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## *A history of veneer cutting*

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## History of Veneer Cutting (Fig 1)

Veneers are slices of wood cut to a particular thickness, that are used in two major ways: firstly, for structural wood products such as plywood or laminates and secondly for decorative surface veneers, the latter often having a high value or prominent or unusual appearance. The use of veneers has a long and illustrious history and for hundreds of years veneers were prepared by hand. Since the early nineteenth century veneers have been generally produced by three methods: sawing, slicing or rotary cutting.

### Hand-sawn veneers

Although it is not known exactly how the ancient craftsmen cut veneers, by the mid-seventeenth century, the production of veneer was a hand-cutting process whereby the timber baulk was held upright in a vice and the sawyers cut slices down the length of the timber. The hand veneer-cutter was able to cut five to six veneers to the inch, whilst for finer work, from smaller baulks of timber, a cabinet-maker could cut seven or eight veneers. (Figure 2) In 1847 Charles Holtzapffel noted that these hand veneer saws 'are now scarcely used in England ... but is still much practised on the Continent' (p. 795 & 805). However, it was not until the 1930s that it had disappeared altogether from England. Some contemporary wood-workers have employed band saws to cut veneers on a small scale very successfully.

### Machine-sawn veneers

However, there were attempts to mechanise the process quite early on. The first English patent that relates to the production of veneers was granted in 1635 to Sara Jerom and William Webb, for an 'engine for cutting timber into thin scales, for making band boxes, scabbards for swords and the like' (Pat. no. 87). Three years later in 1638, Sara Jerom took out another patent for the same description (Pat. no.120). These early patents were isolated, and even though cabinet making developed into a highly skilled craft requiring well cut veneers, the period between 1700 and 1830 was the heyday of the hand sawyer and hand veneer-cutter.

The growing demand for decorative furniture during the nineteenth century put a strain on the hand-cutting process and led to developments in the application of machinery. The potential results were obvious. More veneers were produced, more quickly and much more economically. In 1806, Marc Isambard Brunel obtained a patent for machine-cutting veneers and thin boards (Pat. no 2968). Here were the first beginnings of successful mechanisation. Soon after this, Brunel, with partners, set up a veneer and saw mill in Battersea.

The principle first used by Brunel was based on a horizontal knife to slice veneers from a log. The basis of the process was that the knives would be held in line and they would extend beyond the block to be cut. The knife would then slice veneers as the log was brought forward to the blades. The machine, according to Holtzapffel: '... answered moderately well with straight grained and pliant woods, such as Honduras mahogany, but there were serious objections to its use for woods of irregular, harsh and brittle grain such as rosewood'. He goes on to point out that this was a shame 'as the splitting machine converted the whole of the wood into veneer without waste, whereas the veneer saw on average cuts one third of the wood into saw

dust' (1847, p. 806). Although faulty to start with, this technology was eventually to be revived and become supreme.

Brunel's next attempt after abandoning the knife-cutting process was the application of the circular saw. His initial experiments were again unsatisfactory due to the friction of the saw causing it to buckle and twist. To overcome this, Brunel nicked the saw-blades to avoid buckling, and eventually developed this idea so that his final saws were made up of segments of saw blade, attached to a circular casting, which could be of very variable size. The segmental form of saw blade was the most practical one for repair and replacement. The casting that supported the blades was thick in the centre and had a gradual taper outward, which made for strength, rigidity, and uniformly thin cutting. This arrangement remained the principle of rotary saw cutting (Figure 3) and remained in use well into the twentieth century. It may be no coincidence that the prepared logs for veneer cutting are often called fitches and Brunel's operation was similar in principle to bacon slicing!

The fact that the saws were powered by steam engines added to their success. A visitor to the mill described it thus:

... in a small building on the left, I was attracted by the action of a steam engine of 16 horse power and was ushered into a room where it turned, by means of banding, four wheels fringed with fine saws. I beheld planks of mahogany and rosewood sawed into veneers sixteenth of an inch thick, with a precision and grandeur of action that was really sublime...A large sheet of veneer 10 feet long by 2 feet broad was separated in ten minutes, so even and so uniform that it appeared more like a perfect work of nature than one of human art! (Local history collection, Battersea Library)

This was not a unique example, as in 1827, a provincial sawmill in Barnard Castle Co. Durham, employed 'one veneer saw plate and segments'. (Medlam, p.34.) The incredibly long-running success of Brunel's saw system was noted by the trade press in 1881: 'The soundness of this conclusion [Brunel's segment blade device] has been proved for half-a-century, as nothing in the way of substantial improvement has been added to the machine'. [In the full development of this mill] 'Eleven machines were at work on the ground, the diameter of the saws being from 7' to 17', the largest of the saw teeth being of the gauge of five to the inch'. The report noted that veneer was cut at the rate of about one foot in four seconds, a great improvement in speed:

Saws for veneers are built of a circular cast-iron wheel upon which are fixed segments of soft steel. Upon the soft steel are fixed hardened steel serrated blades, which are the cutting edge of the saw. This saw is capable of handling up to 24 feet long and 5.5 feet wide timber. The number of veneers usually cut varies between 15 with a six-inch wide plank and eight with a sixty-inch wide plank. (*House Decorator*, 15 April 1881)

Other veneer cutting enterprises were attempted in the period 1820-1850. In 1820, the cabinet maker, S. Jamar of London and Liverpool sought financial support for an enterprise that would use his machine that he claimed could cut 'six veneers or more in the inch in mahogany or any other wood'. (DEFM) Although he appears to have been unsuccessful, others kept inventing variations on the machine. A further six patents were granted between 1818 and 1847. Henry Mayhew, writing about the application of machinery to the carpentry and joinery trade in 1850, suggests that

veneers are 'now exclusively made by means of steam machinery'. (Letter LXII *Morning Chronicle*, July 25<sup>th</sup>) Discussing veneer mills further, he noted that the mill he visited in London, situated next to a canal, was the largest in the world with six acres of ground. He described the saw room as 120' long and 90' wide, containing eight circular saws, varying between 7' and 17' in diameter. This was veneer cutting on an industrial scale.

Apart from the application of steam engines, the veneer sawing process was further developed in the mid-century. The horizontal saw-frame was introduced to do the finer cutting work that the circular saw could not achieve. This was accomplished by the use of fine-ground saws, and resulted in the production of one or two more veneers per inch. The disadvantages of saw cutting, i.e. limited veneer sheet size, slow speeds, and waste through saw dust, were overcome by the development of the knife-cutting process, essentially either a slicing or a peeling operation.

Mayhew was probably somewhat premature in his comments, as in 1878, the *Furniture Gazette* claimed that 'knife cut veneers will soon be universally used [as opposed to saw cut], even though the saw cut takes polish better and is more solid'. (19 Oct. p.265) This change was a while in coming. (Fig 4) A description from 1924, discussing saw cutting, noted that 'The saw usually makes a kerf about 1/20 inch thick. The sawing process, though simple, is wasteful of material and time and, therefore, expensive. It is used chiefly in the cutting of certain high-grade finish and furniture woods into veneer'. Despite a thick kerf, a little less than one-half the flitch being cut into veneers, and with the remainder being sawdust and 'dog board' (the remains of the flitch which cannot be converted), saw cutting lingered. One reason maybe that sawed veneer is different from that cut by other processes, in that both sides are equal in quality and appearance. However, by 1935 sawn veneers were no longer viable in the UK.

An early attempt to replicate the vertical cutting process was devised in France in the late-eighteenth century. The rising wood veneer-cutting machine or *scie à bois montant* was patented by a Msr. Cochot of Auxerre in 1799 and is still found occasionally in use in France today by suppliers of restoration-grade veneers. (Fig 5 and 5a)

4) (One of the reasons this system is still used is that the logs are not steamed before cutting therefore they retain their colour and tannins). The log was lowered into a pit, and then fitted onto a rack and pinion mechanism, geared to the cutting speed of the saw. As the log rose up against the blade, so the sheet of veneer fell away. (Fig 6)

### Knife-cut veneers

Cutting veneers with a knife blade overcomes the objection to sawing and reflects Brunel's original idea. It was also the French who revived Brunel's original, though unsuccessful idea of horizontal knife slicing of a log. The benefits of the process were extolled in 1875. It was reported that Arbey's knife-cutting process could not only cut 100-150 veneers per inch, but also leave the surface so even that it was ready for use straight from the cutters. (Fig7) It is also interesting to see that Arbey offered a choice of steam-powered or hand-operated machines. (*Practical Magazine*, 1875, pp.207-8) It was only two years later that the well-known London saw millers and timber suppliers, Esdaile's, were advertising the new process. They said that 'veneers can now be cut by the new knife-cutting process whereby all waste is avoided and a product is given of from twenty-eight to one hundred veneers to the inch'.

There are two types of veneer knife slicer: The slicer where the knife is fixed and the bed is moveable, and the slicer where the bed is fixed and the knife is moved by power whereby the flitch moves only to regulate the thickness of cut. (Fig 8) The process starts with the log or flitch being fitted onto the frame of the cutting machine. On each down stroke the flitch is drawn against the edge of the knife, which is held in rigid alignment with a pressure bar, and a slice of veneer is thus cut off. On the up motion the knife automatically recedes, so that there is no interference with the flitch, and the knife then automatically advances to give the thickness of the veneer and is ready for the next cut. The veneer passes through a slot between the knife and the pressure bar. The veneer is turned over, and each successive slice is piled in order. In this way the veneer slices are kept in the same relative position as in the solid flitch, thus ensuring matching and colour. Generally, veneer produced on a slicer is in long, narrow-strips. The veneers may be edge-grained (quarter sliced), flat-grained (plain sliced), or rift-grained, depending on the manner in which the flitch was mounted with respect to the knife. Timbers intended for slicing are prepared by halving, quartering, or made into flitches and are then steamed or soaked in hot water for up to several days. In the case of plain slicing or the flat cut technique, veneer is sliced parallel to the centre of the log to achieve flat-cut veneer. The so-called 'cathedral effects' are formed by the innermost annual growth rings as the veneer is cut through the flitch. A variation is half-round slicing which cuts on an arc roughly parallel to the centre of the log to achieve flat-cut veneer. This results in a cut slightly across the annular growth rings, and visually shows modified characteristics of both rotary and plain sliced veneer. Rift-cut veneer is designed to utilise the various species of oak. As oak has medullary ray cells that radiate from the centre of the log like the curved spokes of a wheel, this straight-grain cut is at a slight angle to the medullary rays in oak to minimize ray fleck (flake). Quarter slicing bisects annual growth rings and results in a straight grain or ribbon-striped (mahogany) appearance. Due to low yield from the log, this process of veneer cutting is usually more costly. Walnut, mahogany, oak and teak are most often used.

### Rotary knife-cutting

The rotary-knife cutting or peeling process was important not only for veneers but also for the development of plywood. (Fig 9) In a report published in 1817 it was said that a Russian piano-maker in St Petersburg was producing 'sheets of veneer of about a hundred feet in length, and four, five or even more in width'. (Himmelheber, p. 93)

In England in 1818, Henry Faveryear developed (Pat. no.4324) a machine for rotary cutting logs but it seems it was not adopted. However, in 1822, a prototype of a 'peeling machine' was made by the Vienna Polytechnic Institute. A short time later the process was developed in the USA and as the 'Improved Patent Rotary Veneer cutter propelled by steam power', it was used by Richardson and Co. of Philadelphia by 1825. John Dresser of Stockbridge Mass. designed the first rotary veneer-cutting machine that was patented in the United States in 1840.

In 1843, an encyclopedia entry on wood cutting described veneer cutting as being performed 'in a much superior manner in Russia by a planing machine [that] would cut so thin that they have been employed for the covering of books...One hundred feet in length of veneering may be cut by this machine in the space of three minutes'. (*Penny Cyclopaedia*, 1843)

Developments continued with Msr. Fontainmoreau registering a British patent for continuous rotary veneer-cutting machinery in May 1847 (Pat. no.11716). His

main claim was that the log of timber could be cut, whatever its width. It did not need to be crosscut to fit the jaws of the machine and therefore it yielded larger slices of veneer. The Russian connection mentioned above is also supported by a comment from Holtzapffel in 1857, who, writing about ivory veneer, states that ‘ the mode introduced in Russia for cutting veneer spirally from a cylindrical block of wood, with a knife of equal length has been latterly applied to the preparation of ivory.’(p. 154)

Apart from the speed and volume, the *Mechanics Magazine* noted a major benefit of rotary cutting. In a notice published in 1848 they referred to a veneering machine that was able to cut a roll of maple veneer 300' long and 3' wide from a log 3' long and 20" in diameter which easily reveals the bird's-eye figure. (12 February, 1848, p. 155) Despite these advantages, George Dodd pointed out that ‘...the English usually adopt the method described, [Brunel's vertical cutting saw] but on the Continent a singular mode is practised of cutting a continuous veneer in a spiral form. The English plan wastes a little more wood, but yields stronger veneers than the foreign’ (1860).

One of the major developments in rotary cutting was the process of soaking logs prior to cutting, to open the pores and soften them to facilitate cutting. Frenchman, Msr Garand apparently developed this idea in 1860 and it soon became standard, although it affected the colour of the veneers and leached tannins.

Arguments about the nature of the quality of veneers resulting from rotary cutting were commonplace. Holtzapffel suggested that both the knife and the rotary systems had problems since any irregular or brittle grained woods would curl and split and, in many cases, did not expose the ornamental grain. On the other hand a correspondent in the *Universal Decorator* pointed out that with rotary-cut veneers, ‘figures are obtained even in bay mahogany, which cannot be cut in any other way: therefore these veneers must prove a great boom to the cabinet maker and workers in fancy woods’. (p. 250)

The British trade press continued to report on the rotary system as though it were new, and as late as 1881, the *House Decorator* reported that:

a new and highly successful machine is the rotary, on the principle of the knife - a system highly favourable to wood in the round and to figure, as in the case of bird's-eye-maple, found only on the face of logs. The number of veneers in this case is greatly increased, as there is nothing lost by the saw or with the rib or set of the same marking the face of the veneer. (15 April, p.285)

According to this article the veneers were so thin that it was not practicable to use inlay or banding for further decoration. Whatever the problems or merits of the rotary system, it had shown that the application of knives in veneer cutting was successful.

Today the range of techniques related to rotary knife cutting is designed to obtain the best effects from the log or in other cases the best utilisation of the timber. The rotary system produces veneer by centring the log in a lathe and turning it against a broad cutting knife, which is set into the log at a slight angle. Rotary-cut veneer can be sufficiently wide to provide full sheet (one piece) faces. Since the rotary cut follows the log's annual growth rings, a wide, bold grain pattern is produced. Rotary-cut veneer is a cost effective method to obtain remarkable effects from birch, maple and oak.

Knife-cut veneers, whether rotary-cut or sliced, have a firm or tight side and a loose or open side. The tight side is the surface farthest away from the knife blade. This may be important as the veneer may suffer ‘lathe checks’ caused by the stress of

the cutting action. The degree to which the severities of the lathe checks occur, depends on the thickness of the veneer and the quality of the cutting. On veneer 1/32-inch thick, for example, lathe checks may not be detectable by eye, whereas on 1/8-inch veneer they may be clearly visible. In face veneers it is important that the severity of the lathe checks be kept at a minimum and, in gluing, the tight side should preferably be toward the outside, as it is less likely to show defects in finishing.

In 1789, Robert Burns praised veneer for its beauty: 'Veneering oft outshines the solid wood'; this sentiment is probably even more valid in these ecologically conscious times than it was in the eighteenth century.

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