

# TURNING SPHERICAL RADII . . . . . By Geometer

**W**HEN HIGH PRECISION is not essential there are several ways in which the spherical radii of ball-ended components can be machined in the lathe with the minimum of equipment.

On parts that are not required to fit others—such as ball handles or knobs—neat appearance, good finish and reasonable adherence to size are the most important features and should occasion occur, a fair degree of precision can be obtained with care even by simple methods, using gauges for checking in the course of working. Form tools can be used of course in the smaller sizes and when the numbers of components justify their production.

Although it is in the nature of an impossibility to machine a good ball-end solely by manipulation of the top and cross-slides of a lathe, familiarity with its working can greatly improve on the result that might at one time have been considered possible. For a feature like that at A, for example, the ball would originally be left in a "square" by turning down in the neck with a parting tool then chamfering the left side out to the full diameter.

### Cheek with plate gauge

With a round-nosed turning tool, a start is then made on the corners of the square, the top and cross slide handles being manipulated to swing the tool in an arc. Progress can be checked by plate gauge, made by drilling or boring a hole of required size in flat material then cutting the surplus away. When the ball has been roughed-out and shaped-up reasonably by the tool, the surface is finished by files and emery cloth.

For an internal hemisphere, as at B, similar principles apply—except that it is not possible to file the surface for finishing. In place of this, a round-nosed hand scraper can be used on a support bar close to the work, or a form tool can be employed for the final scraping cuts, followed by polish-

ing with emery cloth on the end of a finger or a rounded piece of wood.

Owing to the propensity for chatter to develop on broad cuts with form tools, the depth of cut should be kept to a mere scrape, with the work revolving slowly—the chuck pulled round by hand if necessary, succeeded by high-speed polishing. Again, a plate gauge can be used for checking, the end being filed to a scribed radius, or by clamping a suitable disc to the plate if the disc is not used itself. In most instances it is unnecessary to employ a gauge of the full half-circle type as at B; either half to the top or bottom of X-XI suffices.

A form tool for a ball-end is made in the manner of a plate gauge by drilling or boring a hole through material such as silver steel or cast steel, then sawing or filing the surplus away, as at C. Below the cutting edge the tool should be given clearance, either by careful filing or by finishing the full hole with a taper when it is bored.

### Harden and temper

Hardening and tempering are essential before use; and finish on the ball is much enhanced when the tool is given top rake by carefully grinding a groove behind the cutting edge. Preparation of the work as for A is advisable, keeping the form tool for finishing—at a slow speed and with a flow of suds or oil. Tools of this type should be set with the cutting edge flat and at centre height.

Simple round tubular tools with true ends chamfered like those of washer punches can be used for finishing ball-ends, and will each cover a range of sizes. Round silver-steel rod faced off square, drilled up, chamfered and heat treated can be used for small tools with a support bar on the slide, as at E. Suitable handles should be provided, of course.

A support bar again may be used for a pivoted tool for finishing ball-ends with curved necks, as at F.

