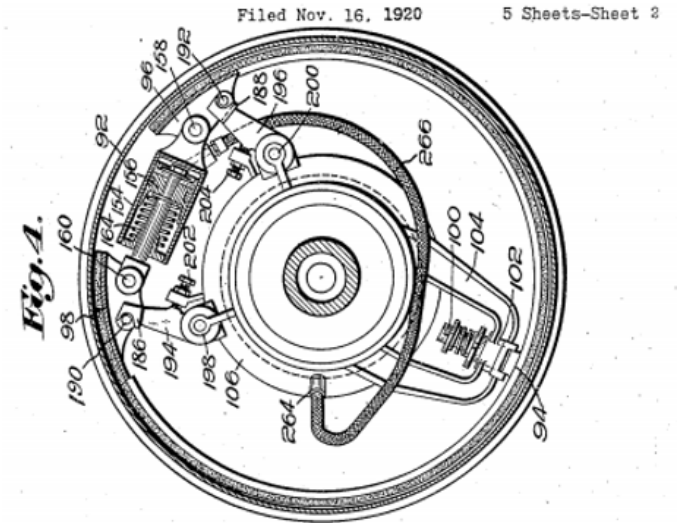
Providing hydraulic brakes on all four vehicle wheels significantly reduced braking distances, which became increasingly important as vehicle speeds increased. All automobile companies eventually introduced four-wheel hydraulic braking systems, although some not until over a decade after Duesenberg.

Mechanical engineering concepts, features and characteristics

In hydraulics-based systems, mechanical movement is produced by a contained, pumped liquid, typically by means of cylinders that contain moving pistons. The mechanical engineering principals are well-known.

All hydraulic systems work on the principle of Pascal's law, which states that any increase or decrease in pressure in an incompressible fluid will be transmitted equally in all directions in a static fluid.

The wheel cylinder of Duesenberg's hydraulic drum brakes (10 o'clock position below) acts as a hydraulic press. The pressure in the input line from the brake actuator (usually a pivoted pedal) is transmitted by an incompressible fluid (the brake fluid) contained in a supply line and exerted on the wheel cylinder piston(s). The force is multiplied by the ratio of the area of the cylinder to the area of the actuator piston.



Left: Illustration of brake mechanism from Duesenberg's patent application. US Patent 1,490,163 filed November 16, 1920.

Besides the multiplication of force achieved, Pascal's law states that the pressure is transmitted equally to all parts of the enclosed fluid system. This provides straight-line braking unless there is a fluid leak or something to cause a significant difference in the friction of the surfaces.

An important requirement is that the hydraulic liquid used in the brake system cannot be compressed. Since air is compressible, a hydraulic system must be free of air in order to function properly.

Competing Braking Systems

While the Duesenberg Model 'A' was the *first commercially produced* automobile to use four-wheel hydraulic brakes and internally expanding-shoe hydraulic brakes, Malcolm Loughead had previously invented a hydraulic automobile braking system for four-wheel applications. Loughead's brakes, however, were external-contracting band brakes and were not introduced in production quantities until late 1923 — two years after Duesenberg introduced his hydraulic braking system.

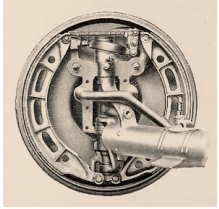
Moreover, neither Malcolm Loughead nor Fred Duesenberg could claim the invention of four-wheel brakes or the hydraulic brake.

- The first known use of four-wheel automotive brakes is due to Henri Perrot, a Frenchman working for Argylls Ltd., manufacturer of the Argyll automobile in Alexandria, Scotland. Perrot filed for a US patent covering a four-wheel brake system – *which used mechanical rather than hydraulic linkages* -- on January 14, 1913, and US patent 1,076,311A was issued October 21 of the same year. The 1912 Argyll 15 HP was the first car equipped with Perrot's brake system.
- The honors for the invention of the hydraulic brake may belong to Frederick Henry Royce, however, it does not appear that his hydraulic brake was ever manufactured. It certainly was not introduced on a production automobile prior to the Duesenberg. There are reports that Knox Motors Co. used hydraulic brakes on the rear wheels of a truck tractor in 1915.[1]
- The Triumph 13/35 was the first to offer hydraulic brakes in the United Kingdom in 1924. The Adler 'Standard 6' of 1926 was the first vehicle to use hydraulic brakes on Continental Europe.

The Landmarked Vehicle

The restored 1926 Duesenberg Model 'A' chassis (in operable condition) in the Auburn Cord Duesenberg Automobile Museum recognizes Duesenberg's landmark achievement. A chassis without an automobile body mounted is especially appropriate, since Duesenberg only manufactured chassis assemblies for the Model 'A.' Automobile bodies were custom built by some of the finest coach-builders of the 1920s and added later. It is also appropriate because the components of Duesenberg's innovative hydraulic brake system are more exposed and viewable by the public in this form.

[1] "Newly Designed Knox Tractor Has Hydraulic Brakes," Motor Age, March 4, 1915, p. 32.



This picture shows the Duesenberg Model ‘A’ vehicle chassis exhibited permanently at the Auburn Cord Duesenberg Automobile Museum. All Duesenberg Model ‘A’s were sold as chasses. Vehicle bodies were provided by other suppliers. Showing the vehicle as a chassis on the museum floor makes it easier to see the mechanical parts—including the hydraulic braking system.

This image shows one of the vehicle’s wheels, including its brake drum. Duesenberg’s hydraulic brake system used internal expanding-shoe hydraulic brakes

The vehicle's dashboard displays the hydraulic brake pressure.

The landmark 1926 Duesenberg Model 'A' chassis was previously owned by some important vintage automobile collectors. It was restored by Al and Dottie Bennett for the late Homer Fitterling of South Bend, Indiana. The chassis was later sold to the noted Duesenberg collector Ed Weaver. Before being sold, the chassis was publicly displayed in the 1995 ACD Labor Day Reunion Meet, where it also participated in the Annual Parade of Classics. Before coming to the Auburn Cord Duesenberg Automobile Museum, it was displayed in a private museum.

Although this chassis is assembled from parts, all of the parts are original Duesenberg Model 'A' components. This car retains an original Duesenberg firewall tag, which labels the chassis as car number 765 and the engine as number 1164. It should be noted, however, that this engine is number 1010 and does not match the number on the build plate.

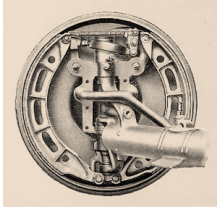
The 90-horsepower Duesenberg overhead camshaft engine is complete and retains its rare, original Schebler Model S updraft carburetor, as well as its original ignition system, water pump, manifolds, starter, and generator. The radiator has its original honeycomb-style core and is fitted with an original Duesenberg Model 'A' radiator shell.

Specifications, including technical description and data.

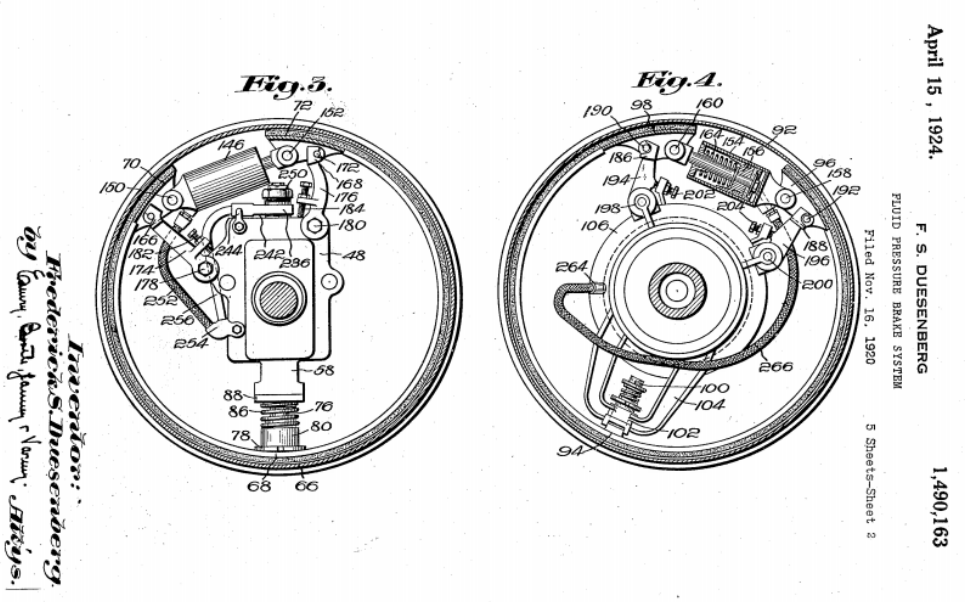
Fred Duesenberg described his hydraulic braking system in two patent applications — US 1,490,163 and US 1,703,483, both filed on November 16, 1920. The first provides a "plan of a motor car chassis equipped with a brake system exemplifying (his) invention."

Duesenberg notes his "invention contemplates the use of a suitable fluid, such as oil, for the operation of all four brakes under the control of a single actuating member conveniently located for operation by the driver. In the present example, the actuating member is a pedal, fulcrumed on a pivot, and suitably connected as by a link with a master piston working in a master cylinder."[2]

[2] The item numbers are omitted from the patent language, for clarity.



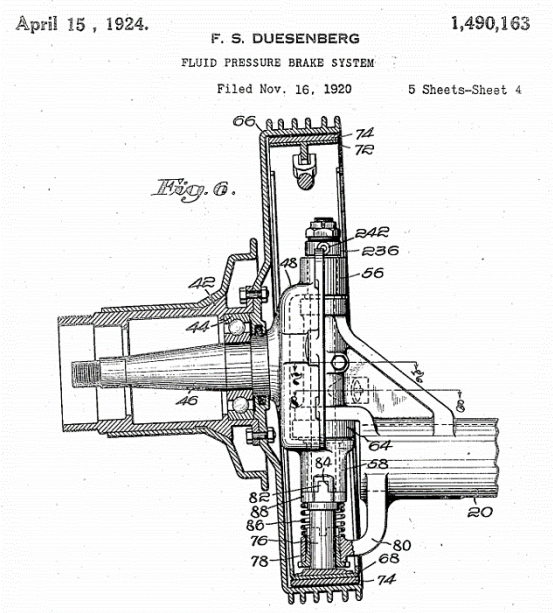
Both patent filings include identical illustrations of the hydraulic drum brakes:

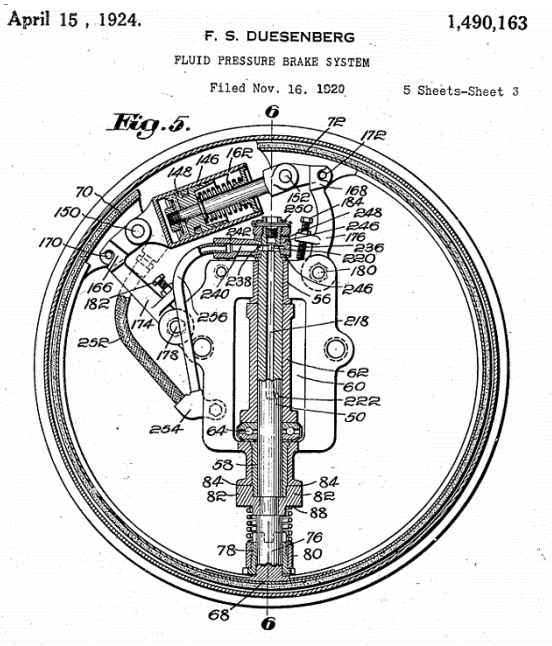


In US Patent 1,490,163, figure 3 shows the front-wheel drums, and figure 4 the rear drums.

In his patent application, Duesenberg describes the operation of his braking system: “Referring to Fig. 5, each of the front wheel brakes is provided with a brake cylinder 146, having a piston 148 working therein, one pivotally connected at 150 to one of the brake terminals 70, and the other pivotally connected at 152 to the other brake terminal 72. Similarly, each of the rear wheel brakes (see Fig. 4) is provided with a brake cylinder 154 and a piston 156 working therein, one pivotally connected at 158 to the brake-band terminal 96, 110 and the other pivoted at 160 to the other brake-band terminal 98. Thus it is evident that the brake cylinders and pistons are supported jointly by the brake-band terminals, and as they are mounted within the 115 circumferential limits of the brake-drums, they are afforded protection by the latter, and the brakes moreover present a more sightly appearance.” … “The brakes are retracted by suitable springs 162 and 164, herein interposed between the pistons and the adjacent ends of the cylinders.”

Additional illustrations from the patent application:





April 15, 1924. 1,490,163

F. S. DUESENBERG

FLUID PRESSURE BRAKE SYSTEM

Filed Nov. 16, 1920 5 Sheets-Sheet 1

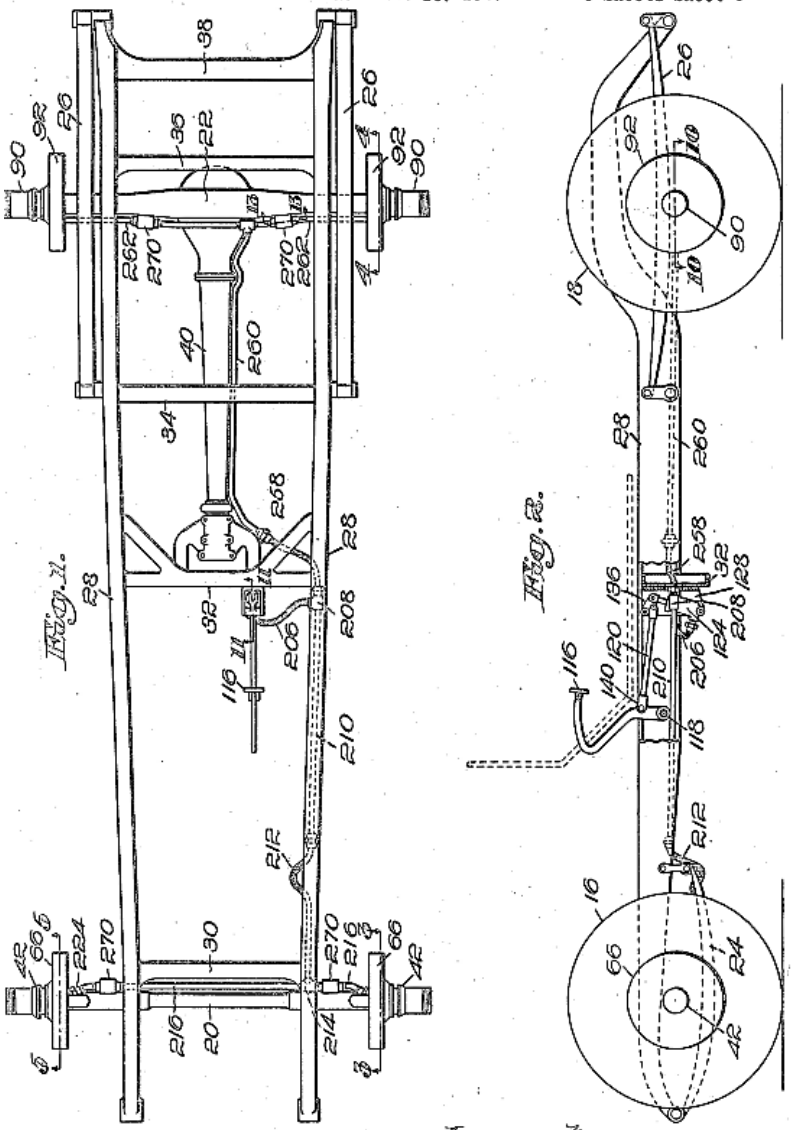
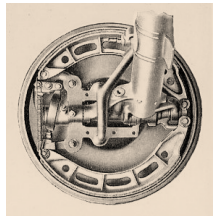


Fig. 1.

Fig. 2.

Inventor:
Frederick S. Duesenberg.



The Auburn Cord Duesenberg Automobile Museum

The Auburn Cord Duesenberg Automobile Museum is a not-for-profit and educational institution owned by the non-profit Auburn Automotive Heritage, Inc. The organization was formed in 1969 by local volunteer leaders with contributed funds. The museum opened to the public July 6, 1974.

As the name suggests, the museum is dedicated to preserving automobiles built by the Auburn Automobile Company and Duesenberg Motors Company/Duesenberg, Inc.

The museum occupies the former Auburn Automobile Company Administration Building. It was part of the campus where cars were hand-assembled, rather than mass-produced. The Showroom and administrative building was designed by architect Alvin M. Strauss in the Art Deco style and built in 1929-1930. The facility's Showroom and administrative buildings, as well as the service and new parts building and the L-29 building were together declared a National Historic Landmark in 2005 and are listed on the National Register of Historic Places.

The museum is organized into seven galleries that display over 120 cars and related exhibits, such as the restored Auburn Automobile Company offices.

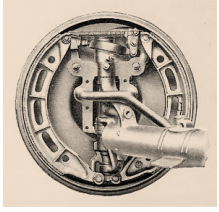
HISTORIC MECHANICAL ENGINEERING LANDMARK

DUESENBERG 4-WHEEL HYDRAULIC BRAKING SYSTEM
1921

FREDERICK S. DUESENBERG'S 1921 MODEL 'A' WAS THE FIRST PRODUCTION AUTOMOBILE TO USE FOUR-WHEEL HYDRAULIC BRAKES. DUESENBERG AUTOMOBILE AND MOTORS COMPANY OF INDIANAPOLIS (EST. 1920) WAS ALSO THE FIRST TO INVENT AND EMPLOY INTERNAL, EXPANDING-SHOE HYDRAULIC BRAKES.

EQUIPPING ALL FOUR WHEELS WITH HYDRAULIC BRAKES SIGNIFICANTLY REDUCED BRAKING DISTANCES, WHICH BECAME INCREASINGLY IMPORTANT AS VEHICLE SPEEDS INCREASED. ALL AUTOMOBILE COMPANIES EVENTUALLY ADOPTED FOUR-WHEEL HYDRAULIC BRAKES DUE TO THE SAFETY THEY PROVIDED, ALTHOUGH SOME MORE THAN A DECADE AFTER DUESENBERG'S PIONEERING WORK.

ASME THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS-2024



Fred Duesenberg[3]

Frederick 'Fred' Samuel Duesenberg, was born on December 6, 1876, in Germany. At the age of nine, he immigrated to the United States with his mother and siblings. Fred Duesenberg attended public schools through the eighth grade, but never received any formal training in mechanical engineering with the exception of a correspondence course in mechanical drafting. Similar to many engineers of the time, Fred obtained his training through apprenticeships and other hands-on experiences. He learned about automobiles by working with Thomas Jeffery in Jeffery's Rambler factory.

Frederick Duesenberg and his brother August established Duesenberg Motors Company in 1913 in Saint Paul, Minnesota, to build engines for race cars. During World War I, they moved manufacturing to Elizabeth, New Jersey, to manufacture aviation and marine engines for military applications. Following the war, they established the Duesenberg Automobile and Motors Company in Indianapolis, Indiana. The company manufactured passenger vehicles from 1921 until 1937, starting with the Duesenberg Model A.

In addition to designing commercial automobiles, Fred and August Duesenberg were involved in racing. Their racecars achieved significant success, winning the Grand Prix at Le Mans in 1921 and the Indianapolis 500-mile auto race in 1924, 1925, and 1927. In 1920 a Duesenberg racecar set a land-speed record of 156.046 miles per hour (251.132 km/h) on the sands at Daytona Beach, Florida.[4]

Duesenberg is credited with a number of innovations in commercial vehicles. These include the introduction of four-wheel hydraulic brakes and the eight-cylinder automotive engine (the Duesenberg Straight 8).

Duesenberg's operations were folded into the Auburn Automobile Company in late 1926 by E.L. Cord. From 1926 until his death in 1932, Fred Duesenberg focused on designs for luxury passenger vehicles, including the Duesenberg Models X, Y, and J. With the market for expensive luxury cars severely undercut by the Great Depression, Duesenberg's automobile company folded in 1937.

Fred married Isle "Mickey" Denney of Runnells, Iowa, on April 27, 1913. He died on July 26, 1932, at the age of fifty-five, due to complications from an automobile accident and pneumonia.

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[3] From: http://www.automotivehalloffame.org/honoree/fred-duesenberg/ retrieved February 13, 2019 and Wikipedia retrieved September 2, 2019

[4] From: http://en.wikipedia.org/wiki/Fred_Duesenberg, retrieved September 15, 2019

THE HISTORY AND HERITAGE PROGRAM OF ASME

Since the invention of the wheel, mechanical innovation has critically influenced the development of civilization and industry as well as public welfare, safety and comfort. Through its History and Heritage program, the American Society of Mechanical Engineers (ASME) encourages public understanding of mechanical engineering, fosters the preservation of this heritage and helps engineers become more involved in all aspects of history.

In 1971 ASME formed a History and Heritage Committee composed of mechanical engineers and historians of technology. This Committee is charged with examining, recording and acknowledging mechanical engineering achievements of particular significance. For further information, please visit http://www.asme.org

LANDMARK DESIGNATIONS

There are many aspects of ASME's History and Heritage activities, one of which is the landmarks program. Since the History and Heritage Program began, 273 artifacts have been designated throughout the world as historic mechanical engineering landmarks, heritage collections or heritage sites. Each represents a progressive step in the evolution of mechanical engineering and its significance to society in general.

The Landmarks Program illuminates our technological heritage and encourages the preservation of historically important works. It provides an annotated roster for engineers, students, educators, historians and travelers. It also provides reminders of where we have been and where we are going along the divergent paths of discovery.

ASME helps the global engineering community develop solutions to real world challenges. ASME, founded in 1880, is a not-for-profit professional organization that enables collaboration, knowledge sharing and skill development across all engineering disciplines, while promoting the vital role of the engineer in society. ASME codes and standards, publications, conferences, continuing education and professional development programs provide a foundation for advancing technical knowledge and a safer world.