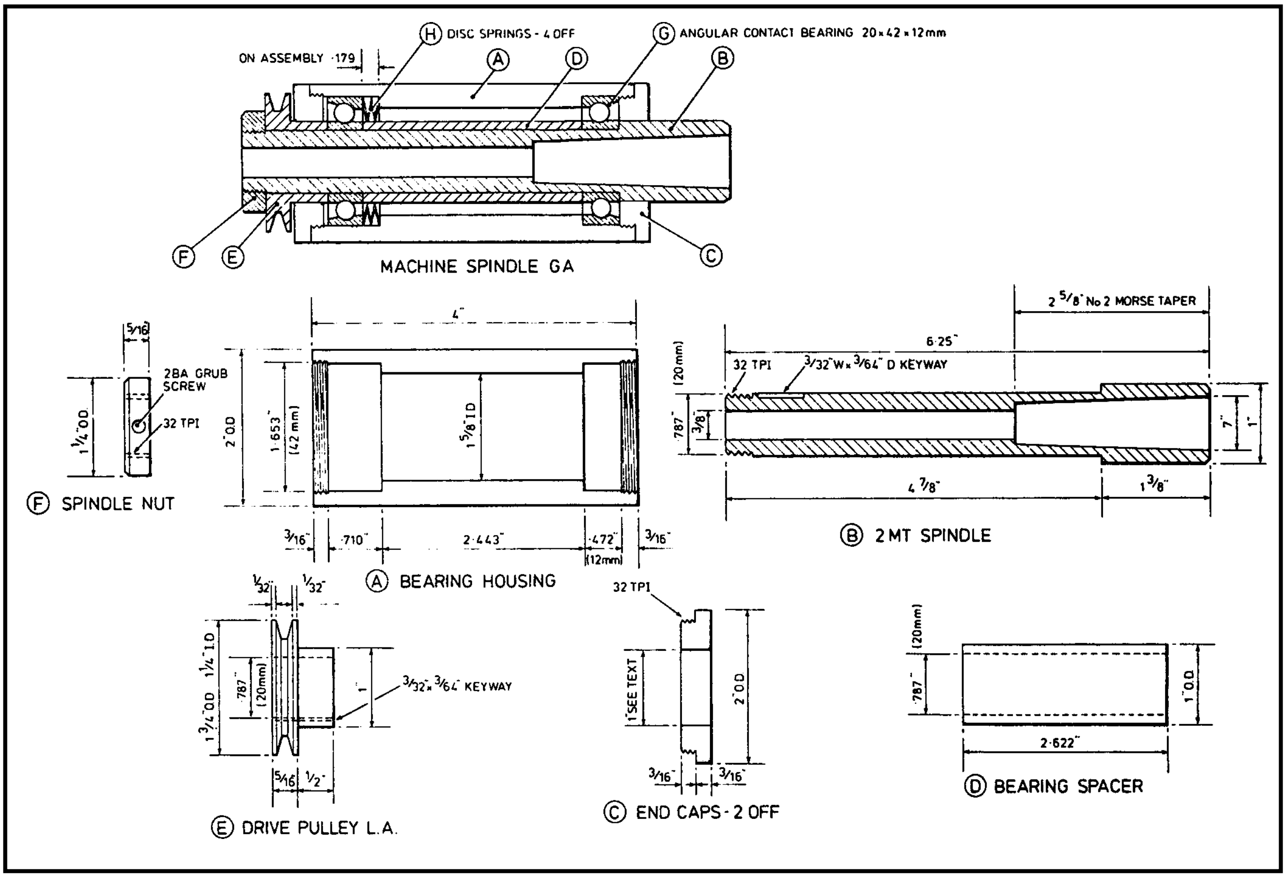
A HEAVIER DUTY SPINDLE

In this concluding article D. Broadley B.E.M., outlines the construction of a heavy duty spindle suitable for drilling or light milling work. He concludes with a description of the properties of the spring washers specified.

Part III (conclusion) from 'Model Engineer' page 85 (17 July 1992)



The principles involved in the design of a grinding spindle have been fully described but the principles need not be confined to grinding spindles which can be made in various sizes within the range of easily available angular contact magneto bearings. As explained earlier the grinding spindle described in this feature is somewhat larger than some, deliberately so in order to make it that little bit easier to make. However much larger spindles can he made on the 3½inch amateur lathe.
The loading on a grinding spindle is very light, taking off a few tenths of a thou. at each pass. There is no reason why the same kind of spindle should not be used for drilling, particularly for high speed, but also for light milling and gear cutting (you clockmakers). Although I have not made one I have checked to ensure that a 1MT taper can also be accommodated in the grinding spindle. For heavier duty 2MT will be preferred and again although I have not produced such a spindle, there are bearings and suitable disc springs available and I see no reason why the design cannot be extended to heavier duty. I have therefore drawn up a larger spindle for those requiring a machine rather than a grinding spindle.

The machine spindle

The machine spindle is more substantial than the grinding spindle but follows the same principles. It uses a larger spindle to accommodate the 2MT taper and therefore has larger bearings for which I have selected 2 angular contact units, although I would also recommend a deep ball bearing at the tool end for the heaviest

duly. If you decide to do this do not forget to adjust the dimensions for the wider deep ball bearing.

A 2MT taper will allow a variety of tooling to be used for milling, gear cutting and drilling as some of many examples and could even feature a Myford nose. As a matter of interest on first drawing it out I was concerned at the notch created between the taper and the front bearing. A simple calculation ignoring any stress concentration revealed that the spindle torque rating was more than 60% the strength of the solid shaft, such is the property of a tube. Although also subject to bending it is supported by the tool. I would however recommend that you put in the small radius allowed for by the bearing. It will make me feel happier.

I appreciate that the spindle is considerably longer than the grinding spindle and that most amateurs will not have access to a 2MT reamer. A blank with the 2MT taper is available from Hemingway's.

It seems hardly necessary to add further comment on the production of this spindle. I would however comment that I have not shown a seal for this design, for one thing not to make it any longer over the bearings than is necessary. I have also, to some extent, changed my mind on the use of oil rather than grease, it being only essential for really high speed use. I would therefore recommend either a fine lapped fit, great care being required in the accuracy of cutting the 32 TPI screw thread for the end caps for it to work, or just a simple felt seal which can be accommodated in the endcap dimensions. The only other point I wish to make is that I have allowed for 10 lbs. of preload in this case to allow for the extra load.

Also since completion of the text I have read those excellent articles on Poly V Belt drives by G.F. Deane which started in *Model Engineer* Volume 165. This would give an excellent solution to spindle drive don't you think?

Spring design

Finally I did promise to say something about bearing spring design. This is more than adequately covered in manufacturer's design instructions, which may not be available to all readers. When you receive them you will see that they are a form of what I know as a Belleville washer but much thinner. They are manufactured in a variety of sizes to suit all sizes of bearings. They are used in a stack of 4 here for the reasons given and since they are used in series their spring rate is only a quarter of that of a single spring. The design data direct from the catalogue is as follows:

Bearing	OD	ID	Thickness	Height	Spring rate lbs./thou.
a) 15mm x 35mm	34.6	22.4	0.4	1.2mm	1.222 (0.30 per 4)
b) 20mm x 42mm	41.6	25.5	0.5	1.4mm	0.960 (0.24 per 4)

I apologise for using a mixture of metric and imperial but I judge, perhaps wrongly, that the majority of readers prefer loads at least in lbs. rather than Pascals! The number in brackets refer to the 4 disc springs used.

Taking a) first the undeflected height of the stack is 4x 1.2 = 4.8mm = 0.189in. This must be reduced by the preload 5 divided by 0.3 = 16 thou. Therefore the deflected height of the stack is 0.173in. which automatically gives the 5lbs. of bearing preload.

Similarly for b) the undeflected height is reduced from 0.22in. to 0.179in. for 10 lbs. of preload. These are of course the dimensions you will find on the drawings. I know that many of you will have your own ideas about making these items, and so you should, but I have attempted to outline a design within the reach of the not so experienced.