Suspension water wheels and rim gearing

Steve Mills **Gloucestershire Society for Industrial Archaeology**

January 2021

Our recent Zoom evening featured two short films made by the late Alan Garnett - one showed Fromebridge Mill in 1993. During the film, we saw glimpses of the surviving water wheel (sadly, no longer visible to the public), but there was little time to talk about what is an interesting survivor. The wheel is an example of one that adopted several important technical advances developed during the 19th century, namely the suspension design, and rim gearing.

Suspension water wheels

The first examples of these appeared in the early years of the 19th century and involved the oddly-named Thomas Cheek Hewes. He was a well-known millwright and machine maker who first set up his business in Manchester in 1797. From here, he supplied a range of textile machinery, installed Boulton & Watt steam engines, and developed and manufactured water wheels and allied equipment. In particular, he is linked to the introduction of the suspension water wheel (where metal rods act as the arms of the water wheel - in a similar manner to a bicycle wheel). This was one of the most far-reaching innovations to be made in the area of water power. One of his most important early commissions was the construction and installation (c1811) of two of the first large iron suspension wheels, in Strutts mill at Belper.

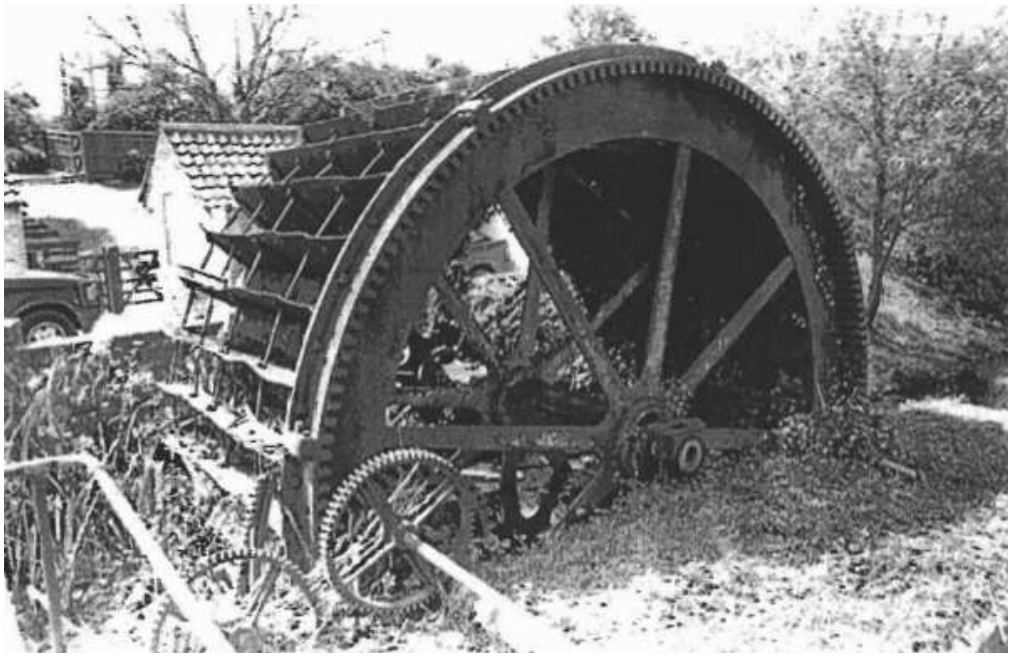
Earlier water wheels were usually made predominantly of wood, with all of the wheel's weight carried on a substantial wooden axle. This clearly had limitations in terms of overall strength. Even after the introduction of cast iron axles around 1770, there were still limits to this type of arrangement, so the newer suspension wheels had a lot to offer - they were usually stronger, lighter and able to handle greater amounts of torque. Gradually, wooden components were increasingly replaced with iron.

The other innovation was the introduction of rim gearing. This entailed adding what was essentially a large, inwards-facing toothed cog to the rim of the wheel. A smaller pinion gear engaged with this and as the wheel turned, so power was transmitted into the mill by a high-speed shaft that carried the pinion. This design removed the rotative stress from the axle which could thus be lighter, and also allowed more flexibility in the location of the power train – it meant that power could be transmitted at higher speeds and over greater distances.

It remains unclear who the suspension wheels' actual designer was – both Strutt and Hewes have been credited with this. However, Hewes was certainly responsible for the widespread application of lightweight iron suspension wheels with rim gearing. By the 1820s, he was active in mills and manufactories throughout much of the country, including Gloucestershire, where suspension wheels were increasingly installed in many local mills.

In some cases, Hewes was directly involved in a particular mill project, whereas in others, he supplied the water wheels and allied equipment. An example where he was active locally was at Churchend Mill in Eastington, where an existing small mill was completely rebuilt for woollen cloth manufacture in first decade of the 19th century. It seems that Hewes was responsible for the modifications and improvements made to the mill's water supply and the installation of new water wheels, possibly extending to the internal gearing and power transmission systems.

Other manufacturers took up his designs, sounding the death knell for earlier, less efficient variants, and suspension wheel technology came to be adopted in many mills, including here at Fromebridge. In its mid 19th century configuration, Fromebridge was powered by two iron suspension wheels, although as we saw in the film, only one now survives, an interesting innovation that helped water power retain its importance for many more years.



Picture 1 ***The surviving water wheel. The rim gearing system is clearly visible***

Picture 2 ***The wheel's opposite side. The second (inner) wheel was later replaced by a water turbine***