USING PULLEYS WITH ELECTRIC MOTORS

There are many types of electric motor from small battery powered mirror ball motors turning very slowly to large 240v motors able to rotate at speeds in excess of 1400 revolutions per minute (rpm). Whatever motor you have decided to use for your purposes, you will need to transfer the drive from the motor to your mechanism.

In the first of this series of blog posts I am going to focus on pulleys and how they are fitted to electric motors and used in the Theatre and Screen metalwork shop. Later I will add information about using cogs, sprockets and gears.

Vee or 'Wedge' Pulleys

Pulleys are commonly used if the motor is going to rotate at high speed, but not always as I have seen them used in heavy duty mirror ball motors. The drive is transferred to another pulley using a vee belt (both pulley and vee belt are shown in the image above).

This type of pulley (with multiple grooves) is called a ‘step pulley’. Step pulleys are used to adjust the speed of rotation of the final drive without having to take the pulley off and replace it with another. The vee belt is ‘jumped’ across the different diameter 'vee groove’ to change the final drive rpm.

A large diameter, driving a small diameter will increase the speed of the final drive rpm. Inversely, a small diameter driving a large diameter will reduce the final drive rpm. These are basic gearing principles that are explained.

If you are using step pulleys to adjust the drive speed, you will need to ensure that they are both identical in size (matched) or the belt will either; not grip, or be too tight, as you change the belt from groove to groove.

Single groove pulleys can also be used to ‘gear up’ or down but will need to be swapped with another of a different diameter if the final drive speed needs to be altered. You will need to include some way of taking the slack out of the vee belt if you are changing pulleys or using un-matched step pulleys. This can be done by using a ‘tension’ pulley which will be explained later.

As well as these 'vee' or ‘wedge’ type pulleys, you may come across pulleys which appear to look like gears. These are normally found in engines not on electric motors. It can be very costly to buy belts or matching pulleys if you intend to use them. Also shown in the image above is an ‘tension pulley’. This is the small pulley in the centre. It will have some way of moving up and down and used to tension the drive belt. You can buy standard tension pulleys sets off of the internet.

Securing a Pulley to the Motor Drive Shaft

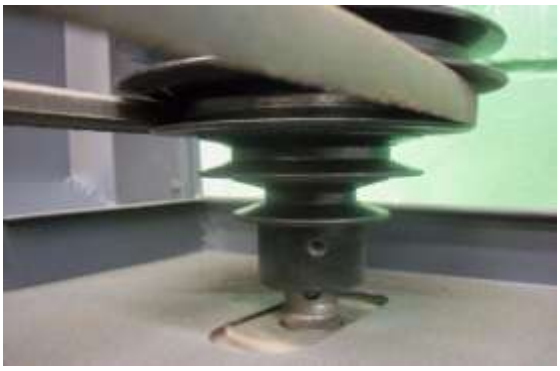
Keys and Keyways

Most vee pulleys are made from aluminium or steel and secured to the shaft of the motor via a key and keyway.

Above you can see the pulley from the front. The square of steel is the key, it aligns with a groove (keyway) in the pulley and on the drive shaft and prevents the pulley from coming off.

There are a number of different types of key (shown above) and from front to back they are: Woodruff key, Gib Head key and Feather key. It is possible to buy key steel that you file up yourself. However, they all work on the same principle.

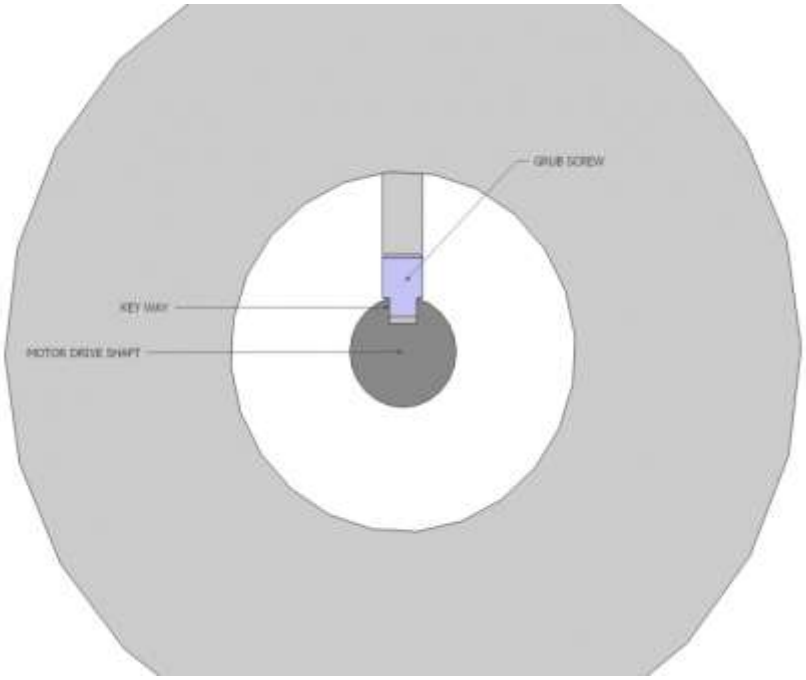
Socket Screws or Grub Screws



Not all vee pulleys are secured with a key and keyway. In the image above, the pulley attached to the motor of this pillar drill is secured to the drive shaft using what is known as a ‘grub screw’ or ‘socket screw’.

These are small screws that are tightened with a ‘hex key’ better known as an ‘allen key’. It’s important to make sure that the grub screw is fastened into the keyway of the motor shaft and not onto the shaft itself, otherwise the pulley will come loose and the motor shaft will get damaged.

You may need to grind a little step into the front of the grub screw as shown above. You can buy this type of grub screw but they are hard to find, they are known as a ‘Dog Point’ grub screws.



If there is nowhere obvious on the pulley to drill and tap a grub screw, you can drill into the bottom of one of the grooves as shown below, however, you must ensure you have removed any sharp edged afterwards and that the grub screw is well below the surface so as not to interfere with the vee belt.

Splined Shafts

Very rarely you may find yourself in with a pulley that has been fitted to a 'splined' or' toothed' shaft.

Generally these pulleys are pretty useless as you will need the teeth of the shaft to match that of the pulley.

You could bore out the pulley on the lathe (more about this later) if there is enough material to do so, but I would avoid using them if possible.

Fitting Pulleys that Do Not Match the Diameter of the Motor Shaft

Pulleys with an internal bore too small that won't go on

If you have a pulley that has a bore that is too small for your motor drive shaft it’s simply a matter of securing the pulley in the lathe chuck and opening out the bore with a drill or boring tool to the correct size.

I recommend using the ‘outside’ jaws to grip the pulley unless there is a nice long parallel section to hold in the chuck.

Pulleys with an internal bore too big and loose on the motor shaft

If you have a pulley that has a bore that is too big for your motor drive shaft then the solution is a bit more complicated and the easiest solution would be to buy a new pulley that fits. However, if an opportunity to use the lathe is something that you have been waiting for then now is your chance.

You will need to machine a 'sleeve' that will fit over the small motor shaft and increase its' diameter. You will also need to ensure that the sleeve can fit securely to the motor shaft and that the pulley can then fit securely to the sleeve. All of this will have to be done very accurately.

Once machined the sleeve is slid over original motor shaft.

The sleeve is fitted securely to the motor shaft with 2 grub screws that line up with the keyway.

In the image above, the sleeve has been secured to the motor shaft with two grub screws, the motor shaft (with the sleeve secured) has been rotated to show a 'D' dent which has been machined into the other side.

Above you can see how the pulley can now be fixed to the sleeve buy using a grub screw into the 'D' dent.

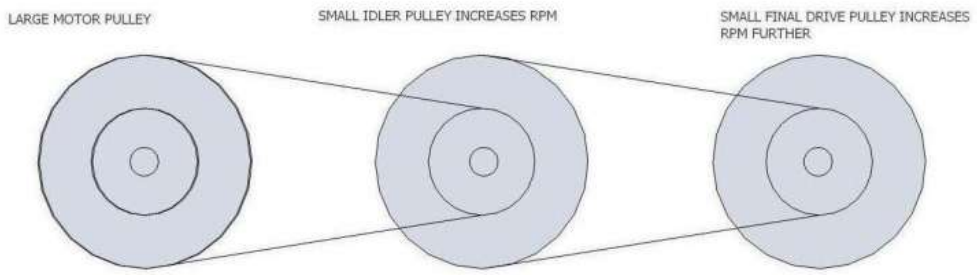
Finally, a nut and washer add extra security to prevent the pulley coming off.

Removing Pulleys from a motor shaft

Once you have determined how a pulley is fitted to the motor and you are sure you have unscrewed any grub screws etc, the easiest way to remove it is with a gear puller. The pulley is ‘jacked’ off of the motor shaft by turning the central bolt of the gear puller using a spanner. The image above is for illustrative purposes, as you must remove the drive belt and isolate the machine from the electric supply first.

Idler Pulleys

Better know as ‘idler wheels’ are used to alter the rpm of the final drive. By placing an idler wheel in between the motor pulley and final drive we can reduce or increase the drive speed. Idler wheels are not powered in themselves, they simply transfer drive via the vee belt. The spindle for the idler wheel will need to run freely in bearings.



Pro's of using pulleys:

Run relatively quietly

Able to drive at high and low speeds

No need to worry about busting a mechanism if it jams as vee belts will slip if there is too much resistance.

Cons' of using pulleys:

Getting the correct size vee belt can be difficult,

A tension pulley or adjustment system may be needed in order to take up the slack as the belt expands due to wear/usage.

Belt slip can be a problem if there is a lot of resistance in the mechanism.

Source: http://process.arts.ac.uk/content/using-pulleys-electric-motors