

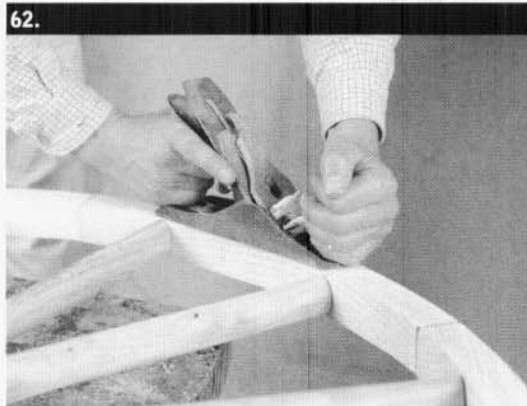
# Dressing the felloes

The next sequence of operations is to plane those three faces of the felloes which can be touched with a plane.

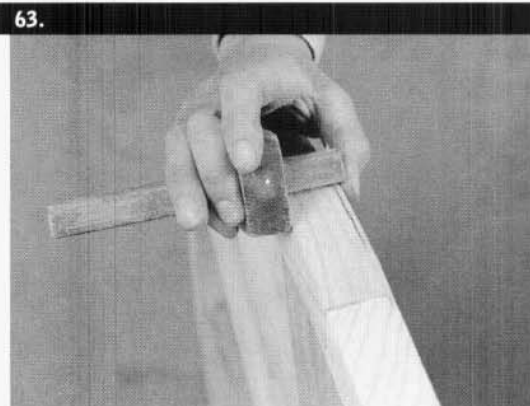
The wheel, face up, is fixed on the wheel stool and the face side of the felloes is planed, so that all their faces lie flat and true with one another. Some wheels may require a bevel to be planed around the face side, this is marked off on the sole of the felloe and planed next.

The sole is marked with a marking gauge or pencil gauge, for the bevel which is to be taken from the back of the felloes.

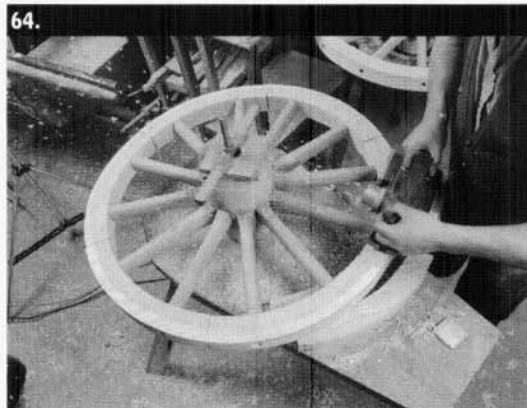
The wheel is clamped, face down, on the wheel stool and planed on the back, down to the line just marked. A power plane may help to take the bulk of the material off.



The face side of the felloes is planed, so that all their faces lie flat and true with one another.



The sole is marked with a marking gauge.



The wheel is planed on the back.



A smoothing plane is used to clean up the cut made by the power plane.

66.

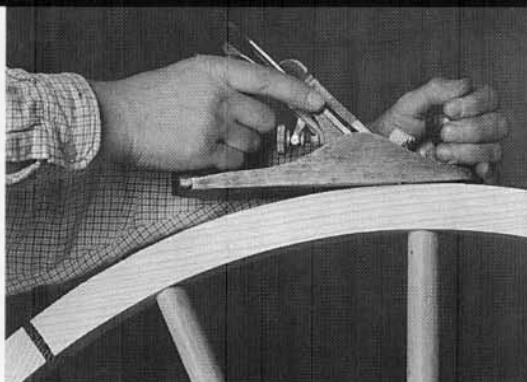


The wheel is rotated slowly upon a spindle.

Next a spindle is fitted into the post vice to accept the wheel, which is rotated slowly upon the spindle. The wheelwright sights across the sole of the felloe to a mark (here a chalk mark has been made on the wall) and turns the wheel slowly. In this way he can see any sudden irregularities in the roundness of the felloes. He then marks the bumps to be planed off.

This procedure is followed until the wheel is acceptably round, a check can be made on the smoothness or truth of the curve of the felloes by drawing a hand along on them, placing the whole length of palm and fingers in contact with the felloe and moving wheel or hand slowly. The irregularities will become apparent.

67.

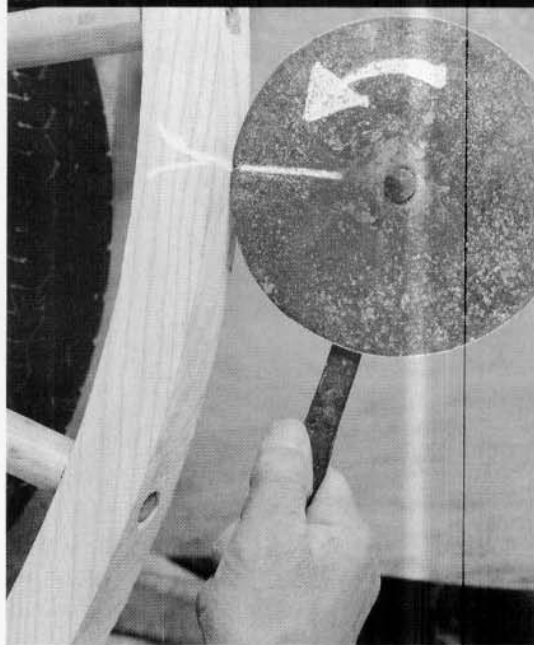


The high spots are planed off, it is convenient to remove the wheel from the spindle and prop it against the bench.

It may be necessary, if much material has been removed in this last operation, to adjust the width of the sole again, the marking gauge is used as before and the plane used to remove excess material. The spoke tongues may need to be trimmed so that they lie  $\frac{1}{16}$ " or so beneath the surface of the felloe, the tyre will only be able to press the felloe onto the nock of the spoke if the tongue does not interfere.

At this stage the wheel is ready to have its tyre fitted. The procedure is the same for channel bonds as for flat steel ones, the channels are bent in rolls in the same way as flat bars. Only when the tyre is bent to the correct radius can it be measured for cutting to length and welding.

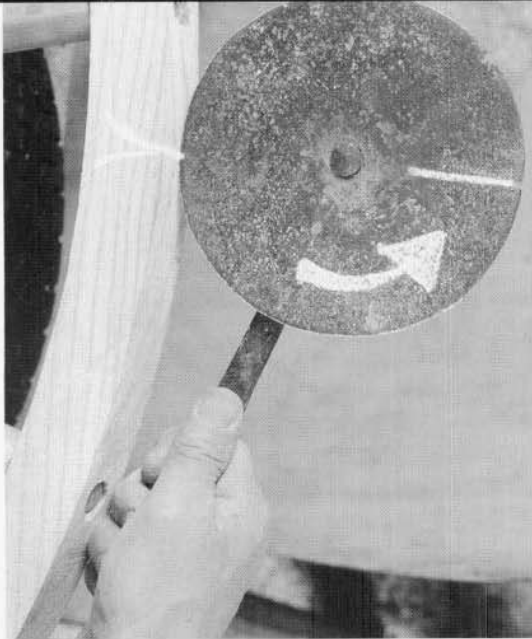
68.



The traveller at the start of the measurement.

The wheel is laid horizontally and the traveller is prepared with an arrow to show the direction in which it rotates. A chalk mark is used to emphasise the notch which the traveller has on its circumference. A chalk mark is made at the point where the measurement is to start on the felloes.

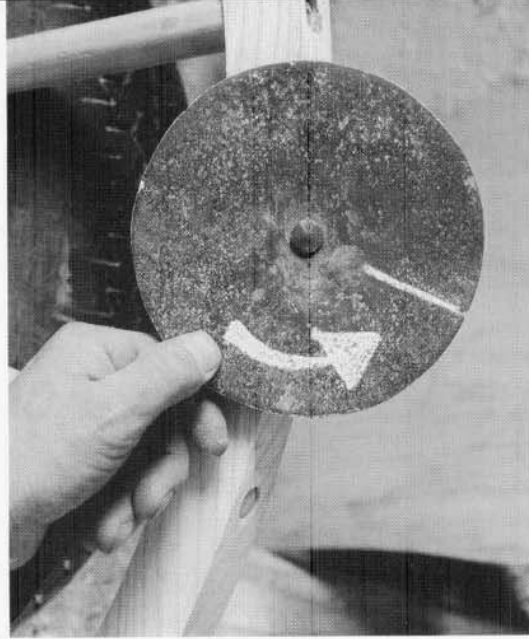
69.



The traveller at the end of the measurement. The traveller is drawn upward across the chalk mark, leaving a trace of chalk on the surface of the traveller.

The notch of the traveller is brought up to straddle that chalk mark and the traveller is run around the wheel, the number of revolutions being counted.

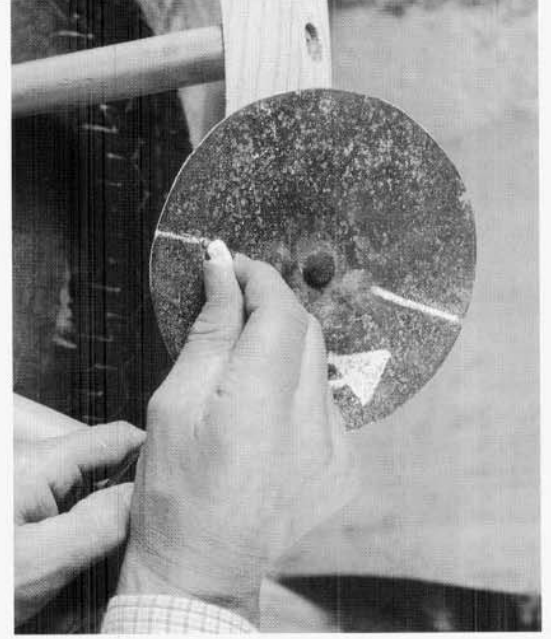
70.



The trace of chalk.

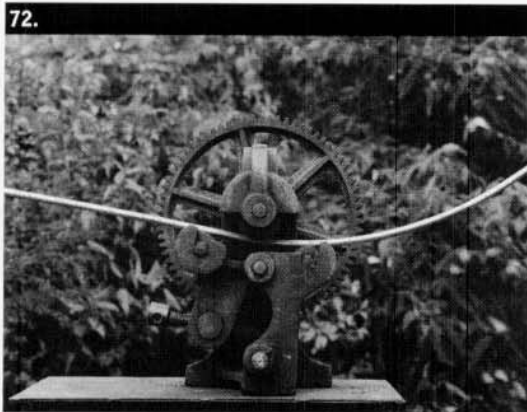
When it reaches the chalk mark where it started, it is drawn upward across the chalk mark, leaving a trace of chalk on its surface.

71.



The mark is emphasised.

This mark is emphasised, and the number of revolutions together with the distance from the notch to this mark is the extended length of the outside of the felloes.



The tyre rolls. A channel tyre is being bent.

Next the measurement is transferred, measuring around the inside of the tyre. The traveller **must** rotate in the same direction, which has the effect of making its user walk the other way about, and the arrow on its surface will indicate in this. The chalk mark is transferred to the inside of the tyre. The shrinkage measurement must next be deducted from the length of the tyre and it is cut to the resulting length.



Beginning measuring the tyre.

## Shrinkage

The tyre is made smaller than the wheel by an amount sometimes known in old workshops as the "nip". When shrunk onto the wheel this allowance enables the tyre to draw the felloes together and the felloes are arranged with slight gapes between them at the joints. These gaps in closing reduce the circumference of the felloes and consequently press them more tightly onto the spokes, so that all the joints in the wheel, between the felloes, felloes and spokes, spokes and stock, are drawn tighter. In making the wheel the joints at each end of each spoke are made as tight as possible so that this compression has the most effect. The joint gap (or amount of "joint") in the ring of felloes is difficult to measure, since there will usually be some compression possible between felloes which appear to the eye to be tight together, until they have once been drawn together by a tyre. The total will be related to the amount of pulling together of the joints at either end of the spoke which is required, and the wider the spoke, the greater this will be. The wheel shown in these photographs will need a joint gap about  $\frac{1}{4}$ " to  $\frac{3}{8}$ " in total.

There is a close relationship between this joint and the amount of shrinkage given to the tyre, one way of expressing the tyre shrinkage is to make it enough to take up all this joint and give an extra  $\frac{1}{8}$ " to keep it tight on the felloes after it has done so. This gives a total in this case of  $\frac{3}{4}$ " to  $\frac{7}{8}$ ".

It is sometimes said that a traditional rule of thumb is to take  $\frac{1}{8}$ " of shrinkage for every foot of circumference. This gives a measurement of about  $1\frac{1}{2}$ " for a 4 ft wheel, which is much higher than the assessment which we have just made and might be suitable for a new, heavy wheel with spokes  $2\frac{1}{2}$ " to 3" wide, although rather tight for most purposes even at that size.

It can be seen that, in assessing the amount of shrinkage, several factors must be taken into account and a degree of confusion is possible. In an attempt to clarify the position we will express it as follows: take the normal shrinkage allowance for a wheel to be  $\frac{3}{4}$ ".

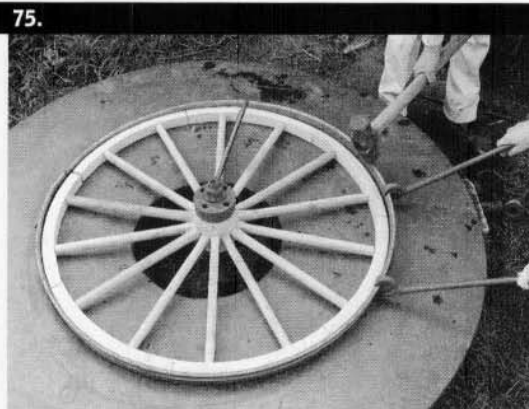
The upper extreme rarely exceeds  $1\frac{1}{4}$ " and the lower is rarely less than  $\frac{1}{2}$ ". The range of choice is therefore very limited. Make a decision within these limits based on the following factors:

1. How loosely constructed is the wheel? If it is an old one whose joints have already been drawn together, there will be less to draw up with the tyre. A new wheel may well need some drawing together, the need for this being greater, as mentioned before, as the size of the spokes increases.
2. The height (ie diameter) of the wheel - a tyre of a small diameter will be incapable of expanding in the same total amount as a large diameter one.
3. The section of tyre and felloe has an effect. Larger section tyres will not necessarily expand more than small ones (the metallurgical nature of the steel or iron will affect the linear expansion but not its sectional size), but a heavy tyre and large felloe will more readily withstand the hammering necessary to drive the tyre on if it is tight.
4. Long thin spokes and slender felloes will not withstand too much compression, the spokes may bend unduly and the felloes may distort, not infrequently bursting at the points where they are bored for spoke tongues.

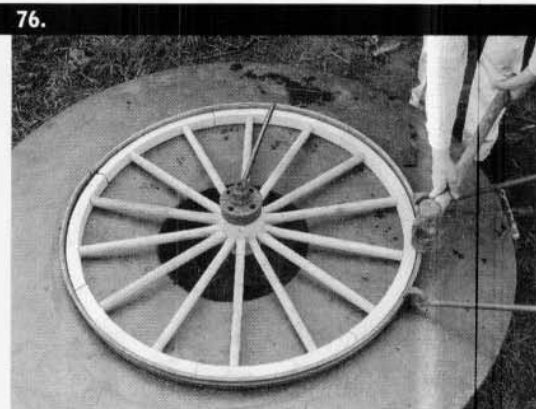
# Shrinking the tyre



The tyre dogs are applied to the tyre and one sledge hammer holds the tyre steady and over the felloes.



The sledge hammer drives the tyre on over the edge of the felloes, working towards the dogs, assisting the dogs which are levering the tyre over the edge.



The sledge hammer strikes between the two dogs to drive the tyre down at the last point. The dogs are now put aside.

When cut to length the ends of the tyre are welded together. Preparations are made to shrink it onto the wheel.

The fire is laid to burn to heat the tyre to near red heat evenly around and without putting pressure on the tyre to distort it which happens all too easily when the tyre is hot. It is naturally economical to heat several tyres at once and dry wood is usually be most convenient fuel, bottled gas may be used but several burners are needed and even then only light tyres can be heated.

The wheel is clamped through its centre to the tiring plate. At least one sledge hammer is needed and a pair of tyre dogs, watering cans or buckets and a supply of water to re-fill them - a tub is quick whereas a hose would be too slow. A hook or pair of tongs is used to take the tyre from the fire when it is hot and it is dropped over the wheel.

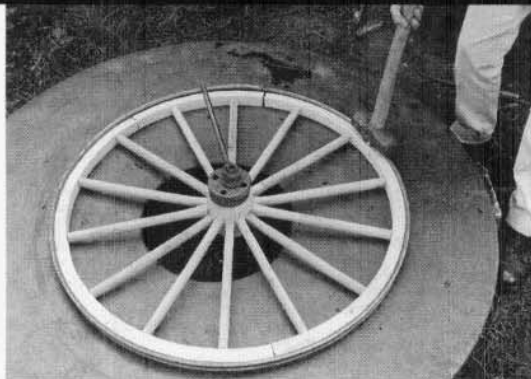
The hot tyre must be cooled as quickly as possible in order to avoid burning the felloes which will loosen the tyre.

Water cans direct the water onto the tyre more accurately and effectively than buckets. Several used at once have the desired effect.

When cooled the tyre may need to be "set" to the right position on the felloes. A wooden block, best used with the grain end-on, is applied to the felloe and struck with a hammer while the edge of the tyre is placed on a steel dolly or anvil. If the tyre has a little residual warmth in it from being shrunk on it will be easier to move on the felloes (see 79).

In setting the tyre, the front edge is usually allowed to over-hang the face of the felloes by perhaps  $\frac{1}{8}$ "; this protects the painted face of the felloes from abrasion against obstacles such as kerbstones.

77.



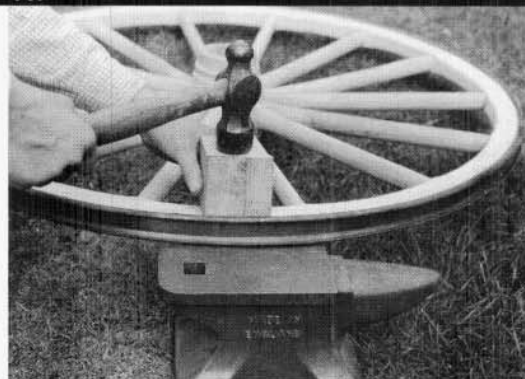
The sledge hammer taps the tyre down to touch the tiring plate all round the wheel.

78.



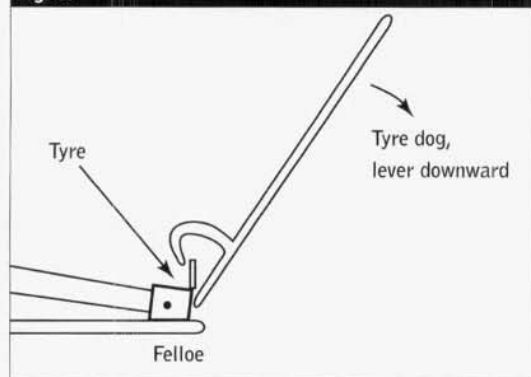
Water cans direct the water onto the tyre.

79.



A wooden block, best used with the grain end-on, is applied to the felloe and struck with a hammer.

Fig. K



Application of tyre dogs.

The felloes will need to be sanded and chamfers worked on the arrises between the spokes. The chamfers are rounded and normally stopped before they pass in front of the spokes. For wheels which require a continuous rounded edge to the front of the felloes, the round chamfers in front of the spoke faces will need to be worked on the felloes before the felloes are fitted to the spokes.

### Tyre nails

The tyre is secured to the felloes by one of several methods. Most agricultural vehicle tyres are fixed with nails, one per felloe, of a special form with tapered heads fitting into a tapered hole in the tyre. Carriage tyres were fixed with rivets in English practice, most frequently with two per felloe, fixed either side of the dowelled joint between the felloes. Small diameter wheels may only be fixed with one rivet per felloe. A common modern practice is to use countersunk woodscrews. Continental and American practice uses tyre bolts for carriage wheels.

# Glossary of expressions used in the wheelwrighting

**Arris** : the sharp edge of a piece of timber.

**Belly** : the concave radius inside surface of a felloe.

**Bender** : a machine for bending tyres.

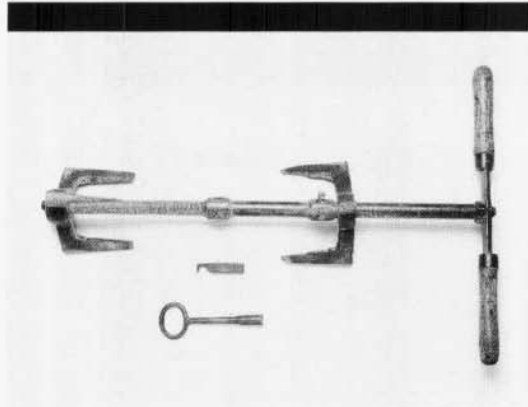
**Bevel** : or sliding bevel, a marking tool with a stock in which a blade is able to pivot and slide. It may be clamped at angles to the stock and is used to mark out angles.

**Bond** : a tyre, a ring of iron which is fitted around the wheel. It serves to bind the joints of the wheel tightly together. Smaller diameter bonds are fitted around the wheelstock to strengthen it and keep it from splitting.

**Box or Bush** : the metal bearing in the centre of a wheel which runs on the axle arm.

**Boxing Engine, Boxing Tool, Bushing Tool** : a machine, usually hand powered, used to enlarge a pilot hole through the wheelstock to the point where it is large enough to accommodate the axle box.

**Breast Mark** : a lightly incised groove around the wheelstock which marks the face edges of the spoke mortices.



Boxing Engine, Boxing Tool, Bushing Tool.

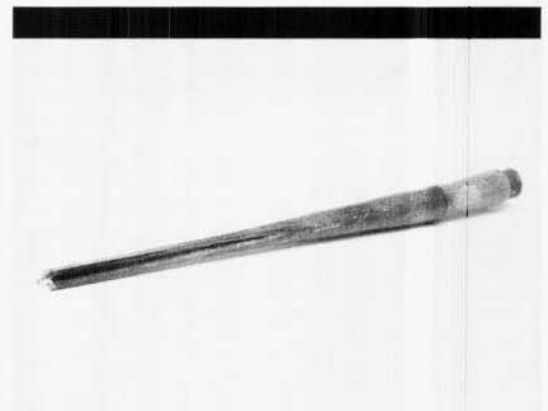
**Bridle or Spoke Bridle** : a crooked piece of wood, or a whippy piece, used to press against a spoke by levering on its neighbours. This may help to drive it into line with the others.

**Bruzz or Buzz** : a v-section chisel used to cut the corners of spoke mortices.

**Clincher Channel and Rubber** : a rubber tyre system in which the tyre of the wheel is a channel section with over-turned lips, which clasp a rubber insert whose purpose is to silence the running contact between the wheel and road. Other systems exist which use wire to hold the rubber into a channel of a simple section.



Boxing Engine, Boxing Tool, Bushing Tool (self-centring).



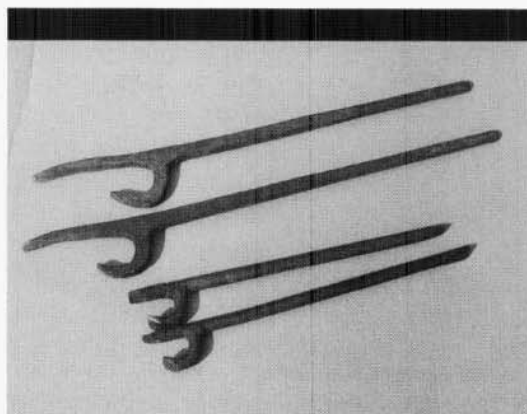
Bruzz or Buzz.



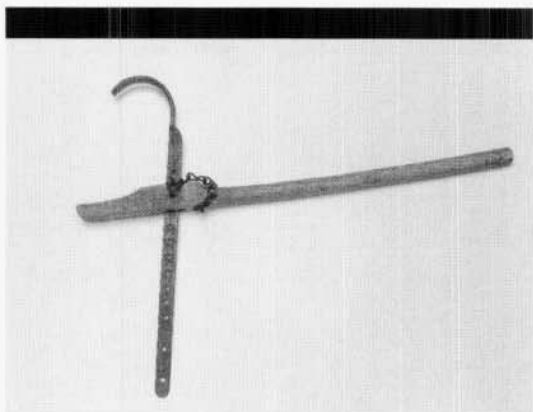
# trade



Compass Plane.



Tyre dogs.



Spoke dog.

**Compass Plane** : a plane with a curved sole used for planing inside curved surfaces, such as the bellies of felloes.

**Cutting and Shutting** : the operation of cutting a tyre from a wheel, shortening it and re-welding it and shrinking it back onto the wheel to tighten the joints of the wheel. Blacksmiths use the word shutting to describe fire welding.

**Dish** : describes the saucer-shape of wooden wheels, achieved by setting the spokes in the stock at an angle.

**Dogs** : this is a word used to mean levering tools. A spoke dog levers two adjacent spokes together to facilitate the fitting of the felloe. Tyre dogs lever the tyre over the felloe during the process of shrinking the tyre onto the wheel.

**English wheel** : a wheel with certain stylistic features traditional in England, but basically a term used to describe a carriage wheel with a stock hoop at the front and one at the back. It distinguishes this wheel from other arrangements of stock hoops used on the Continent and in the USA.

**Felloe** : one of the wooden segments which make up the ring of wood which forms the rim of the wheel.

**Felloe-Bound** : the situation when the joints between the felloes have been drawn up tight before the joints at either end of the spoke. The spokes are therefore too loose in their joints and the wheel will work loose.

**Gedge's Bit** : one form of auger bit with back-curved cutting wings. Gedges bits are particularly useful in cutting elm, but suit all wheelwrights' work well.

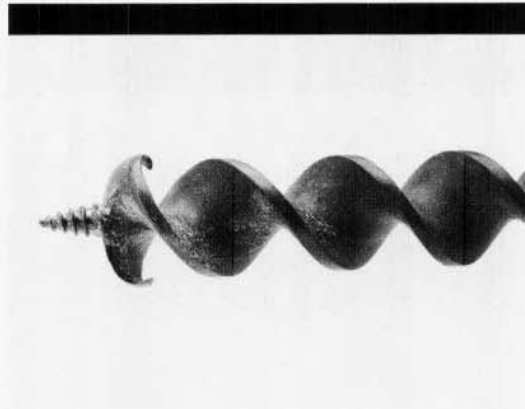
**Hollow Auger** : tonguing bit, hollow bit - a bit used with a brace or machine borer for cutting tongues onto the ends of spokes, after they have been driven into the stock. There are various types of adjustable tools and fixed size ones comprising a casting approximating in form to a very deep top hat with two cutters, set at an angle like a plane blade, in the brim. They cut the knock of the spoke and leave the tongue inside our imaginary hat.

**Hoop** : see Bond. Stock bonds are often called stock hoops.

**Hub** : one of the names for a wheelstock, stock, nave, naf, nut etc, but it usually refers to the stock with bonds and box fitted.

**Jervis** : a plane or shave, similar to a large spokeshave, with a blade about 2" wide, ground to a convex curve and a sole curved to suit. A useful tool in forming spokes, shafts and other workpieces with a rounded section.

**Joint** : the word joint describes the gaps between the felloes of a wheel which are provided to enable the tyre to compress the components of the wheel tightly together.



Gedge's Bit.

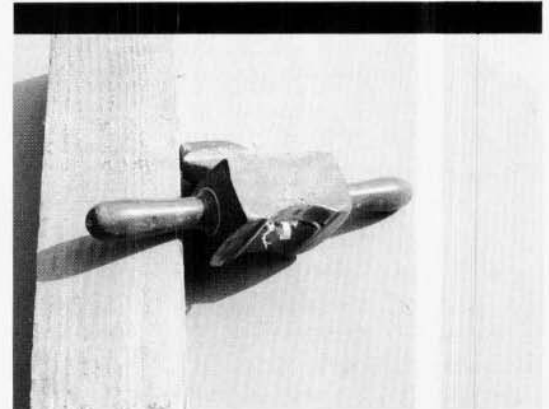
**Knock** : the flat surface left at the back of the spoke after cutting the tongue into its end, on which the belly of the felloe abuts.

**Land** : the surfaces turned onto a stock where the stock hoops are fitted.

**Nip** : the contraction allowance between the dimensions of the tyre and wheel.

**Naf, Nave, Nut** : names for the stock.

**Pencil Gauge** : a marking gauge made to hold a pencil.



Jervis.

**Post Vice** : a vice comprising a vertical post, generally set in the floor and a wooden bar, vertical and parallel to the post. The screw of the vice passes through bar and post to a nut fixed behind the post. The jaws are at the top of the bar and the post.

**Rolls** : a machine equipped with rollers for bending iron bar into rings for use as tyres.

**Rounder** : a hand tool for making the spoke tongues round and an exact size.

**Samson** : a clamp used for bringing the ends of the felloes together when strakes are being fitted to a wheel.

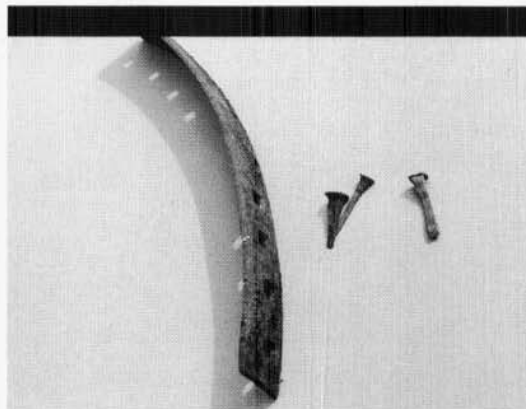


An English stock.

**Set** : the ends of an axle are inclined downwards so that the wheels lean outwards at the top, this is called the set of the axle. The word is also used to describe the process of moving the tyre into the right position on the felloes after the tyre is shrunk on.

**Shoulder** : that part of a tenon, usually at right angles to the axis of the tenon, which butts against the timber into which the tenon fits, hence the shoulders of a spoke but down onto the wheelstock.

**Sole** : the concave curved outside surface of the felloe, against which the tyre fits.



Strakes.

**Speech** : a name occasionally given to a wheel without its felloes, also known as a wheel of stock and spokes.

**Spoke Fiddle** : a holding device used in shaping spokes.

**Spokeshave** : a small planing tool held in both hands used to give the final finish to spokes and in numerous other situations.

**Spoke Trimmer** : a bit which cuts a conical end on a spoke, acting very much like a pencil sharpener, in preparation for a tongue to be cut with a hollow auger.

**Strakes** : short lengths of iron fitted around a wheel performing the same function as a continuous tyre. They are about the same length as the felloes and overlap the felloes across the joints.

**Strake Nails** : the nails which fix strakes to felloes. They have tapered, square or rectangular shaped heads which fit tapering holes in the strake. Each strake has normally eight.

**Stagger** : in 19th Century English practice alternate spokes were morticed to alternating face lines (the breast marks) when the spokes are said to be staggered with alternate ones set one behind the other.

**Stock** : the central part of the wheel into which the spokes are morticed.

**Stock Hoops** : see bonds.

**Stool** : a piece of standing equipment in a workshop found in many forms for a variety of operations, usually lower than a bench and generally standing on legs.

**Tenon** : in a wheel the spokes are given tenons, which fit into mortices in the stock. They always taper in at least one elevation in wheelwork.

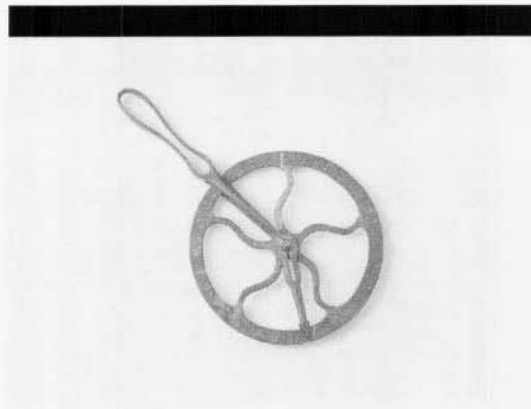
**Tongue** : the tenon at the outer end of the spoke.

**Traveller** : a measuring instrument consisting of a wheel, usually with a notch in its rim, it is arranged to pivot on a handle. The edge must be thin to avoid misleading readings and it is used to measure the circumference of wheels and their tyres, the process known as "running the wheel".

**Tyre** : the same as bond, the iron ring which surrounds the wheel, it tightens all the joints and therefore ties or binds the wheel together.

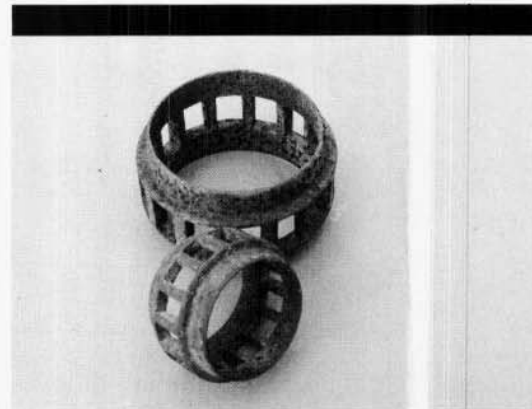
**Tyre Bar** : iron bar was once rolled in a variety of sections known as tyre bar, specifically for the purpose of being used for tyres. One form had one flat edge at right angles to the face and the other a half-round radius. This radiused edge was arranged to overhang the face of the wheel felloes, pushing the wheel away from obstacles such as kerbstones and thereby protecting the painted surface from abrasion.

**Viller** : a felloe in some parts of the West Country.



Traveller.

**Warner Wheel** : an American invented system in which the wooden wheelstock was bound by a band of iron which had mortices formed through it to receive the spokes, which had a tenon formed to fit through this mortice and into a smaller mortice in the wooden stock. There were several variations on the theme by other inventors, Sweet and Sarven among them.



Warner wheel.

**Whalebone Gauge** : a bar of wood with a series of holes through it, a spring pointer (formerly a piece of whalebone) is set through the holes with a wedge and the bar is fixed across the face of the wheelstock. The pointer is used to set the angle for cutting the face of the spoke mortice and for driving the spoke in to ensure that the wheel runs true.

**Wheel Horse** : a post with a nearly horizontal bar fixed at its top on which a wheel can be placed for painting.