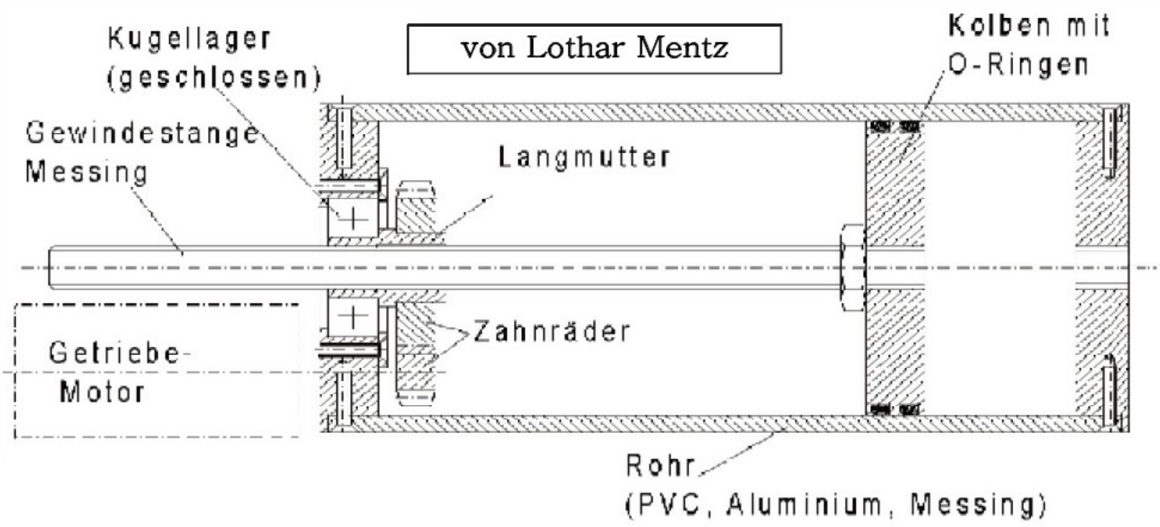


Piston tanks

Many modelmakers have built four or five subs, own a lathe but only use it to make bollards, antennas and associated fittings.
Why not use it to make a piston tank, as opposed to expensive ready made tanks?

The design presented here is the result of many years of testing in harsh operating conditions. It's not the last word in piston tank design, but is proven reliable.

First job is to select some suitable tubing for the cylinder.
The inside bore should be smooth with no bumps, scoring or grooves. It must not be highly polished *(presumably this is so it retains a film of grease, much like the cylinder bores of a cars engine).*
Plastic drainpipe, waste pipe, worn-out toner scrolls from photocopiers (aluminium) and brass tubing from steam models can be used. I use whatever material is available to me, and what is appropriate in diameter for the tank I wish to make.

The piston and end caps for the tank can be constructed from aluminium, polycarbonate/lexan or PVC. For the threaded spindle, I use brass metric threaded stock.

The spindle nut is machined from mild steel.

With this set-up, the softer brass threaded spindle is the part that wears (because brass is softer than steel). The spindle nut is harder to change, as it is pressed onto the gearwheel, the brass threaded rod on the other hand, is easy to replace.
Ball races should be sealed on both sides with rubber seals (sealed ball race)

For the gears (in my tanks there are only two) I use a steel gear and a plastic (e.g. acetal, nylon etc) gear both module 1. I purchase these from Conrad.

HPC gears and Muffet are good UK suppliers of gears, you can contact them for free catalogues or visit their webpages http://www.hpcgears.com/ http://www.muffettgears.co.uk/
Unfortunately gears rarely come cheap, unless you can cut them yourself, and a pair will likely be the most expensive part of the tank.

When I use motors any type of geared motor, found surplus (radio shows, ebay etc.) or Conrad (Buhler, Maxon, Mabuchi, Faulhaber, Portescap)

To seal the piston I use two simple O-rings 2-4 mm thick.

Airzet rings are better (lower in friction), but are more expensive, and not as readily available as o-rings. In addition, my tanks are probably not accurate enough to get the best from such seals.

Building the Tanks

The piston and end caps are cut from the material of your choice (PVC, lexan, aluminium etc.) *Additional notes, rough cut these with plenty of allowance- you can turn them to high accuracy once on the lathe. You can also use acrylic, but I would recommend PVC or lexan for the piston itself.*

In the middle of the all three discs drill a hole to the tapping size of your chosen thread.

Mount these onto a mandrel or bolt of corresponding size so that they can be mounted in a chuck on the lathe and turned down to size. *A simple mandrel can be made using a bolt with a couple of washers and a nut or two.*

Turn the piston down so that it is 0.5-0.7 mm smaller than the inside diameter of the tube. Do the same for each of end caps, but leave a step 2-3mm thick that corresponds to the outside diameter of the tube, so the end caps butt up against the tube.

The grooves for the two O-rings should be 1-1.5 mm wider than the thickness of the O-ring.
The groove depth I turn by feel. Turn down, fit the o-ring, and try the fit in the tube, if it’s too tight, turn down a little more.

Some notes on o-rings:

On the piston you should have 10% - 15% o-ring thickness compression (e.g. 3mm thick o-ring = 0.3-0.45mm compression)
On the cover you should have 15% - 30% o-ring thickness compression
That’s the reason why there are 2 o-rings on the piston and 1 on the endcaps.

The pressed o-ring should fill the groove within 50% - 75%. A 3mm o-ring don’t fit in a groove that is 3mm width! So the groove must have more than 3mm.

All o-rings should be a little stretched. Here you can take try a little bit. Normal is 3% - 7%.

Cut the tubing to the desired length. You can use the piston in conjunction with the threaded rod to form a simple mandrel to hold the tube in the lathe (you will need a rotating centre in the tailstock) to trim the ends of the tubing true.

The spindle nut can be machined from piece of round steel, as in the drawing.

The inside thread should not be any longer than the height of the thread diameter.

The seat for the ball bearing should be 0.1-0.2 mm over the inside diameter of the bearing.

With the spindle nut machined press this into the bearing (you can use a bench vice for this)!

The metal gear for the spindle nut can also be pressed onto the spindle nut (interference fit) with a drop of Loctite or cyano to lock it fast. *(I would just machine the nut so that the gear slides on snugly then just use a good bearing retainer Loctite (e.g. 603),the gear will never come off, unless you heat it up. Interference fits can be a struggle to achieve sometimes and just aren't necessary with modern adhesives.*

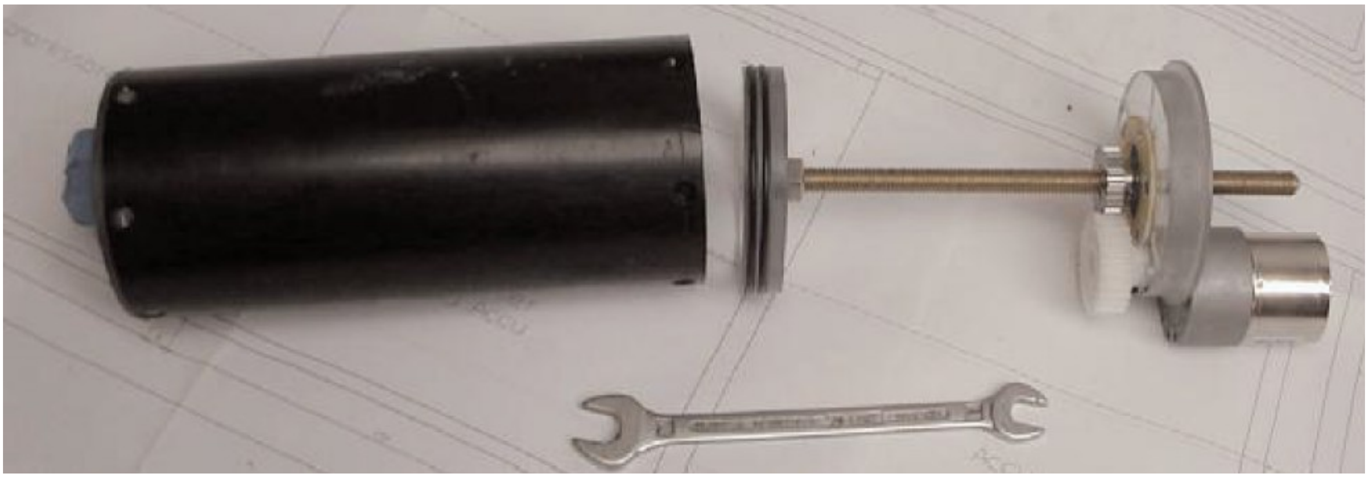
Bore out one endcap to fit the ballrace and drill holes for 3-6 screws to secure the ballrace with nuts and bolts.

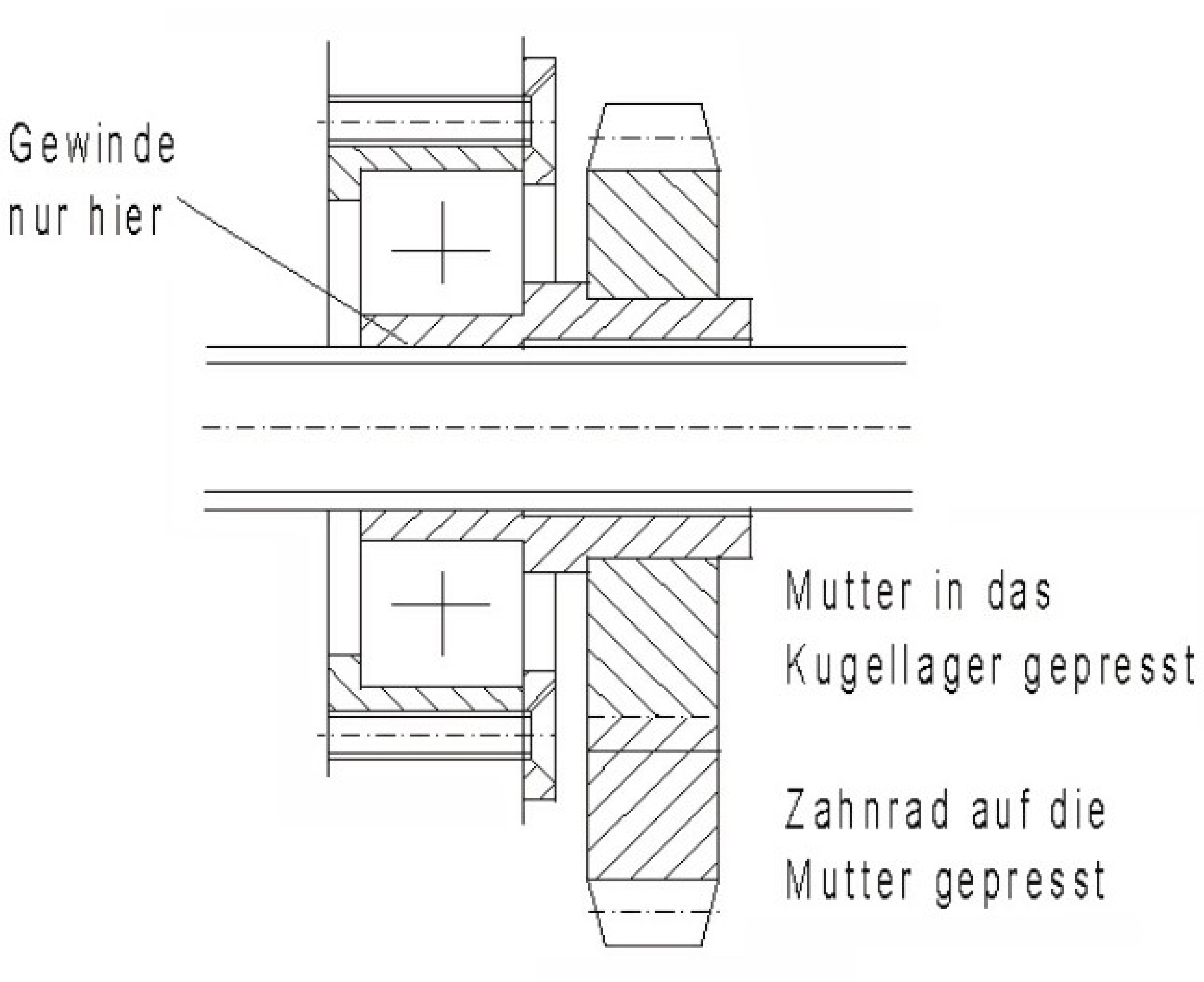
Drill holes through tube and into end cap to secure it to the cylinder (note use of countersunk screws)
The other cover needs boring for the hose connection, and mounting screws. Seal this end cap with silicone sealant.

Now we just need to mount the motor.
Almost all motors feature two mounting screws, so only three holes need to be drilled
You start with the middle hole for the motor shaft.
If the gears mesh well drill the two mounting screws, if not file the hole to allow the motor to move until you get a good mesh.

Mount the limit switches, and you are done.

Selection of the correct motor comes with experience and experimentation. Good luck and have fun with your project.

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