Notes on 

LATHE DESIGN

By “G.E.S.”

ALTHOUGH many articles have been written about small lathes and many ideas suggested for model engineers’ lathes, there is little information available as to those principles and proportions which make for success in lathe design. Out of a long experience and much research the following data have been obtained. These, wisely used, will produce a sound design for any ordinary sliding and surfacing lathe whether of 1-1/2 in. centres or of 9 in. centres—the same proportions will answer in all cases. It would be a fascinating exercise to make a 1-5/8 in. or 1-3/4 in. centre lathe for tiny jobs.

The proportions are worked from the centre height, thus allowing for a design of any centre height. Where awkward fractional figures are obtained, these may be brought up to the nearest standard fraction above, C.H equals centre height.

(I) Bed sizes: Width, minimum, 1-1/2 x C.H. If possible, the distance from the centre line to the front edge should be equal to the centre height, if not 2/3 of the width should be in front of centre line. Height, minimum, 1-1/4 x C.H. with feet extra or flat base and feet bolted on. Shear thickness, at least 1/8 x C.H. or 3/16 x C.H. for small lathes. The front shear should be of rectangular section and narrow in width. The back shear should be from one third to three eighths of the total width, and is best with two 60 deg. (or 55 deg.) edges. The centre line of the lathe can be the front line of this shear, on which the tailstock is wholly carried. The drawing illustrates one idea embodying this.

The bed casting should be of box section, as this can be designed with no loose strips, and only one draw-off core piece. A bed of 150 pounds weight was successfully cast in this way. Quite thin metal can be used, if great care is taken to avoid sudden changes of section (see drawing).

(2) The headstock. This is a simple casting, which may be any one of several shapes. As drawn, it is an easy matter to cast and machine, without

tag bearing, 5/8 of C.H. and with length, 1/2 to 5/8 of C.H. The pulley bearing is some standard size in between these sizes, and the nose of the mandrel is equal to main bearing, or larger, according to collets fitted. The mandrel should be of at least 30-ton tensile steel. Finish to the mandrel can be either fine turned and lapped; or turned and ground, but in the latter case some slight lapping must be allowed for, to give the necessary precision fit.

Tailstock. This is a simple casting, which may be any one of several shapes. As drawn, it is an easy matter to cast and machine, without

Widia” or “Wimet” tools, and hand lapped to fit. Proportions: Front bearing, 4/10 of C.H. and half the centre height in length;
Sectional elevation of lathe headstock based on data contained in the article

Part plan of headstock base
elaborate patterns or complicated machining operations. The barrel is fully floating, as the nut and screw are inside the barrel. Proportions—the barrel should be at least 1-1/2 x the diameter of the centre fitted and have a travel equal to the normal length of a standard 3/8in. drill (4-1/2in.) in sizes up to 4-1/2 in. lathe, and equal to the normal length of a 5/8in. drill (5-1/2in.) in sizes above. The loose base makes for ease of fitting, and gives a desirable accessory, even if not used frequently.

Whether an apron is fitted depends on the desires of the users. In practice, it is vital that if one is fitted, there should be a separate leadscrew and tail shaft; not, as so often done, a combined tall shaft and leadscrew. Where no screwcutting is contemplated, a simple apron with cross and sliding traverses later on. All that is required as a basis for calculation is the highest speed and the lowest speed required (worked from the largest diameter to be worked and the smallest ditto). There are standards available in table form, but in cases of special nature, the formula is:

\[ R = \frac{n - 1}{\frac{b}{a}} \]

This formula can be written and worked as follows:

\[ \log R = \frac{\log b - \log a}{n - 1} \]

In actual practice, the figure given would involve too many changes for the range desired in small engineering, so up to 66 per cent. is used to give few changes. The drive to give these can be an all vee-belt drive in small sizes of lathes, and a vee-belt drive with epicyclic gear for lower speeds in larger lathes. This gear is housed in the shaft pulley, out of the way, but handy to throw into gear if wanted, (see drawing).

(To be continued)