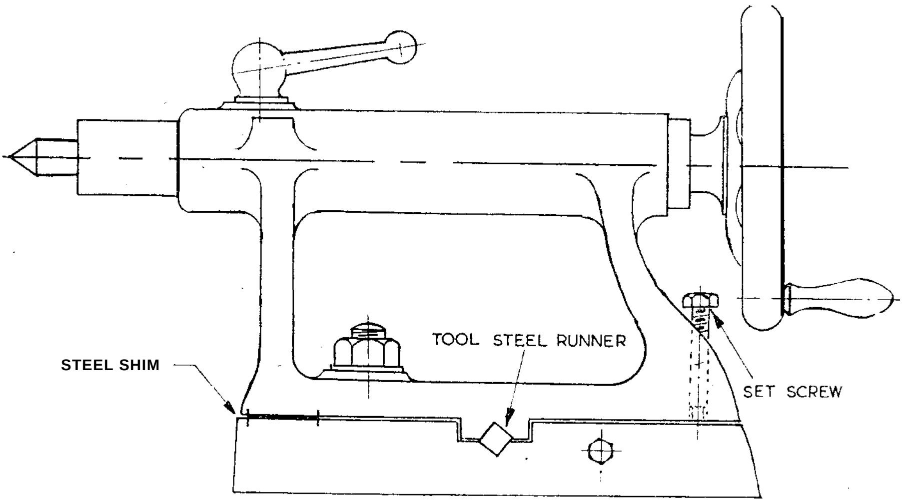
LATHE TAILSTOCK ALIGNMENT

by F. BUTLER



THE effect of wear and tear of the tailstock assembly of a lathe affects the accuracy of the finished product in several different ways. Wear on the bed-ways or tailstock soleplate lowers the effective centre height and results in the production of tapered work, the rate of taper being dependent on the work diameter and length. On flat-bed lathes in which the parallel central slot serves to align the movable headstock through the medium of a parallel gib-piece fixed under the soleplate and sliding between the bed-ways, there is normally no provision for adjustment, and in time the tailstock barrel becomes capable of some small angular movement which can result in the production of inaccurate work. Worse still, the errors are not consistent and it becomes necessary to make trial cuts before they become evident.

Further inaccuracies owe their origin to the set-over device employed for taper turning. They arise because of slackness between the soleplate and the upper portion of the tailstock assembly. Still another source of error is due to the barrel locking mechanism. Usually the basic design is rather poor, the clamping forces give rise to eccentric stresses and the axis of the spindle is often swung out of alignment with the principal axis of the lathe.

In lathes with American-pattern V-beds, wear results only in a small reduction in the effective centre height while the axial alignment remains undisturbed, but the errors due to the set-over mechanism are just as serious as in other types of machine. The present note describes some work undertaken to correct serious inaccuracy in a 6-in. centre lathe. Before starting on this operation, the fixed headstock had been completely overhauled, a new mandrel fitted and the main bearings had been re-bored. Chucking operations showed that a 4-in. test-piece could be turned parallel within 0.0003 in. Similar small errors were present in deep bored holes. It proved impossible to better these figures without employing a dangerously small clearance between the main spindle and the split gunmetal bushes.

Returning to the tailstock modifications, it will be seen from the diagram that the worn rectangular tenon under the tailstock is no longer employed to constrain the motion of this part while it is being set over. Instead, a short length of square-section machined tool-steel is fitted into V-grooves cut into the upper and lower components of the assembly. To correct for the small reduction in centre height, already mentioned, a slip of hardened shim-steel sheet is employed to pack up the front end of the tailstock. At the handwheel end, a set-screw adjustment is provided, and serves to remove any tendency for the upper component to rock on the edges of the tool-steel bar, and it also provides additional support which prevents the tailstock centre lifting appreciably under heavy cutting stresses.

Before undertaking any of the work of alignment, the existing tailstock spindle was removed and the bored hole in the main casting lapped out parallel throughout its length. An expanding cast-iron lap was used, driven from the lathe headstock. A new spindle was then machined from a nickel alloy-steel forging and fitted tightly into the lapped bore.

The two V-grooves were then finished to size,

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screwed end is turned to size first, it may be supported in a hollow centre while machining the main diameter, which should be dead parallel, well finished, and a good fit in the bore of the guide Set the top-slide over to 45 deg. to finish the seating. After parting off, the valve stem may be held in a shim of metal foil for cleaning up the head. A slot may be cut across the head to take a screwdriver for grinding in, but very little of this treatment is either necessary or desirable ; I find it sufficient to twirl the other end of the valve between thumb and finger, using a little brick dust or Vim as an abrasive.

To make the thrust plate, a piece of round steel bar about 7/8 in. diameter may be used ; this is held in the chuck, faced, drilled and tapped 4 B.A., and a slight boss turned to locate the spring. It is then parted off and cleaned up on the top surface, after which the hole for the nipple is drilled and tapped 5/16 in. off centre, and the unwanted metal cut away. This will be found easier and quicker than making the plate from flat or rectangular bar of more approximately correct initial shape.

The cable adjusting nipple is of the type very commonly used on Bowden cable fittings, and therefore calls for little comment. It will be found worth while to make this of mild-steel, which is more durable than brass, though the latter is often used for the sake of easy production. The recess in the head should form a close-fitting socket for the cable casing, and a hole giving free clearance for the inner cable is drilled right through.

When assembling the components, a spring strong enough to seat the valve positively and firmly should be fitted. Readers often expect me to give exact specifications of springs referred to in these articles, but that is not so easy as it sounds. The strength of a spring is not necessarily dependent entirely on the gauge of wire, number of turns, and diameter of the coil, as the elasticity of different spring materials varies within wide limits. Even in commercial practice, spring design is often tentative and experimental, and I know of many cases where several different springs have had to be tried before the desired result is achieved. In the present case, I suggest that a spring of about 20 gauge piano wire (without subsequent tempering), about 1/4 in. internal diameter, and having six complete turns, excluding flattened end turns, will be about correct. The ends of the spring should be ground square with the axis, and the free length should be not less than 5/16 in

As the end of the cable does not have to be fitted with a soldered nipple, it is not necessary to slot the thrust plate to get the cable in ; all that is required, after fitting the nipple and inserting the cable, is to bend the end of the latter into a tight loop with round-nose pliers and clamp it to the body with an ordinary 4 B.A. steel screw and a couple of washers. If subsequent shortening of the cable is found necessary, beyond the amount provided by the adjusting nipple, a new loop can be made and clamped again as before. By the way, I presume readers to have some knowledge of fitting cable controls, and if so, they will know that the cable ends should always be soldered to keep the strands together while fitting.

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the bulk of metal being removed by drilling, sawing, chipping and filing. As the finished size was approached, periodic checks were made with a dial indicator, care being taken to keep the centre height safely above the nominal figure of 6 in. When it became evident that the final adjustment could be made by scraping to size, the measuring technique was changed. A dial indicator was clamped to a small faceplate on the lathe headstock spindle. The tailstock was then moved along the bed until the indicator plunger came into contact with the outside of the barrel. Hand rotation of the lathe spindle pulls the indicator round the end of the tailstock spindle in a planetary motion. The object to be attained is to ensure that, during one entire revolution, the indicator reading remains quite steady.

This particular operation was first performed with the tailstock barrel fully retracted and then repeated with the spindle projecting about 3 in. A succession of tedious adjustments were required before identical indicator readings were observed in the two cases. After each scraping process, all the dimensions were altered. Extreme caution was required in the final stages of the adjustment. It was then found that, by tightening the clamping set-screw at the end of the tailstock, there was sufficient spring in the castings to cause a slight vertical movement of the end of the tailstock spindle, amounting to about 0.002 in. This fault seemed unavoidable, but it causes negligible errors in plain turning, since there is no appreciable lateral motion of the spindle. All indicator readings were made with the tailstock barrel tightly locked.

It is clear that the standard design of this part of the lathe is open to a great deal of criticism, and the same inherent faults are often present in modern tool-room lathes. From the point of view of the model engineer, a complete redesign should be worth considering by some enterprising manufacturer. If the soleplate was constructed in the form of along and rigid cross-slide and if the tailstock spindle was made of heavy square-section bar, capable of being clamped in two places along its length, a wide range of milling operations could be undertaken with the aid of simple attachments. Other accessories would convert the unit into a useful capstan head. Additional fittings could be provided or slotting, keyway cutting and internal grinding operations.