Stingers and struts

The stinger or the strut is an important part of the drive chain – not only does it house the bearings supporting the flex-shaft, but it provides a way of adjusting the height and/or the angle of the flexi-shaft as well.

Struts

A strut is a simple mechanical arrangement in which the flexi-shaft runs in bearings in the body of the strut and this is clamped to angle brackets fixed to the transom via fixing screws. Adjustments to drive height and angle are achieved by loosening the fixing screw(s), setting the relevant parameters – usually with reference to the line of the bottom of the hull – then, of course, by re-tightening the fixing screw(s). Such a strut provides a cheap and mechanically robust solution to mounting the propeller shaft on the transom. As we will see later, a more methodical approach to making adjustments is an advantage, otherwise it is easy go around in circles trying to achieve the intended settings. Nevertheless, once the optimum settings of drive shaft angle and height are achieved the simple strut can offer a very good option rivalling a stinger in many other respects. There are some examples of struts with independent adjustments of height and angle but these tend to be very expensive.

Fig. 1a *Conventional strut*

Fig1b *Larger version of a strut for 8 mm diameter shafts*

Stingers

A stinger is usually used when the propeller is required to be located further from the transom than is practical with a simple strut. Stingers usually, but not always, provide better support to the propeller shaft extension than a simple strut. Heavy-duty stingers are frequently used on off-shore racing boats when there can be significant stresses on the drive train. With a stinger, precise mechanical adjustments of angle and drive height can be made independently which is helpful when setting up a boat. In fact some stingers now have angle adjustments which can be made via a servo.

Fig.2a *Stinger with removable housing for bearings*

Fig. 2b *Stinger with fixed shaft bearings*

Some stingers have adjustments that allow their overall length to be changed. The advantage of this feature is that the stinger length can be trimmed to match the precise length of the flexi-shaft which is particularly useful when using a square-drive flexi-shaft.

Because a stinger tends to have a large internal bore – in some cases up to 12 mm, it is important that the stuffing tube is supported and centralised within the bore of the stinger. This is easily achieved using a collar which is fixed to the end of the stuffing tube.

An Arneson drive is a special case of stinger design and are frequently used in scale powerboats. In the full-size version a complex universal joint is used to allow the drive-shaft to achieve various trim angles. In the scale version the flexi-shaft enables different trim angles to be accommodated. The length of an Arneson drive is usually significantly greater than most conventional stingers, but the drive is normally supported by a fixture connected to part of the hull which overhangs the transom.

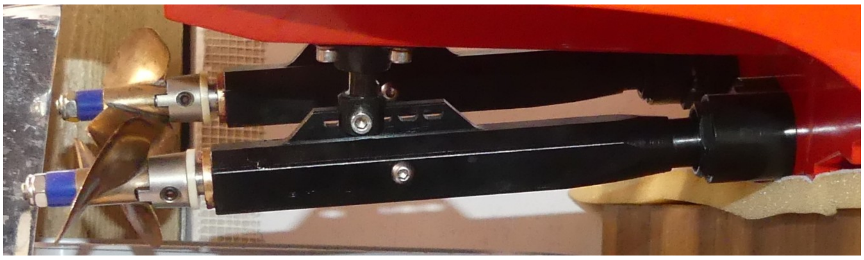

Fig.3 Typical Arneson drives

Retaining the propeller shaft

High-performance propellers are expensive and it would seem sensible to protect this investment by some sort of safety measure to retain the propeller on its shaft. A simple collar placed on the flexi-shaft between the end of the stuffing tube near the engine and the engine drive collet will stop a square-ended flexi-shaft falling out, or a round-ended flexi-shaft falling out if the drive collet becomes loose. However, in the rare event of a flexi-shaft breaking, another feature should be considered. By carefully machining a shallow groove in the drive shaft between the two strut bearings, perhaps about 6 mm long, and fitting a screw in the body of the strut which can be adjusted to just extend into the groove, the drive shaft can be effectively retained. Note that using a screw larger than M3 risks the screw loosing grip and defeating the safety feature.

Fig.4 Typical location of the screw used to restraining the drive shaft

Because of a stinger's more robust construction a separate unit is sometimes used to house the propeller shaft and its bearings. This housing is mounted in the main body of the stinger – and usually has a left-hand thread to fit it into the body of the stinger. The advantage of this arrangement is that a flexi-shaft can be manufactured with a collar fixed to the drive-shaft near the join of the flexi-shaft and the stub. This provides an excellent way of retaining the propeller in the event of a flexi-shaft problem.

Bearings

Petrol engines and large electric boats

The most common type of bearing used for petrol powerboat applications using a ¼" diameter drive shaft is a plain bearing bush with a lead teflon liner. Two bearings are usually used, although some people use three, with lubricating grease is trapped between the bearings. From a design point of view it is difficult to see why bearing materials, such as teflon, not particularly suitable to high-speed operation are used so widely. It is probably a combination of "if it ain't broke, don't fix it" and the difficulty of obtaining Imperial size bearings manufactured from other bearing materials. However, with 8 mm diameter drive shafts, which are more commonly used in Europe, different sorts of bearing materials, more suited to high-speed operation, are readily available in the UK in metric sizes.

Bearings fitted to stingers and struts do wear out, or get damaged, usually by the effects of using poorly balanced propellers. It is important to replace bearings with those of known quality. It is not unusual to get bearings that slide too easily into an 8 mm ID bearing housing in the strut, or that need a press fit to insert them – so buy wisely!

It is very important to ensure that the flexi-shaft and the drive shaft are properly lubricated, whether by grease and/or oil. This means that the shaft needs to be taken out and replaced frequently. In the case of a round-ended flexi-shaft, a shaft that has been stressed during use can expand in diameter and can damage the bearing surface when removed. With a square-ended flexi-shaft, the square-end very often has sharp edges so inserting and removing such a shaft and can easily wreck the bearing surface. In the case of a square-ended shaft, it is a good idea to carefully check the fit of the flexi-shaft in the bearings and, if necessary, smooth the edges of the square end, but do not overdo this procedure as the drive will ultimately loose its strength[1].

Another type of bearing can be made using a cross-drilled brass tube which fits over the drive shaft. Although the area in contact with the drive shaft is significant, the loading is low and the lubricated area is significantly greater than with bearing bushes. An article in Model Gas Boats describes the method. The only thing to watch is that the arrangement is designed around Imperial tube sizes (see the following web-site https://modelgasboats.com/magazine/how-to-articles-mainmenu-606/328-make-your-own-strut-bushings.) so it may need some modification to work on metric struts[2].

Fig.5 The inner part of a home-made “Speedmaster-style” bearing with a soldered collar

Smaller glow motors and electric boats

Although 8 mm, ¼” and 3/16” diameter drive shafts are most commonly used in large and mid-sized powerboats, other sizes of shaft are often encountered particularly in the field of fast electrics and the mid-range to small-sized power boats. 5 mm diameter drive shafts are often used – specially in Europe – as well as 3/16” (4.78 mm) diameter – obviously these are not interchangeable, but it is sometimes difficult to immediately recognise the difference. 4 mm shafts are often used in fast electric boats and they are often supported in ball-races. The main requirement for choosing a particular size of drive shaft in the smaller ranges is usually the availability of suitable propellers. The hardware for these smaller sizes are a specialised field and so are not covered in this article.

1 If a 6.35 mm diameter flexi-shaft is forced into a square shape, the square drive will have a diagonal dimension of 6.42 mm so it is worth checking this dimension before fitting.

2 A 9/32” diameter tube has an ID of 6.43 mm and the telescopic tube is 5/16” OD which is 7.94 mm, therefore this tube may, or may not, fit well in a metric strut.