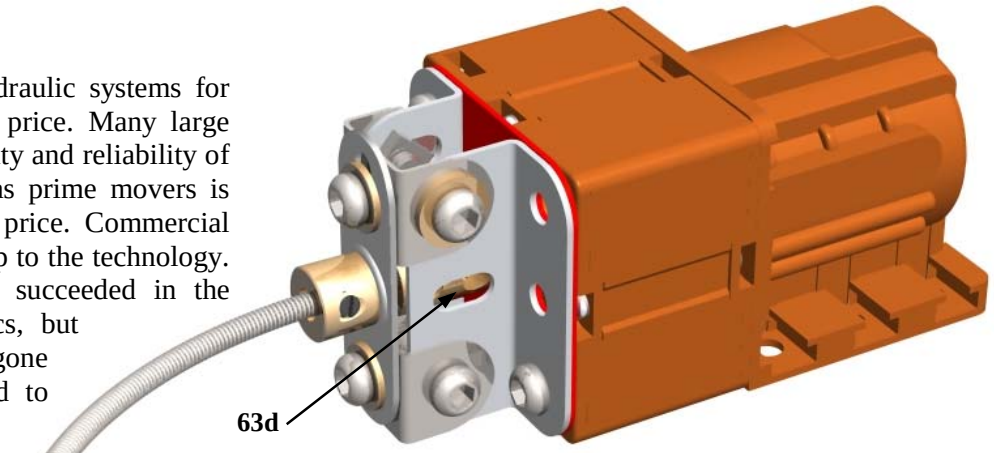
Tech Stuff!

A compilation of ideas from all walks of the world of Meccano, by Anthony Els



Usable pneumatic or hydraulic systems for Meccano are available at a price. Many large models demand that the quality and reliability of miniaturised liquid pistons as prime movers is second to none. Hence the price. Commercial Meccano just never caught up to the technology. Several manufacturers have succeeded in the field of miniature hydraulics, but somehow they've never gone mainstream. If anything had to go wrong, oil or water end up all over the place or at the least, you have failure for all movements.

For many Meccano collectors, staying within the system is more circumstance of not having a cost effective, complete hydraulic system on hand. I'm in the same boat, and spent some time attempting an effective simulated hydraulics piston that any Meccano modeler can put together. There is no small measure of controversy on this subject of simulating a piston. Some Meccano modelers seem to think it's a waste of time using threaded rods to pretend a piston is there. My argument is that as long as a model looks like the real thing, and operates a fair degree like the real thing, who cares if it is done mechanically. I chose the pleasant diversion of using Meccano to solve a small scale problem in a believable manner.

I've had my eye on building a sky platform for quite some time now, but up until now haven't managed to scale key concepts down far enough to make a small model practical. Many modelers face a similar problem and with limitations in cylindrical parts, you have the choice of a sleeve piece or a Cylinder to scale the rest of the model to! Getting the pistons as small as possible was the objective, with the flexibility (to some degree) of scaling up the idea to any length piston.

At least 15-20 completely different variations of rising spindles, rotating nuts, and other ideas were tried and most failed quite thoroughly. Several variants destroyed parts when things went awray. I can see why most people give up trying this. It took a really long time to get only one or two ideas working, but I believe it was worth the effort.

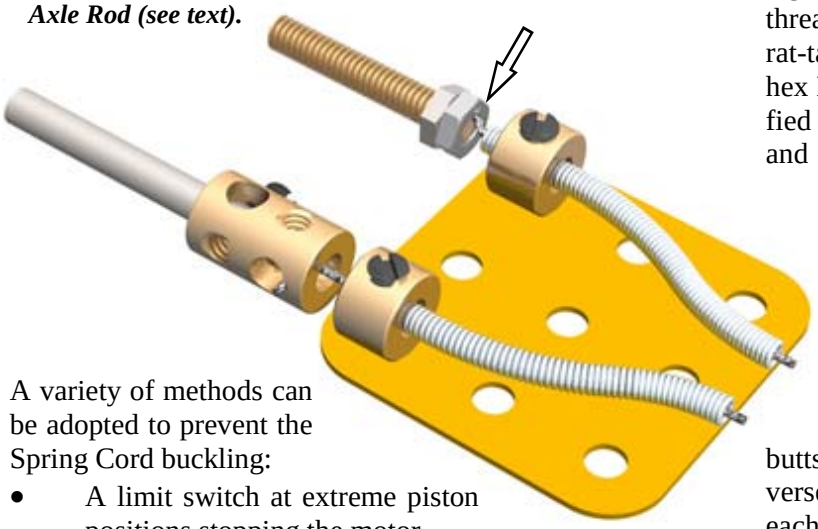
Driving the pistons was the first consideration. I knew that a huge amount of power would be lost to friction simply by trying to get a model to behave like the real thing. I have seen many extremely elaborate systems using pulleys and wire, but they can take forever to set up properly. Other solutions laboriously wend a mechanical drive shaft through a torturous route to the destination cylinder, and (with respect) an enormous amount of movement is visible when the pistons actuate. Other solutions use micro-mini motors en-situ to drive threaded rods.

As a compromise solution, I chose to transmit rotary motor power through Meccano spring cord, driving a screwed rod at the destination. A MO MKIII motor with 19:1 gearbox was selected for a power unit. I intend to dedicate a motor to each movement, with motors conveniently housed in the "engine" part of a reasonably sized model. Something along the lines of that described in the "Bucket on a String" article would be ideal. Running motors on 6V may be a bit slow, so consider using 7-9V if possible.

Fishing trace wire can be threaded through standard spring cord to deliver power up to 500mm away from the motor. However, there is a great deal of "wind up" before full torque is transmitted.

Much of the wind-up in the drive becomes irrelevant if a screw ram is used at the final destination (the piston locks in position when the screwed rod stops rotating). Preventing the flexible cord from going out of control and buckling is important. Typical failure under wind-up load is torsional buckling, like an elastic wound up too much. This is why in the real thing (weed eaters, etc), the sheath is flexible, but made torsionally stiff by a further plastic or metal sheath. In Meccano this extra stiffness is not present. The moment the motor overloads the wire, the weakest spot in the spring cord buckles and it "scrunches up".

Attaching fishing trace to Threaded Rod or Axle Rod (see text).



A variety of methods can be adopted to prevent the Spring Cord buckling:

- A limit switch at extreme piston positions stopping the motor.
- A slip clutch to prevent over-torquing.
- An outer sheath in the form of stiff aquarium air hose of the right diameter.
- Rigidly restrain the Spring Cord at support points, instead of allowing it to freely run through bores
- Keep distance between Spring Cord support points short.

Suitable supports are a requirement along the length of the spring cord to destination. Rigidly supporting the Spring Cord can be elegantly achieved by attaching Aero Collars to model framework. Grub Screws with a touch of Loctite (so they do not work loose) fasten the Spring Cord running through the bore. Try to keep radius in the Spring Cord large while at the some time constraining bends from beginning to end.

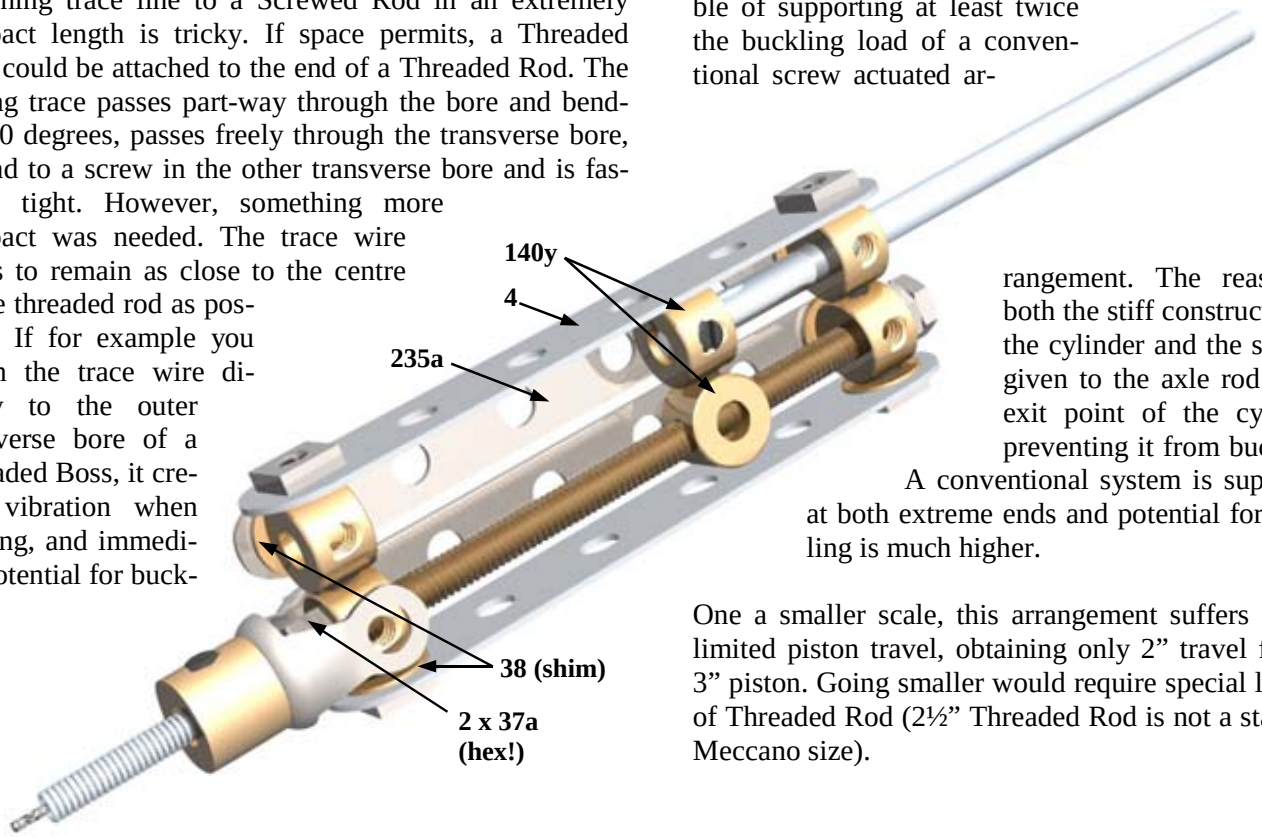
Attaching trace line to a Screwed Rod in an extremely compact length is tricky. If space permits, a Threaded Boss could be attached to the end of a Threaded Rod. The fishing trace passes part-way through the bore and bending 90 degrees, passes freely through the transverse bore, around to a screw in the other transverse bore and is fastened tight. However, something more compact was needed. The trace wire needs to remain as close to the centre of the threaded rod as possible. If for example you attach the trace wire directly to the outer transverse bore of a Threaded Boss, it creates vibration when running, and immediate potential for buckling.

Again, as a compromise, I used a normal hex Nut threaded onto the end of a Threaded Rod. Use a mini rat-tailed file to open a small internal slot in another hex Nut. The wire passes through the slot of the modified nut and the two nuts are still able to trap the wire and lock-nut together (see arrow in graphic opposite). In-elegant, but effective. I could have used a more time-consuming route of soldering up a special loop at the end of the wire, so that no parts need to be modified. However, if the wire fails, it will take a long time to replace. A method is also shown opposite to attach line to an axle rod (for example the 19:1 gearbox stub). This uses a Short Coupling, and the Axle Rod butts up and jams the wire passing through a transverse bore. A suitable support frame can be made for each motor, as shown on page 23. This simplifies construction of a model.

Regarding pistons, an initial design requirement I set was that any piston seen to be coming from a simulated hydraulic cylinder was to be a Meccano Axle Rod. The smallest cylinder and piston I could conceive of was 3" long (shown on the opposite page). The Piston is created by joining a pair of 4-hole collars together using a Grub Screw.

A touch of Locktight will prevent the grub screw "drifting" (I did not have any trouble with drift). In a similar manner, the cylinder is built up by locking together Collars. To make the cylinder look less bulky, use Grub Screws inside Nuts to fasten Strips in place.

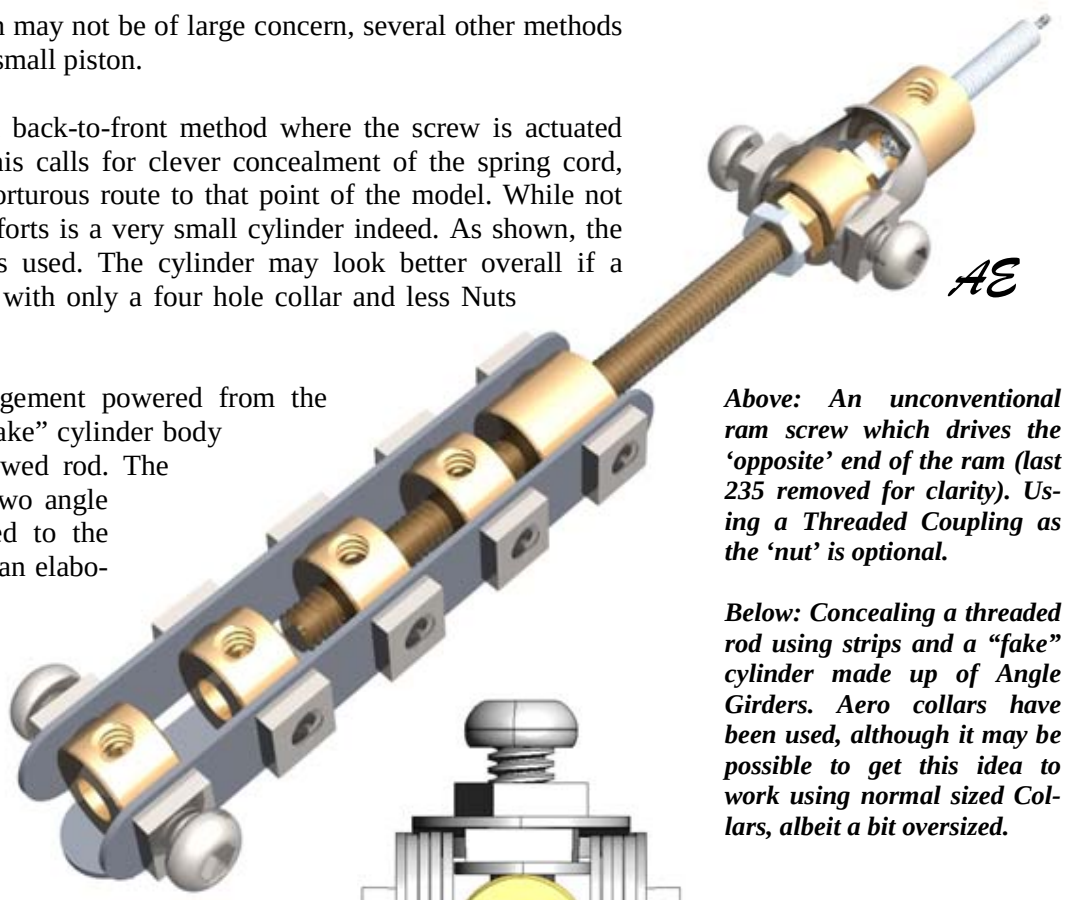
This first piston arrangement is capable of supporting at least twice the buckling load of a conventional screw actuated arrangement. The reason is both the stiff construction of the cylinder and the support given to the axle rod at the exit point of the cylinder, preventing it from buckling. A conventional system is supported at both extreme ends and potential for buckling is much higher.



One a smaller scale, this arrangement suffers due to limited piston travel, obtaining only 2" travel from a 3" piston. Going smaller would require special lengths of Threaded Rod (2½" Threaded Rod is not a standard Meccano size).

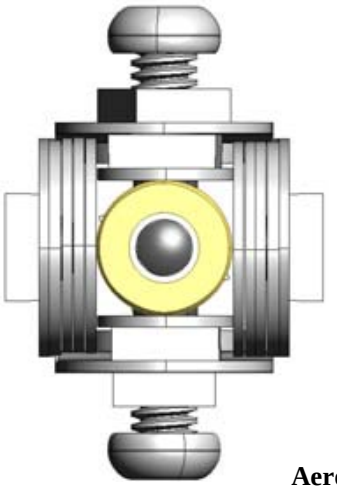
Where buckling of the piston may not be of large concern, several other methods can be employed to create a small piston.

The second piston idea is a back-to-front method where the screw is actuated from the "delivery" end. This calls for clever concealment of the spring cord, which may have to take a torturous route to that point of the model. While not easy, the reward for your efforts is a very small cylinder indeed. As shown, the bore of a Threaded Boss is used. The cylinder may look better overall if a Threaded Coupling is used, with only a four hole collar and less Nuts with Grub Screws.



Above: An unconventional ram screw which drives the 'opposite' end of the ram (last 235 removed for clarity). Using a Threaded Coupling as the 'nut' is optional.

A more conventional arrangement powered from the bottom pivot point uses a "fake" cylinder body to conceal the rotating screwed rod. The cylinder body made up of two angle girders and is only attached to the bottom collar. The piston is an elaborate construction using Aero Collars (mainly to reduce the overall size—ordinary Collars and Threaded Boss may suffice). The rotating Threaded Rod drives a square Nut trapped between the Narrow Strips. A wider nut from a non-Meccano set also works well.



Below: Concealing a threaded rod using strips and a "fake" cylinder made up of Angle Girders. Aero collars have been used, although it may be possible to get this idea to work using normal sized Collars, albeit a bit oversized.

An advantage of this method is the 3" of travel obtained from a 3" cylinder. Care must be taken not to over-drive the piston, or the mechanism can buckle catastrophically if the piston falls out under load.
In theory, two pistons can be actuated simultaneously (on both sides of a digging arm for example) and still be fairly synchronised. A requirement would be to gear both trace lines together!

A couple more tips if Mr. friction just won't let anything run: use grease liberally on screw thread and load bearing surfaces! Alternatively, use one of those wonder-oils they always seem to punt on TV—they really do work! MW used to sell washer-sized thrust bearings which can be put to good use in strategic locations, without significantly reducing the travel of the piston.

Failing that, try get some 4mm dished washers from your local hardware store and use 2mm ball bearings trapped in the dish as a great thrust washer.

A final idea is in development.