THE BRAKE THAT GOT AWAY

The Positech mechanism was all set to revolutionise cycle braking – but it never happened. David Gordon Wilson tells the story.

“In the 1971 Tour de France, several severe accidents were attributed to poor stopping ability in wet conditions.” So reported Fred DeLong, then technical editor of *Bicycling!*. And while the professional racers of the Tour were taking some tumbles, less-skilled cyclists riding in traffic were being killed, all as a result of deficient braking in the wet. Why was this happening?

In the 1960s, almost all bicycle wheel rims were made from thin steel sheet, rolled into the desired cross-section, then formed into a circle, trimmed, butt-welded and chromed, as they had been for much of the history of cycling. Brake blocks were of black or red rubber, sometimes incorporating fibres. Braking in dry weather was superb, but in wet weather it was abysmal and extremely dangerous.

This seemed to me, a mechanical engineer, a crazy state of affairs. I put the topic of wet-weather braking on my project list for students at MIT in around 1968, and that year the first of three excellent students chose to work on the problem. David Asbell measured the coefficients of friction of commercial brake blocks on chromed-steel bicycle rims in wet and dry conditions, and found that the standard black-rubber block suffered a loss of well over 90% of its friction capability when wet – clearly unacceptable for a road vehicle’s main braking system.

He also tested some automotive friction materials, and found one which had only one-quarter of the dry friction that rubber could generate – but about three times the wet friction. We later found a material used in aircraft brake pads that also had about a quarter of the black-rubber dry friction, but virtually identical friction performance wet or dry.

So, for a given pad pressure, it looked like wet-weather braking could be dramatically improved at the cost of some diminished dry performance, using different pad material. To ‘restore’ dry weather braking performance to ‘black rubber’ levels, the new material would need to be applied with four times the force. The rims were strong enough to take the force, but could we produce a mechanism to apply it?

Four times the force

The following year, two students enlisted to work on the topic, and we discussed how we could use the ‘new’ material. We could not simply increase the leverage of the brake operating mechanism, because then the pads would move only a quarter as far. Bicycle wheels cannot be produced and maintained ‘true’ enough to have a pad such a short distance from the rim without it rubbing.

We then hit on the breakthrough concept: a mechanism that would bring the pads rapidly up to the rim, moving with little force, and then when they hit the rim, automatically switch over to a high mechanical advantage. In other words, once the pads hit the rim, instead of a hand movement on the brake lever moving the brake pads rapidly and with little force, further hand movement would move them just a small distance, but with massively more force. This system would produce a sufficiently forceful squeeze to take advantage of the new material, but still give plenty of clearance between pads and rim when the brakes were ‘off’.

John Malarkey worked on a nice design to do this using hydraulic brakes. However, we found that it had previously been patented for automobiles. Brian Hanson, for his bachelor’s thesis, measured more precisely the friction behaviour of the new material, and subsequently, for his master’s thesis, worked with me on a mechanical braking system. He achieved his objective: the innovative brake worked, although appearing, as one would expect from an academic project, rather ‘clunky’. MIT wasn’t interested in patenting it, and we did so ourselves.

How the Positech brake works

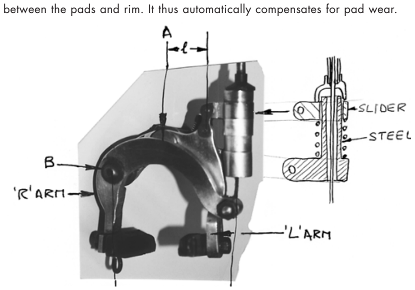
The left-hand arm ‘L’ pivots around A, and the right-hand arm ‘R’ around B. This ‘R’ arm has a strong torsional spring holding it open against a stop (neither the spring nor the stop can be seen).

The chain link on the ‘L’ arm is attached to a slider which smoves up and down a steel tube inside the protective barrel. A relatively weak coil spring pushes the slider to the top of this tube.

When the brake lever on the handlebar is pulled, at first it does not overcome the torsional spring, so that the brake cable does not pull up on the ‘R’ arm. Instead, the slider is moved down over the tube, and the link pushes the ‘L’ arm quickly against the rim with a low force level, because of the small leverage represented by the distance ‘l’. Further pulling on the lever causes the brake to rotate on its pivot (unseen) so that the ‘R’ arm also contacts the rim.

Further pulling of the brake cable can’t move the slider further, so it now overcomes the torsional spring on the ‘R’ arm, and presses the blocks to the rim with the large force represented by the distance ‘r’.

In use one does not notice any of these actions: the brake seems to operate with a smooth motion that gives almost instant braking even with large gaps between the pads and rim. It thus automatically compensates for pad wear.



Campaigning in vain

Subsequently I spent a lot of time over many years repeatedly redesigning the brake and making new ‘sexier’ versions. I tried to interest major manufacturers such as Schwinn, Raleigh, Weinmann, and Sears Roebuck. I had no success, so I tried assigning the patent to a local ‘high-tech’ design firm, Foster-Miller Associates. They tried, unsuccessfully, adding their weight to the campaign to have the brake adopted by a large manufacturer.

Then, I passed the patent to a local two-man firm, Positech. Their designer, Allen Armstrong, phoned me in 1974, and introduced himself as the designer of a positively-shifting derailleur. That encouraged me greatly, as I had also spent much effort on the same quest in 1948-9. He had heard about our brake efforts, and we signed an agreement in 1975.

Allen Armstrong produced a beautiful new design of our double-leverage brake. He kept the same locking-slider system for changing to the higher leverage, but he added a feature to decrease the leverage during the pad-approach stage of the braking action. For this design he obtained a new patent. He had several of the brakes built and sent for trial to brake companies such as Shimano and Weinmann, and to bicycle companies including Schwinn and Raleigh.

I also demonstrated the brake fitted to the front wheel of a Raleigh Gran Sport with steel rims (standard at the time) to Raleigh management at their US HQ in Boston. I could show exactly the same emergency stopping distance with the wheel wet as when it was dry.

All the advantages

The brake had additional advantages: it was self-adjusting, and the pads seemed to last for ever: over two years for me – at a time when I was bicycling over 15,000km per year. It required no modifications to the bike or the brake lever. It could be made much lighter than was our prototype. We thought that the brake would be irresistible.

All the companies that carried out tests obtained the same or better results. Two confessed that their technical people could not explain how the brakes performed so well. But not a single company wanted to take out a license to manufacture them.

Fred DeLong publicised the brake in Bicycling! under the heading ‘The Positech Brake: good news for cyclists... if it ever hits the market’. A cycling lawyer read the piece, and unsuccessfully petitioned the Consumer Product-Safety Commission, the governmental body with jurisdiction over bicycles, to require the use of brakes meeting specifications for good wet-weather performance. I even visited the Raleigh HQ in Nottingham, UK, and was entertained to an impressive lunch in the panelled boardroom with the senior people in the company. None still rode a bicycle, and no one wanted to discuss our brake. Someone stated that they were working on another solution to the wet-braking problem.

A new solution

Within a few months the new solution was revealed: the whole bicycle industry switched to using aluminium-alloy rims. They are much better than steel rims in wet weather. They provide a reasonable solution for people who will travel less than 2000km on their bicycles.

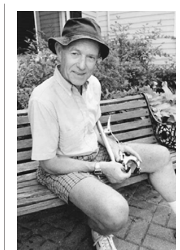
Those of us who use a bicycle for everyday use are less well served by aluminium rims. The braking surface wears very fast. Also, the pads pick up pieces of grit, which cut grooves around the rims. The rider has no indication of how much wear has taken place until the rim explodes under the huge sideways force of the tyre pressure. A rim exploding on the rear wheel just stops the bike unexpectedly. When it happens on the front wheel it can be fatal. How can this be a good solution?

Where now for Positech?

Although the people behind Positech are active and productive, they are involved in other directions now and the company is long gone.

While I sometimes yearn for the days when I used a steel rim and a Positech brake on the front wheel with almost no concern about any aspect of stopping ability, wet or dry, I must confess that there was always one worry. All rim brakes heat the rims in long high-speed descents, and the heat can burst or deflate tyres, which, on the front wheel, can lead to nasty injuries.

There is a brake now being introduced that avoids tyre bursts, rim explosions, and lost wet-weather braking: the disk brake. It’s pretty expensive right now. But I’m going to fit one, to my front wheel, as soon as I can afford it. When I do, perhaps it’ll be time to admit that the Positech, that so promising idea which never quite made it, has finally met its match.



About the author

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