

BEADED EDGE TYRES IN THE MODERN WORLD.

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MY BACKGROUND

With 'Dunlop' Tyres for 43 years, the first half spent within the Technical Division on the then 'modern' tyre manufacture. The second half within the 'Motorsport Division' which as well as producing many Le Man 24 hour and motorcycle Grand Prix winning tyres, also manufactured a range of Edwardian, Veteran, Vintage and Classic road and race tyres.

During the early 1980s, production of E.V.V. and C tyres was intermittent with high factory waste levels.

Decisions were taken to conserve the range of 'old' tyres, this involved improving manufacturing processes and reclaiming 'old' moulds from Dunlop factories as far as Australia, New Zealand and South Africa, and making new moulds to original drawings to try and provide a comprehensive range of 'wired on' and 'beaded edge' tyres.

Redevelopment of the manufacturing processes included use of modern materials in rayon, nylon and aramid (Kevlar) replacing the original cotton casings, at the same time matching performance to modern conditions.

A great amount of design effort was spent on beaded edge tyres to best meet the demands of modern roads and conditions - the subject of this article.

Since 2000 I have acted as a consultant for Edwardian, Veteran and Classic tyre manufacture. I also have a practical, involved, interest in all vehicles pre-second World War.

Before considering the use of beaded edge tyres on motor vehicles today, we should briefly look at the history of the pneumatic tyre to understand how the beaded edge tyres ever came into use.

Originally invented in 1845 by Scotsman R W Thomson, the first pneumatic tyre was patented for intended use on carriages and carts (see figure 1).

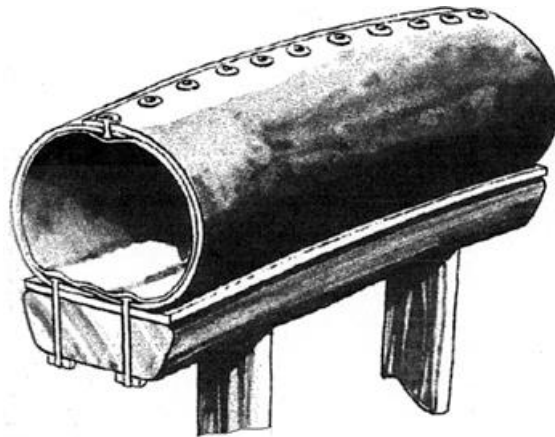


Figure 1. Robert Thomson's patent 1845

This invention comprised of a reinforced vulcanised inner tube surrounded by a leather casing. Regrettably there was little practical application for this concept and its development languished until 1888, when J B Dunlop independently re-invented the concept, this time for his son Jonny's tricycle. (See figure 2).

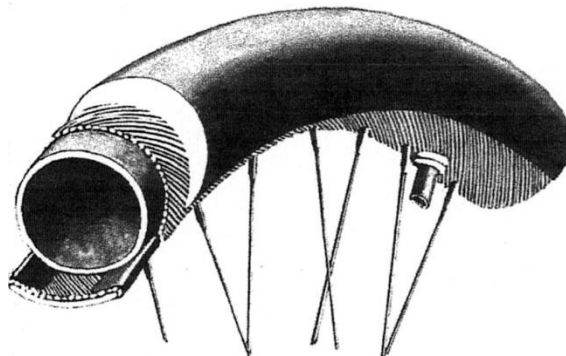


Figure 2. John Boyd Dunlop's Composite tyre and wheel, patent 1888

This was a composite tyre/wheel, and trials and competitions showed its superiority over solid tyres both in comfort and rolling resistance. Manufacture of this concept was taken up 'The Pneumatic Tyre and Booths Cycle Agency' (later to become 'Dunlop Rubber Company').

The concept of a composite tyre/wheel was both costly and inconvenient so when Charles K Welch patented his 'Welch' (Well Base) rim in 1890 it enabled a tyre with wire beads to be mounted and demounted very simply from the wheel (see figure 3).

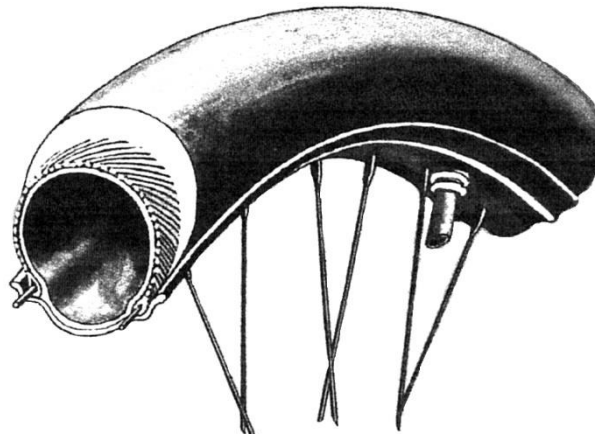


Figure 3, The Welch, well based rim patent 1890

The forerunner of ALL modern motor vehicle wheels, the Welch patent was immediately bought up by the Pneumatic Tyre Company and protected universally. At the same time as Welch, other people had also been concerned with making a demountable tyre that did not infringe the Welch patent.

The most significant of these was a design by W.E. Bartlett, an American working in his uncle's company, The North British Rubber Company, based in Edinburgh. In 1890, Bartlett patented his design, this was what we now know as the Beaded edge tyre.

The difference between the wire beaded 'Welch Rim Tyre' and beaded edge tyre was that the bead core was formed from very hard vulcanised rubber. This enabled the tyre bead to be stretched over the rim flange and located within a flat base rim with turned over edges (see figure 4).

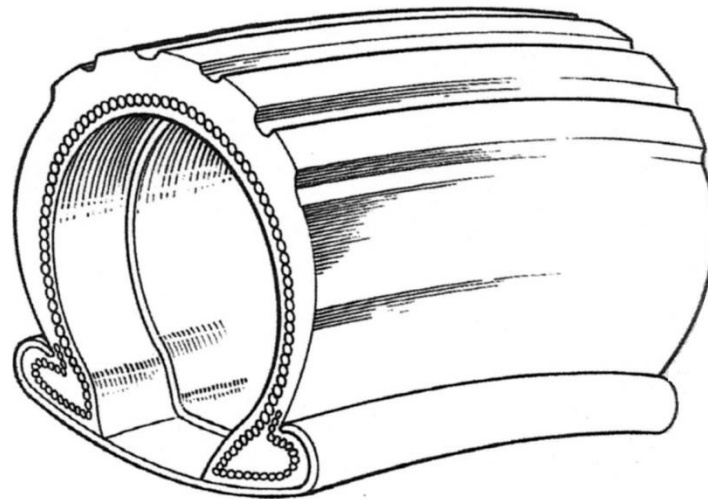


Figure 4, The Bartlett patent 1890

The English rights to this patent were bought by the Pneumatic Tyre Company with the patentee given licence to manufacture tyres in Scotland, with a royalty on each tyre, payable to the Pneumatic Tyre Company.

The aforementioned inventions were solely concerned with bicycles which were the height of fashion at this time.

During this time very few motor vehicles existed and those that did, were all running on solid rubber tyres or steel rimmed wheels. (See figure 5 on next page).



Figure 5, 1895 Daimler Benz on solid tyres.

One of the first published uses of pneumatic tyres on a 4-wheel vehicle was the L'Eclair, built by the Michelin brothers, Andre and Edouard and based upon a 4 HP Daimler engine and fitted with 'Bartlett' type beaded edge tyres. (Figure 4). The car was built for the 1895 Paris to Bordeaux race (745 miles), and though the L'Eclair did not win, it was still running at the end after using 24 spare tubes. (Figure 6).

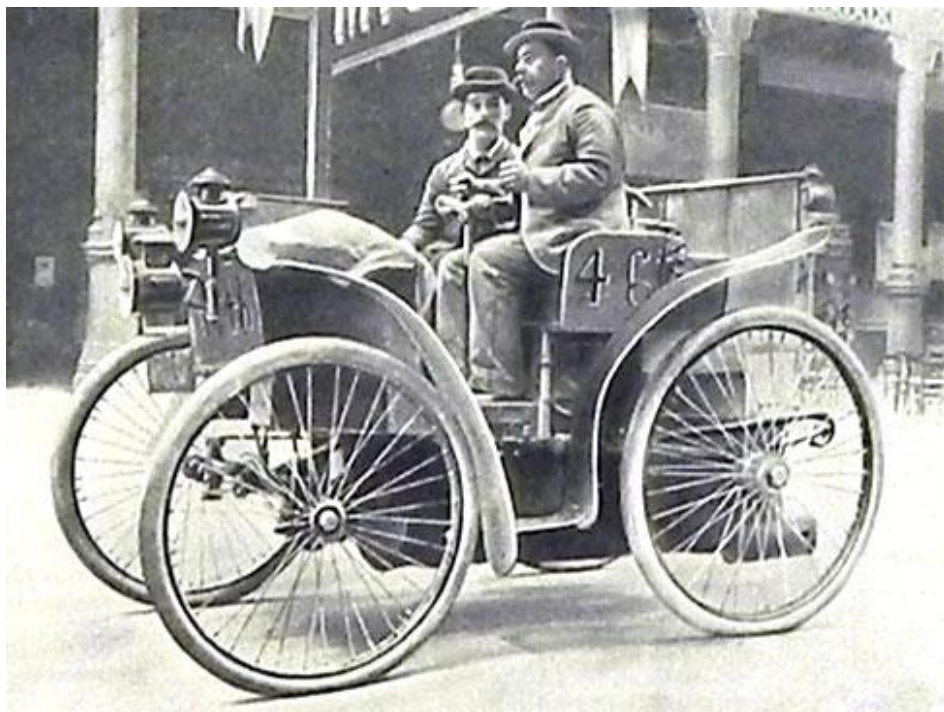


Figure 6, The L'Eclair, built by Edouard & Andre Michelin for the Paris to Bordeaux race 1895

The Welch rim patent restrictions enforced by the Pneumatic Tyre Company meant that most 4-wheel vehicle development (particularly in Europe), adopted the far less safe principle of beaded edge tyres. Though quite suitable for bicycles where forces act generally through the diametral axis of the wheel, and for very light cars where speeds were low and little cornering force is developed – the principle became far less safe on heavier faster cars (particularly after 1904 in the UK where the 4 mph restriction was lifted). Cornering in a 4-wheel vehicle develops a cornering (pulling) force, trying to pull the outer (loaded) bead from its seating on the rim – limited only by the coefficient of friction between the tyre tread and the road surface.

The majority of early cars were quite 'lightweight' with fairly low load transfer when cornering, however, very rapidly vehicles became faster and heavier with the addition of multi-seating bodywork – sometimes still on narrow section tyres – load transfer increased dramatically resulting in frequent tyre dislodgements.

Recorded examples include: Rolls Royce London to Edinburgh and Alpine Trials, S.F. Edge 1907 Napier 24 hour (av. 66 mph) run at Brooklands requiring 24 tyre changes, and Bugatti's, withdrawal from Grand Prix due to tyre dislodgement.

Attempts to reduce tyre dislodgement brought many weird and wonderful inventions, most of which were fairly impractical from the tyre fitting aspect (see figure 7). This shows the use of wedges and security bolts at intervals around the rim, in an attempt to prevent bead dislodgement.

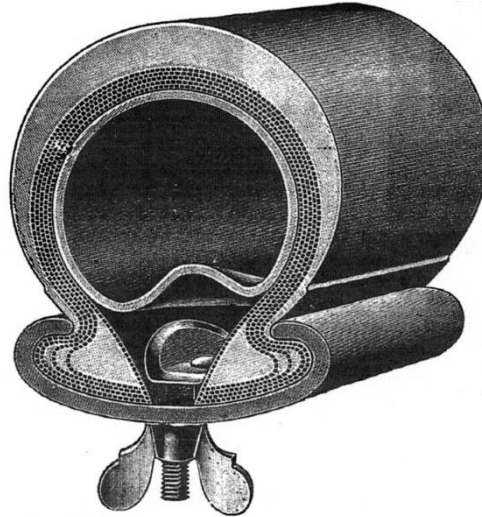


Figure 7, one of the many ideas designed to hold the tyre onto the wheel rim.

Some manufacturers sought alternatives to beaded edge tyres and figure 8 shows the principle of the 'straight sided' rim that avoided the Welch patent with the ability to use 'wired on' tyres – this design never became very popular in Europe but was widely taken up in the USA.



Figure 8 The principle of the 'straight sided' rim

At this time, development of the motor car was far more rapid in France than in the UK and USA, for example in 1896, France had 200 motor vehicle manufacturers, whereas the UK had only 29 and the USA 4.

At the turn of the century in the UK motor vehicle speeds were low (limited to 4 mph until 1904), town roads were predominantly granite setts and country roads either dirt or loose gravel – this meant that cornering forces on tyres were very low. Sharp flints and loose horseshoe nails coupled with very crude rubber compounding accounted for many punctures which soon became one of the accepted hazards of motoring.

With the Pneumatic Tyre Company's vigorous protection of its 'Welch Rim' patent, beaded edge equipped cars remained predominant, with many being imported into the UK, bringing with them inherent dislodgement problems. Beaded edge tyres continued to be fitted to new cars across Europe even after the 'Welch Rim' patent expired in 1904. It was only just prior to the First World War that movement away from beaded edge to wired on tyres began to take place, but of course this was hampered by the war effort. However, by the early 1920's the tide was turning and by 1925 beaded edge tyres finally became obsolete.

Today we have totally different motoring conditions. We take it for granted that our modern tyres will give 30,000 plus, puncture-free miles. Modern tarmac roads are designed to provide very high levels of adhesion and with modern high tech rubber compounding, high cornering forces can easily be developed, though obviously an advantage for modern safe motoring, it does create significant problems for beaded edge tyres.

A high level of grip between road and tread surface will try to pull the bead from the outer (loaded) rim edge. As soon as this starts to happen, the bead can rock which allows the inner tube to ingress beneath the bead, the tube will then burst or "blow out" inflation pressure is lost and the beaded edge tyre demounts from the rim often causing irreparable damage to the tyre.

CONSIDERATIONS FOR USING BEADED EDGE TYRES IN THE MODERN ENVIRONMENT.

Today there are many Edwardian, Veteran and Vintage car owners who understandably desire to retain the originality of beaded edge fitment to their vehicles. But it is important that these 'modern' owners of historic vehicles recognise the vulnerability of 'beaded edge' tyres compared with wired on tyres (either well-base or straight sided rims).

THE BEADED EDGE WHEEL RIM: this is of critical importance. In the early days of beaded edge car tyres, there were no standards laid down and until comprehensive dimensions and tolerances were established by Society of Motor Manufacturers and Traders (S.M.M.T.), rims could be haphazard. The 'ideal' fit of tyre to rim is shown in figure 9.

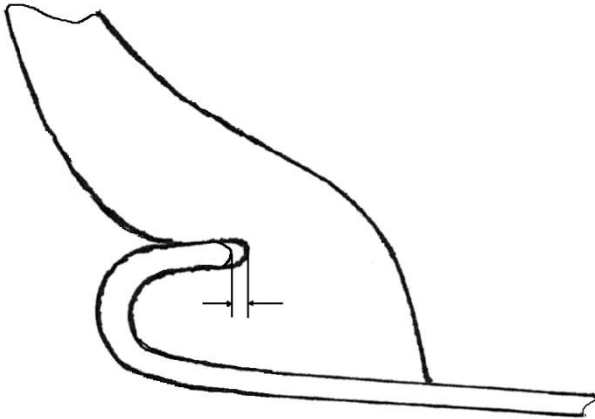


Figure 9, Ideal fit

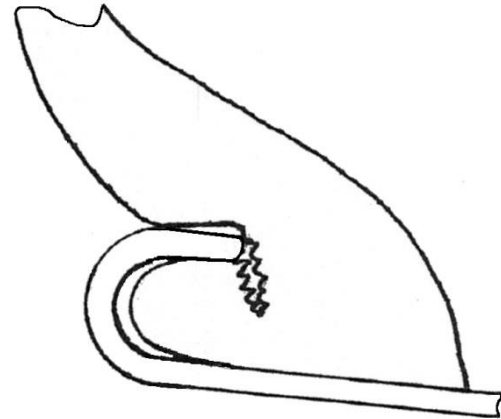


Figure 10, the result of excessive rim turnover

Figure 9, shows the 'heel' of the bead to be a 'snug' fit in the rim turn over with a clearance of 0.5 – 1.0 mm, between the inner edge of the turned over rim and the undercut in the tyre clinch. Interference caused by poorly repaired rims, between the wheel rim inner edge and tyre clinch undercut prior to the heel of the bead seating into the radius of the wheel rim turnover WILL cause chafing and subsequent 'bead' tearing (figure 10).

Early rims were formed from hot rolled profiled strip creating different material thicknesses, in order to compensate for the various contraction changes that took place in the final drawing process (figure 11).

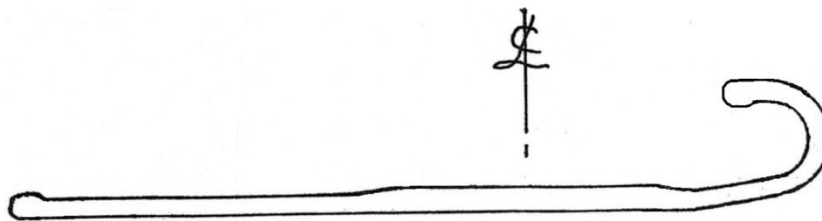


Figure 11, NOTE: The teardrop end to rim turnover.

Figure 12, Beaded edge wheel rims made today are generally flow formed from flat strips. It is important to note that the inner edges of turnover MUST be radiused and polished.

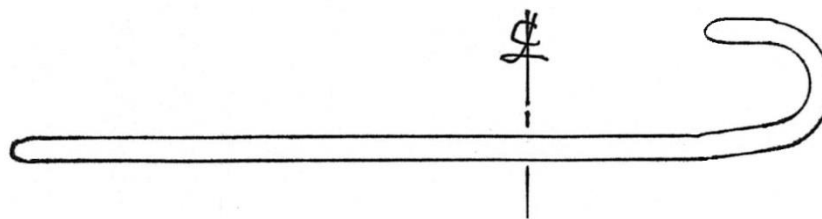
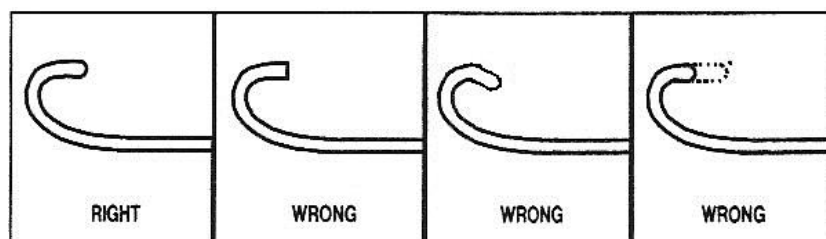


Figure 12, Beaded edge wheel rims made today.



Figures 13 show typical unsatisfactory rims.

It has become common practice amongst restorers to grind back the corroded tip of the rim, in order to provide a more sympathetic surface; this is a mistake and will lead to premature failure as it drastically reduces the support in this area. Your tyre or rim supplier should be able to supply the acceptable dimensions and tolerances for your rims by providing drawings or profile gauges (see figure 14 below).

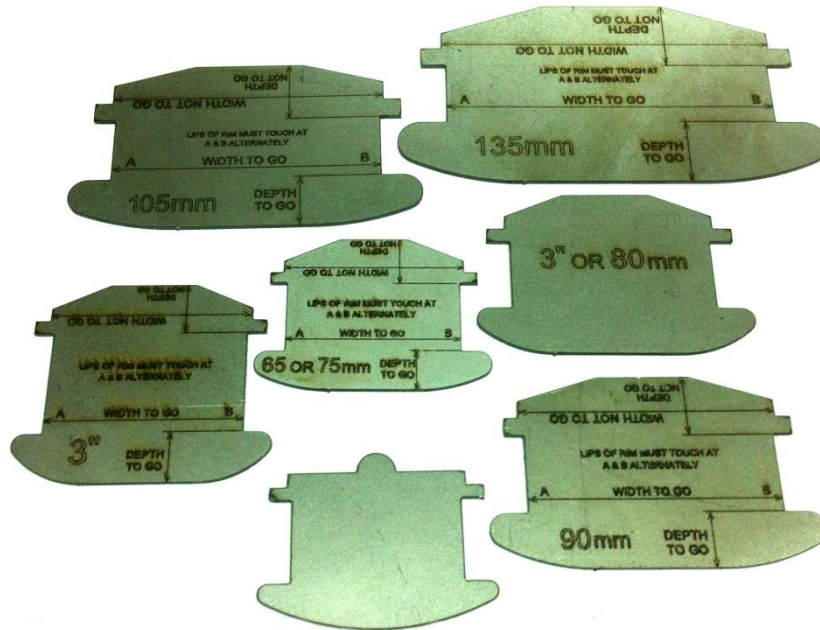


Figure 14, beaded edge rim profile gauges.

NOTE: Beaded edge tyre manufacturers will design tyre moulds to match S.M.M.T. rim dimensions and tolerances.

THE BEADED EDGE TYRE: Early tyres were built using multiple layers of cross woven cotton canvas (Dunlop tyres used a material known as ‘Gents Yacht Sailcloth’) rubberised and built into the tyre in multiple layers. This process continued into the 1920’s when multiple layers of ‘weft less’ cotton cord were used (hence, ‘Dunlop Cord’ on the sidewall of Dunlop beaded edge tyres). ‘Modern’ beaded edge tyres use much stronger modern materials (rayon, nylon and aramid). These materials give a much stronger casing and do not suffer degradation from water ingress (as did cotton).

Recently made tyres will feel more ‘flexible’ than old tyres due to age hardening and the use of less casing ply layers. The single most important parameter for ‘stiffness’ is inflation pressure.

Beaded edge tyres are ‘INFLATION HELD’ meaning that they are only held in place by air pressure, the minimum pressure should be that recommended by your tyre supplier, and if the car is heavily loaded, an increase in pressure will give added safety. On no account EVER, should inflation pressure be reduced to improve comfort – this is only asking for problems, the old adage still holds true; *“if in doubt put more air in!”*.

Also important is the ‘stretch’ fit of the tyre to the rim – it should require significant effort to stretch the tyre bead over the rim flange turnover and when seated it should not be possible to rotate the fitted tyre on the rim, even without inflation pressure.

Caution should be exercised in the use of lubricant during fitting and if water is not enough then only lubricants that positively dry out should be used. Any circumferential slippage between tyre and rim during use will take the tube with it and can easily tear the valve from the tube causing rapid deflation and probable dislodgement.

If you own a heavy car on ‘small’ section tyres you should consider a tyre and rim change to upgrade to a larger section tyre (smallest beaded edge section is around 65 m/m (2.5”) the largest is 135 m/m (5.3”). Due diligence should be given to the correct tube, tyre, wheel – fitting procedure to void ‘pinched’ tubes.

Even with the best intentions the worst can happen!!

The beaded edge tyre has its place in automotive history, but its limitations for modern motoring conditions must be recognised and respected, particularly perhaps to a generation of drivers unfamiliar with beaded edge principles.

‘SAFE AND HAPPY MOTORING’

Acknowledgements:

- The history of the Pneumatic Tyre - Eric Tomkins
- The Tyre Book - Vintage Tyre Supplies Ltd
- Care of Beaded Edged Tyres – Dunlop

VINTAGE TYRES

CLASSIC TYRES FOR CLASSIC VEHICLES

Vintage Tyre Supplies Ltd, is based in the UK and specialises in the supply of Vintage and Classic car and motorcycle tyres. We are the exclusive worldwide distributor of the Dunlop classic range. When John Bramma retired, he became a consultant working closely with us. John's knowledge of Beaded edge tyres and their shortcomings is immense and for that reason he was at the centre of things when we were developing our own range, WAYMASTER.

Chris Marchant
Managing Director

Visit www.vintage tyres.com