ON BALLOON TIRES INTO THE AUTOMOTIVE SOCIETY

THE DEVELOPMENT OF THE PNEUMATIC TIRE AND ITS IMPORTANCE FOR ROAD TRANSPORTATION

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By tradition, there is a focus on the private car as the history of road transportation is written. The power of the motor, its speed, and its layout are described. Those aforementioned characteristics are in the spotlight when the vehicles are exhibited.

When the theme is for the first few decades of the 20th century was motor vehicles, this is a very natural consequence. However, there are other factors that should be discussed when the history of road transportation from the beginning of the 1920's to the present is told and explained. In this history, the pneumatic tire should play an important role as one of the single most important components for the development of transportation.

INTRODUCTION

In 1909 the Danish Royal Post wanted to try the new transport technology, the motored car, and bought three of the best motor cars that could be made at that time. They were built by Berliet in Lyon, France and could handle goods between 500 and 800 kg. The postal service was satisfied with the vehicles after they had been in action for some years. Even though they had to stay one whole day at the repair shop after an average driving of 340 km, the postal service was satisfied: The new type of vehicle was a better business than the old-fashioned carriage.[1]

We all know the technical advance of the building of cars since then. The modern car had to spend some few hours at the repair shop for a service inspection after 50,000 km. That is all. What we possibly are not aware of is that the technological development of tires is one of the most important single parts in this development. That is what this paper is about.

Around 1910 a car could not drive more than around 491 km before one of its tires was punctuated. This was the case for the cars at the Danish postal service that drove in Copenhagen, the capital of Denmark. The town had the best roads in the country because many of them were paved. Driving in the countryside would have caused many more punctures probably one for only each 200 km on average. Still, these tires were better than the first used; the first of its kind for horse-drawn hackney carriages from French Michelin in 1894 had only been capable of driving about 129 km before they had to be changed.[2]

In 1895 the Michelin brothers presented the first pneumatic tire for cars. Their Eclair racer was equipped with the new tire.

TIRES - THE WEAK POINT

Literally, the tires were the weak point of the cars. They had the mentioned problem with punctuations. The tube in the tire had to be filled with air to a high pressure (tubeless tires were first introduced in 1947), and this high pressure caused the vulnerable tube.

Tires for cars before then had been introduced for bicycles. Based on the invention of vulcanization by Charles Goodyear in 1843, in which a mix of crude rubber with sulfur and heat could be converted to a durable material unaffected by changes in climate, the famous John Boyd Dunlop granted a patent on an air-filled tire in 1888 (the infamous Robert William Thomson had made a similar patent in 1846, and soon most bicyclists drove on those smooth tires. After the introduction of the bead in 1892, the system for bicycle tires was laid.[3]

When the first experiments began with motorized cars, no one could think of a similar tire for this heavy machinery. The first serious exception was the Michelin brothers, who in 1895 announced that their company could build the first pneumatic tire for this type of vehicle. They tried the new tire on three cars in a car race. Even though only one of their cars finished the race as the last out of the nine finishing participants after many punctures — they had to change 12 tires and 22 tubes— they found that the new tire was a success, and around the turn of the century, pneumatic tires were becoming the norm for the automobile industry: rubber tires built by enforcement by woven cotton and with an air-filled tube inside.

Three years later Michelin created the Michelin man for its advertisements. The man got its nickname Monsieur Bibendum from a poster with the text *Nunc est bibendum* (time for a drink) and in which the man took a glass filled with nails and sharp pebbles.

Punctures and the following patching were a recurring routine for car transportation in its first years. Therefore, the car was primarily a tool for leisure.

THE CORD TIRE INNOVATION

For many years this cocktail of nails and sharp objects spoiled the tires, even those from Michelin. Many efforts were made to improve the tire. In the long row of improvements, the use of cord was one of the most important. Originally the body or carcass of a tire was composed of plies of cotton fabric meshed with rubber covered by a rubber tread that met the road. Around 1903 the first tire, the Palmer cord tire, was introduced in the UK by Palmer Tyre. It was made by experiments with the more flexible loom made by small cotton stranded threads like stranded rope: the cord.[4] The cords eliminated the cross threads from the woven cotton that used to form the plies and hereby the abrasion of cotton thread against each other.

The tire was made in the USA by Diamond Rubber under license in 1910[5] (this company later merged into B.F. Goodrich, and the tire was marketed under the Silvertown brand, the town of the original tire in England).[6]

Goodyear was another of the first companies with cord tires. The company made a cord tire for electric automobiles in 1907.[7] The production of cord tires made the company the world's largest tire company in 1916.

Firestone made its first experiments in 1915 and launched the first cord tire in 1917[8]. Michelin introduced it in 1919.[9] It was a key product innovation that eventually all firms adopted. In 1917 only eight firms produced the cord tires, and three years later two-thirds did so. All firms in the town of tire production, Akron in northeastern Ohio, USA, with its many firms did it at that time.[10]

The cord tires were expensive to produce, which limited their rate of diffusion, but after a few years the technique was accepted. In 1917 the cord tire sales were 10% with a rise to a peak of 59% in 1924.[11]

It can be added that the use of cord was only one of many inventions and improvements. The use of carbon black as a reinforcing filler for rubber was another issue. It was first observed by the chief chemist S.C. Mote at India Rubber, Gutta Percha and Telegraph Works in Silvertown, UK, in 1904. The observation was not

patented, and other tire companies made analysis of the tires from Silvertown and realized the high content of carbon black. All tire companies adopted this innovation after some years, and that is why tires are black.[12]

"The necessities of war brought home to us the importance of the motor truck". So was the argument from Harvey S. Firestone when he launched the first tire for trucks. Here is shown an advertisement from 1919.

SOLID TIRES ON HEAVY CARS DESTROYED THE ROADS

The mentioned development was for the light personal cars only. They could use the pneumatic tire. However, the heavy vehicles could not use it because the pneumatic tire could only handle light weight. Therefore, the first trucks had to use wheels with solid rubber tires or tires with a special hollow construction.
It was not possible to construct a tire that could handle the weight. This gave several severe consequences. The driving created vibrations, and therefore the vehicle could only drive around 25 km/h with its heavy load. The trucks had to have a reinforced construction to counteract the shaking. More serious was that the heavy trucks in combination with the solid tires destroyed the roads. This problem was found rather early. The technicians did not yet have the exact knowledge that one heavy truck wore and tore as much on the roads as 70,000 small personal cars. The authorities had to make rules, and they became rather similar all over the world. In Denmark only small vehicles with a maximum weight of 500 kg were allowed on the small roads in the countryside around 1910. Later the restrictions were modified but still with strong limits. In 1921 the general rule became that a vehicle including load only could have a weight of 8 tons on highways.

It was obvious to use pneumatic tires on those vehicles too. For the smaller trucks dual tires in passenger sizes could carry a small truck. Shortly after the First World War the first useful tires in larger sizes were made. Firestone introduced such a series at the end of wartime in 1918.[13] A tire could then handle more than 1 ton, and with a pressure of 7 bars it could be used on 3-ton trucks. The durability was not rather high. It could only last for 10,000 km where an ordinary tire for a personal car could be in service for 17,000 km.

Those early tires increased both the frame and body heights. A 1920 Packard truck weighing 3 tons needed a 44 x 10" pneumatic tire compared to the 36 x 5" solid tire. The pneumatic tire allowed up to twice the speed – at that time 50 km/h. Trucks could be built to use the new tire, where Packard could sell a larger engine to handle the higher speed.[14]

THE MOTORIZATION – STATUS 1920

The motorized vehicles first were experiments and later toys for rich people. Next, they came of age as a useful tool. In the countryside many small cars – most in the USA – transported people and light goods in the summertime and to a lesser degree in the cold winter. The highway engineers had begun to improve the roads.

The big cities were filled with cabs, buses and vans. Even though the technology still not was 100% stable, the closeness to repair shops made the vehicles rather useful. The heavy trucks did not yet drive on the highways and in any case not on the small roads in the countryside. The mentioned improvement of the roads in the countryside was mainly not in the carrying capacity but made for the surface. Hereby, the fast wheels could not destroy the roads in the same way they did with an ordinary graveled road where the fast cars left the roads with wheel tracks in a cloud of dust. The heavy trucks would still destroy the road.[15]

In a larger perspective, the railways still had their mission as the long distance transport system for goods and widely for passenger transportation, too.

THE BALLOON TIRE REVOLUTION

The high pressure of the air in the tires created a vulnerable point. Several producers tried to reduce this pressure to have a tire with better comfort and longer life. One solution was to build larger tires with more air. One was delivered by General Tire in 1920 with its "General Jumbo" tire solution. but the construction of the so called balloon tire became the future. The secret behind it was to lower the pressure through another shape of tire. Instead of the circular tire, the shape became like an ellipse, named after the shape of the large balloons of that time.

This new construction was made possible through the use of new ways to handle the cord. Reportedly, it was Firestone that widened the cross section of the tire through a method to impregnate cotton cords with rubber. Every fiber of every cord in every ply should be impregnated with rubber to increase the flexing life.[16] The first goal was to make a more convenient tire, but it showed a much longer lifespan too. Its soft performance counteracted vibration and enabled the motorist to drive at greater speed. It was not necessary to slow down for rough spots ahead, and the softness yielded to sharp obstacles, which gave the longer lifespan.

Firestone began to produce balloon tires in April 1923.[17] Even though the new tire was a result of an evolution, it was a radically better tire than the normal ones. It was soon copied by other producers, and in October at least 20 other factories had started production.[18] Michelin developed its model *Comfort*, and by October 1924 the firm had made over one million balloon tires. In April 1925 its American plant had made three million of those tires.[19] At the end of 1924 61% of the 111 different models of automobiles offered to the American customers at that time were equipped with balloon tires. Many European cars got the new tire, too. In 1925 the Citroen TL got the Michelin tire as a standard, for instance.

Ford was the most conservative (and the largest) of the automotive producers. He was not the first to implement the new type of tire in his production. At least he had to use the new tire after the racing driver Peter DePaolo won the Indianapolis race in 1925 (all the first ten cars drove on balloon tires) with an amazing record as the first person to average 100 mph at the track.[20] In 1926 the Ford T got the balloon tire as a standard in the 21 x 4,40", where the standard before was 30 x 3" and 3½" for the rear wheel.

Within a single year after its introduction the balloons formed 12% of all tires and 34% the next year.

The first balloon tire was introduced by Firestone in 1923. Here is shown the first announcement from the company.

ON BALLOON TIRES INTO THE AUTOMOTIVE SOCIETY

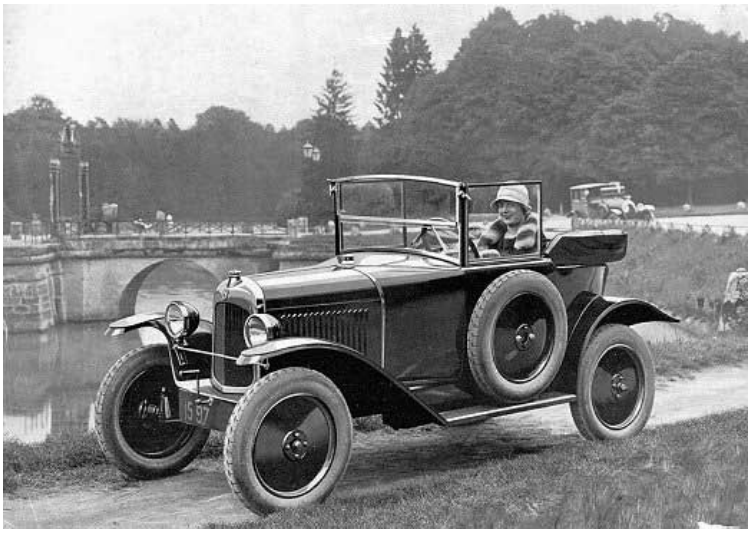
The balloon tire was one of the most important inventions in the automotive business. It was a precondition for many of the changes that formed the society into an automotive-based society.

If we look at the figure over the overall length that it was possible to drive per tire, it is impressive that the development came so fast that it only can be denoted as a revolution. Between the five years 1927 and 1932, the durability for a tire raised two to three times.[21]

The tendency for the development is much more dramatic than this figure shows because it is made through a simple calculation through the use of car spirit divided by the number of sold tires. In the same years the operating economy for the car motors

was improved. While a Ford T could drive 5-9 km per liter of petrol, the new Ford A from 1928 could handle 8-12 km — an improvement of 33-60% — and therefore each tire in the 1930s could last for many more kilometers than the figure shows. More important is that the number of punctures fell more drastically than this figure shows. Thereby, the car became a reliable means of transportation.

In the following subchapters some of the consequences for the society are explained.



From mid-1920s the balloon tire became a standard on all new cars. Here is shown the Citroen TL from 1925 with the Confort balloon tire from Michelin.

ON THE ROAD ON WEEKDAYS, TOO

The first cars were mainly used for leisure and fun. This was obvious for the very first 20 years of the history of the car, and it dominated traffic for a long time. Still, in the 1950s long distance traffic was dominated by holiday trips and visits to the family.[22] Analysis of this traffic showed (at least in Denmark) a very great difference between the holiday season and the rest of the year. There was twice as much traffic in the summertime as in the winter. Even in wintertime there was a lot more traffic on the weekends than on workdays.

This tendency toward a strong dominance by the leisure traffic changed a little when the personal car became more stable. We can see a shift from the open car, which was not suited to drive in the wintertime – at least not in the cold part of the world – to closed models. The market for sedans expanded quickly at the end of the 1920s. Whereas the closed models accounted for 43% of the sold cars in 1924, they accounted for 85% in 1927.[23]

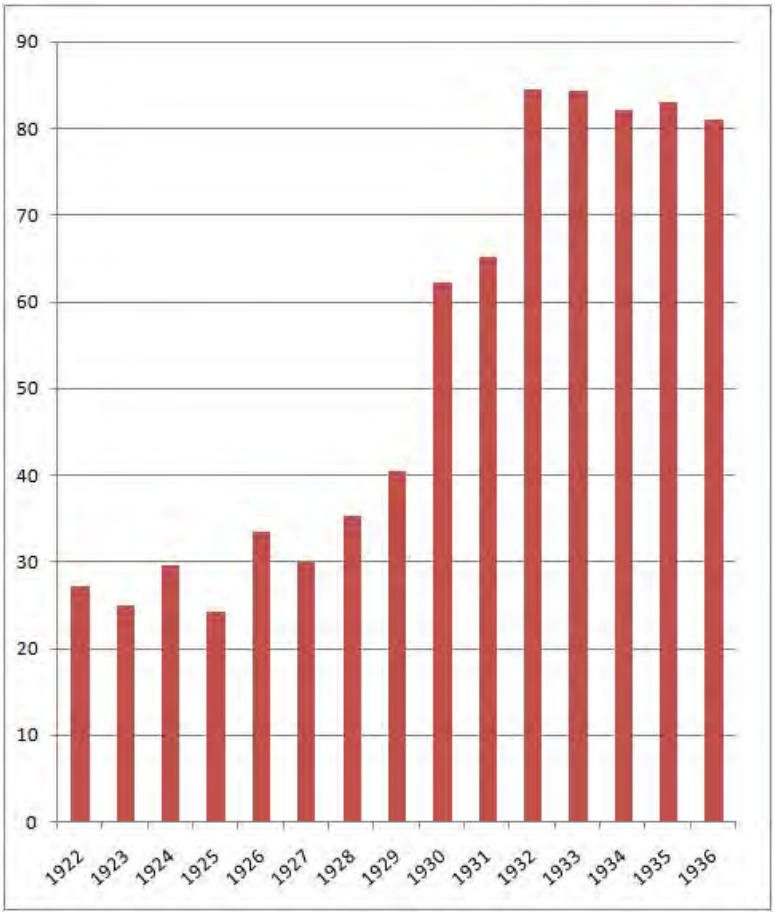
Even closed cars could be used for leisure, and many were placed on jacks in the wintertime to protect the expensive tires when the car was not in use. But in the 1930s those jacks became a bad business. The producers of jacks lost their former fine business. So did one of the leading companies, Walker, which went on to other business areas as a spare part producer to survive.[24]

The new type of tire gave the possibility for the cars to drive faster. While the Ford T could drive up to around 72 km/h, its successor Ford A could have a motor that kept it up to 104 km/h. Of large importance was its smooth driving, which created a new standard. The lightweight chassis, like that of the Ford T, could not handle the weight

of a heavy sedan body, and it soon became noisy and leaky. The new cars could have a higher weight with the new tires and drive on the same roads and conditions like the old Ford T had done before the balloon tire came into action.

The new cars had to be built according to the new tire. The structure and design of the bodies had to be changed by the car makers, the broader tire required a modification of guards, and the higher speed created a demand for new designs for brakes and suspension. Brakes on all four wheels became the standard so that all American-built cars had four-wheel brakes in 1929.[25] Now the personal car could deliver a longer and safer transportation between home and work. The precondition of an automobile-oriented way of life was made.

Car owners saved a lot of money because the new tire was so economical in use. Before the new type of tire came into action, the cost of tires had been a large part of the total expenses for driving, perhaps up to 30%. When the Swedes discussed how to lay taxes on cars for the first time, they seriously discussed having a tax on tires but not petrol; they wisely chose the petrol.[26]



The figure shows the tendency of the lifespan of tires. Through a few years at the end of the 1920s the life was extended two to three times. This liberated the potential for the personal car.

THE TRUCKS WAITED TO CHANGE THE WORLD

The first balloon tires were only made for small cars. The construction of larger tires was complicated, and a series of improvements had to be made before the trucks, too, could have the benefits of the new tire.

Where the first tires in 1923 could handle an axle load of two tons, this limit was heightened to 4 tons in 1928. Five years later very heavy tires were made so that tires could handle an axle load of 10 tons.

This development happened so that the old-fashioned solid tires could be phased out. With this new alternative in mind, the road builders in Denmark made the rule for transportation that there should be an extra duty on solid tires in 1927 of 50% and 25% on half solid tires. In 1934 it was possible to make a total prohibition on any kind of solid tires on the public roads.[27]

Recall the previously mentioned rules made around the axle load. The scientists in road building had realized that it was not only the load from a single wheel that made problems. Two twin tires could only partly solve the weight problem.

When the balloon tires became common, they gave the trucks the same advantages as mentioned with the private car: Longer distances, better driving, and heavier load were possible. Hereby, the trucks became a competitor to the long distance railway transportation, and through the next decades the rail was outdone except for the most bulky and cheap goods.

Another important development was the localization of the industry. It no longer had to be placed near a railway line and a harbor. From now on industries and even new industrial towns could be placed more freely. The old town with its industrial area became history. From now on industrial parks could be places anywhere but near a highway.

The new long distance truck transportation created a whole new technological and social infrastructure with its trucker culture, motels, and other services along the highways. The production side of the society became automobile-oriented, too, and went on balloon tires.

CONCLUSION

The balloon tire made a revolution even it was the result of an evolution of the production process of tires. In a few years the new technology made large changes possible as an important part of the change of the society to a more automobile-dependant way of life.

In the examples are mentioned the change in the private transportation with its new possibilities for settlement and for the long distance truck transportation and its similar new possibilities for the localization of industry. Many more examples could be mentioned. The balloon tires for farm tractors made a similar change in the farmland and in construction, and in the wartime the airplanes grew in size thanks to their new kind of tires.

The development of tires has in this paper only been shown briefly in comparison to the development of road building. This aspect could have been extended. Most important was the aspect that the new type of tire came at a time when the road builders still had to develop their new technologies for fast and heavy transport. The new gentle tires gave them an important five- to 10-year period with freedom to prepare for the actual challenges. .

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NOTES

[1] Burchardt 2006.
[2] Classe, Answers.com.
[3] Classe, Answers.com.
[4] Victoria and Albert Museum 2007.
[5] Klepper and Simons 2000.
[6] Times, May 17, 1937 and Shannon.
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[16] Klepper and Simons 2000 and Lief 1951.

[17] Lief 1951.

[18] Klepper and Simons 2000.

[19] Tesi 2007.

[20] Automobile Quarterly.

[21] Data from Reynolds 1938 (US or worldwide production of tires) and Department for Business Enterprise & Regulatory Reform, UK (import of car spirit). The figure can only show a tendency and is in no way an exact measure of the characteristics of the new tire.

[22] Burchardt 2006.

[23] Hugill 1982.

[24] Burchardt 2008.

[25] Hugill 1982 and Lief 1951.

[26] Burchardt 2007.

[27] Burchardt 2006.