*Specialized Lathes.—*Outside of these main types of lathes there are a large number which do not admit of group classification. They are designed for special duties, and only a representative list can be given. Lathes for turning tapered work form a limited

number, and they include the usual provisions for ordinary turning. In some designs change wheels are made use of for imparting a definite movement of cross traverse to the tool, which being compounded with the parallel sliding movements produces the taper. In others an upper bed carrying the heads and work swivels on a lower bed, which carries the slide rest. More often tapers are turned by a cross adjustment of the loose poppet, or by a taper attachment at the rear of the lathe, which coerces the movement of the top or tool-carrying slide of the rest. Or, as in short tapers, the slide-rest is set to the required angle on its carriage. Balls are sometimes turned by a spherical attachment to the slide-rest of an ordinary lathe. Copying lathes are those in which an object is reproduced from a pattern precisely like the objects required. The commonest example is that in which gun-stocks and the spokes of wheels are turned, but these are used for timber, and the engineer’s copying lathe uses a form or cam and a milling cutter. The form milling machine is the copying machine for metal-work. The manufacture of boilers has given birth to two kinds of lathes, one for turning the boiler ends, the other the boiler flue flanges, the edges of which have to be caulked.. Shaft pulleys have appropriated a special lathe containing provision for turning the convexity of the faces. Lathes are duplicated in two or three ways. Two, four, six or eight tools sometimes operate simultaneously on a piece of work. Two lathes are mounted on one bed. A tool will be boring a hole while another is turning the edges of the same wheel. One will be boring, another turning a wheel tire, and so on. The rolls for iron and steel mills have special lathes for trueing them up. The thin sheet metal-work produced by spinning has given rise to a special kind of spinning lathe where pressure, and not cutting, is the method adopted.

*Methods of Holding and Rotating Work. Chucks.*—The term chuck signifies an appliance used in the lathe to hold and rotate work. As the dimensions and shapes of the latter vary extensively, so also do those of the chucks. Broadly, however, the latter corre­spond with the two principal classes of work done in the lathe, that *between centres,* and that held at one end only or *face work.*

This of course is an extremely comprehensive classification, because chucks of the same name differ vastly when used in small and large lathes. The chucks, again, used in turret work, though they grip the work by one end only, differ entirely in design from the face chucks proper.

*Chucking between Centres.*—The simplest and by far the commonest method adopted is to drill countersunk centres at the ends of the work to be turned, in the centre or longitudinal axis (fig. 34, *A*), and support these on the point centres of headstock and poppet , The angle included by the centres is usually 60°, and the points may enter the work to depths ranging from as little as 1/16 in., in very light pieces to ½ in., ¾ in. or 1 in. in the heaviest. Obviously a piece centred thus cannot be rotated by the mere revolution of the lathe, but it has to be driven by some other agent making con­nexion

between it and the mandrel. The wood turner uses a forked or prong centre to obtain the necessary leverage at the headstock end, but that would be useless in metal. A *driver* is therefore used, of which there are several forms (fig. 34), the essential element being a short stiff prong of metal set away from the centre, and rotat­ing the work directly, or against a *carrier* which encircles and pinches the work. As this method of driving sets up an unbalanced force, the “ Clement ” or *double driver* (fig, 34, *D),* was invented, and is frequently made use of, though not nearly so much as the common single driver. In large and heavy work it is frequently the practice 10 drive in another way, by the dogs of the face-plate.

*Steadies.—*Pieces of work which are rigid enough to withstand the stress of cutting do not require any support except the centres.

But long and comparatively slender pieces have to be steadied at intermediate points (fig. 35). Of devices for this purpose there are many designs; some are *fixed* or bolted to the bed and are shifted when necessary to new positions, and others are bolted to the carriage of the slide-rest and move along with it—*travelling*