large quantities, the guide-screw and change wheels give place to other devices, one of which involves the use of a separate master-screw for every different pitch, the other that of encircling cutting in­struments or *dies.* The first are represented by the *chasing lathe,* the second by the *screwing lathes* and *automatics.* Though the principles of operation are thus stated in brief, the details in design are most extensive and varied.

In a chasing lathe the master-screw or *hob,* which may be either at the rear of the headstock or in front of the slide-rest, receives a hollow clasp-nut or a half-nut, or a star-nut containing several pitches, which, partaking of the traverse movement of the screw- thread, imparts the same horizontal movement to the cutting tool. The latter is sometimes carried in a hinged holder, sometimes in a common slide-rest. The attendant throws it into engagement at the beginning of a traverse, and out when completed, and also

changes the hobs for threads of different sections. The screwed stays of locomotive fire-boxes are almost invariably cut on chasing lathes of this class.

In the screwing machines the thread is cut with dies, which encircle the rotating bar; or alternatively the dies rotate round a fixed pipe, and generally the angular *lead* or advance of the thread draws the dies along. These dies differ in no essentials from similar tools operated by a hand lever at the bench. There are many modifications of these lathes, because the work is so highly special­ized that they are seldom used for anything except the work of cutting screws varying but little in dimensions. Such being the case they can hardly be classed as lathes, and are often termed screwing machines, because no provision exists for preliminary turning work, which is then done elsewhere, the task of turning and threading being divided between two lathes. In some cases

this is an economical system, but in others not. It cannot be considered so when bolts, screws and allied forms are of small dimensions.

*Hollow Mandrel Lathes.—*It has been the growing practice since the last decade of the 19th century to produce short articles, re- quired in large quantities, from a long bar. This involves making the lathe with a hollow mandrel; that is, the mandrel of the head- stock has a hole drilled right through it, large enough to permit of the passage through it of the largest bar which the class of work requires. Thus, if the largest section of the finished pieces should require a bar of 1½ in. diameter, the hole in the mandrel would be made if in. Then the bar, inserted from the rear-end, is gripped by a chuck or *collet* at the front, the operations of turning, screwing and cutting off done, and the bar then thrust farther through to the exact length for the next set of identical operations to be

performed, and so on. This mechanism is termed a *wire feed,* because the first lathes which were built of this type only operated on large wires; the heavy bar lathes have been subsequently developed from it. In the more advanced types of lathes this feeding through the hollow spindle does not require the intervention of the attendant, but is performed automatically.

The amount of preliminary work which has to be done upon a portion of a bar before it is ready for screwing varies. The simplest object is a stud, which is a parallel piece screwed up from each end. A bolt is a screw with a head of hexagonal, square or circular form, and the production of this involves turning the shank and shoulder and imparting convexity to the end, as well as screwing. But screw-threads have often to be cut on objects which are not primarily bolts, but which are spindles of various, kinds used on mechanisms and machine tools, and in which reductions in the form