PARTS IS PARTS: Mounting Weapons Blades and Pulleys

● by Pete Smith

A lot of builders dream of creating a bot with an active weapon but are put off by the apparent complexity. How do you attach a blade to the axle? How do you know if the axle will be strong enough? How do you drive the axle, and finally, what kind of bearings should you use?

I faced all these questions when I developed my first Blade Spinner ***Surgical Strike*** (**Figure 1**). The design needed to be simple so that it would be something I could build and repair with my limited skills and budget. I also wanted to design something that could be the basis for a kit for more advanced builders.

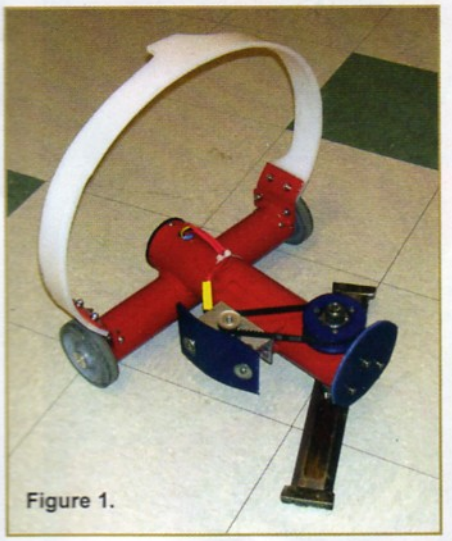

Figure 1.

The solution I came up with uses mostly off-the-shelf parts to make a tough, reliable, and very successful weapon system.

The main component is the axle (**Figure 2**). This is a precision ground, case hardened, steel shaft from **www.mcmaster.com**. These shafts have the very hard surface and smooth finish required for a bearing surface combined with a softer, tougher core to resist fracture. I made the mistake of using 0.5" fully hardened shafts on the first version of my robot but moved to 0.625" case hardened (McMaster part# 6061K111) after a couple of them failed during fights.

Figure 2.

I grind the bottom end of the shaft into a dome shape (**Figure 3**) so that the spinning of the shaft has less effect on directional stability. A flat end on the shaft will tend to pull the bot to one side or the other. The dome also helps the axle ride over any irregularities in the floor.

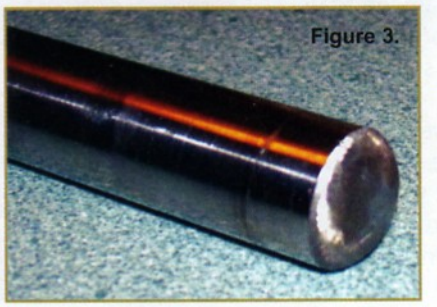

Figure 3.

I lighten the top half of the shafts by drilling out the first couple of inches with a 0.3" drill in my lathe (**Figure 4**). The soft core drills quite easily and the pulley end of the shaft does not have to be as strong as that required to attach the blade.

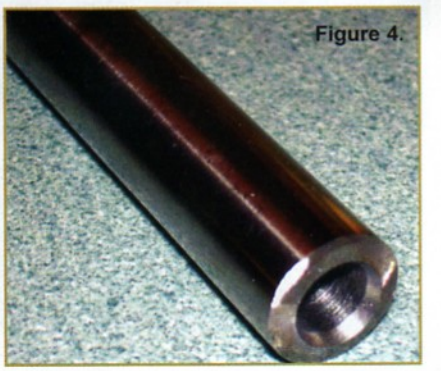

Figure 4.

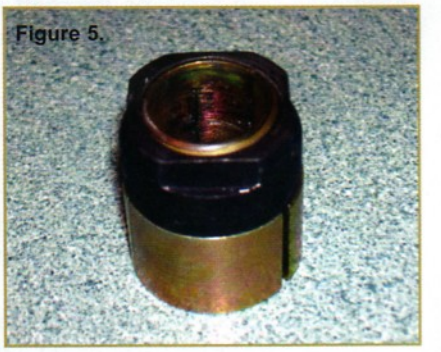

Figure 5.

One of best and certainly the easiest ways to attach the blade to the axle is to use a keyless bushing. There are two main types: Trantorques (**Figure 5**; McMaster part# 5926K18) manufactured by Fenner Drives at **www.fennerdrives.com** and Heavy Duty versions (**Figure 6**; McMaster part# 1058K13), also made by Fenner and some other suppliers.

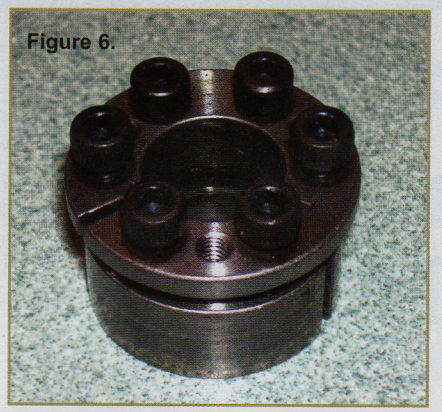
Figure 6.


Figure 8.

a small slot in the bearing flange and a matching screw in the chassis to stop them from being able to rotate (**Figure 10**). This latter point is important because if they start spinning they will very rapidly wear the tubes and become a very sloppy fit. I use thick steel washers between the bearing flanges and the keyless bushings to reduce wear caused by the irregular faces on the bushings. The notch in the bush can be a stress point so watch for cracks developing here.

The basic design could be scaled to suit most robot weight classes. I've only used it in 12 lb and 3 lb bots, and it works equally well in both. You need to make sure that you check that all the bushes are tight before each fight.

It's too easy to assume that just because there were no problems in the last match that everything is still okay. Also check the position of the bush in the blade and on the axle as they can move with a big hit. **SV**


Figure 7.

The main thing to get right when using these parts is to bore the hole in the blade the correct size (**Figure 7**). Typical tolerances required are ± 0.001". The Trantorques are quicker to fit and remove but are not as strong as the heavy duty versions and are more prone to loosen under shock. The versions available from McMaster also have this annoying habit of moving axially on the shaft as you tighten them. Other versions on the Fenner website do not have this problem.

The heavy duty ones are fitted by tightening multiple smaller screws. The instructions specify a particular torque for these screws but I have found that this is not critical. I can get them tight enough using a standard hex key. I now use the heavy duty bushings for the blades and the Trantorques for the pulleys.

Flanged, bronze Oilite sleeve bearings (**Figure 8**; McMaster part# 6338K426) work well to mount the axle to the chassis. These have proved very tough and keep working after damage that would likely have shattered any ball or needle bearing (**Figure 9**). The bearings are self lubricating and maintenance free.

My chassis have a hollow tube welded into them to mount the bearings and axle. You could press-fit the bushes into the tube but that would require a high precision on the bore of the tube and makes replacing them much harder. Instead, I bore the tube out to give a neat clearance fit then added

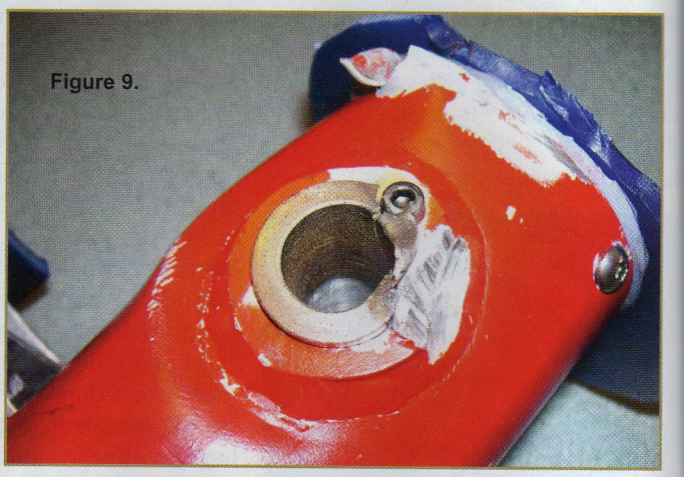
Figure 9.

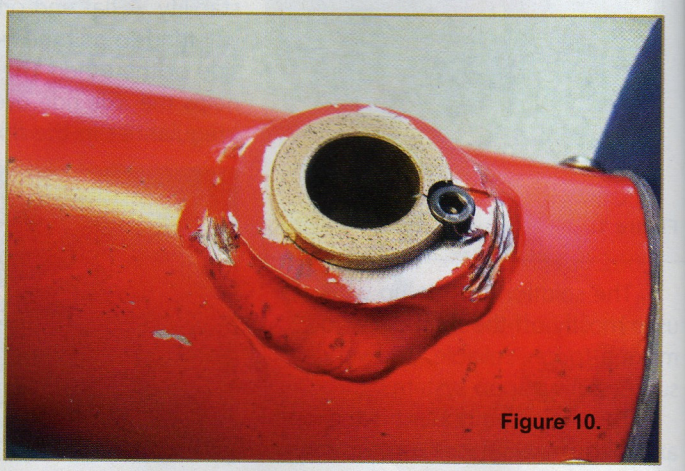
Figure 10.