Testing a Lathe

By J. Latta

THERE is an old saying that a bad workman blames his tools ; the converse of this is that a good workman is one who knows how to put his tools right. I don't propose to explain how to correct an inaccurate lathe, but only to show how it should be tested for faults, which, after all, is the essential preliminary to making up your mind to do something about it.

Few amateurs are in the happy position of being able to pay the price of a first-class machine, the accuracy of which the maker will guarantee to Schlesinger limits; nevertheless, quite cheap lathes are often surprisingly accurate as regards the straightness of the bed and slides, and the true running of the mandrel, but fall short because the alignment of the various parts one to another has not been made with sufficient care. Careless handling in transit, or faulty setting up, can also cause trouble. If any errors in these respects can be put right, the time spent will be well worth while.

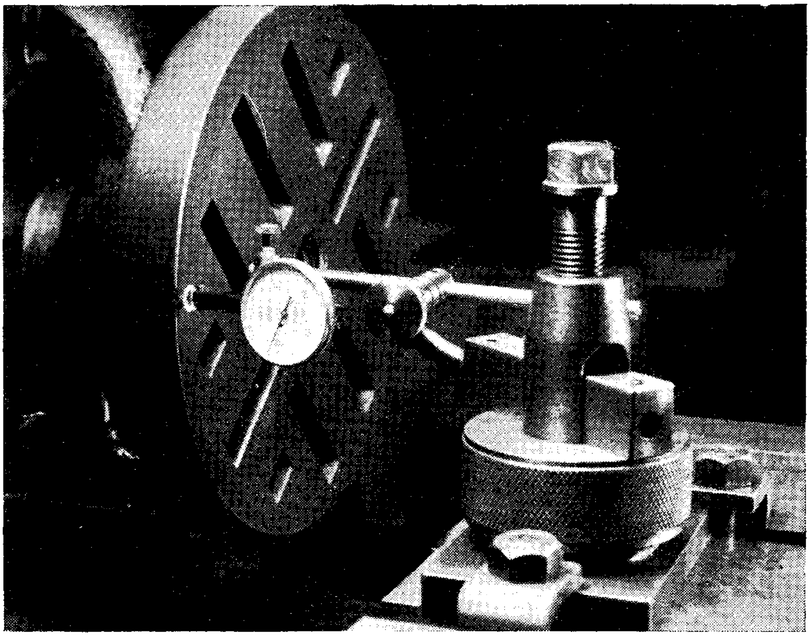
Now it might be thought that the quickest way to test a lathe for truth would be to check the work produced, but anyone who has tried this way will agree that it is slow and unreliable. It is seldom realised how much spring there is in the work itself, even with the lightest of cuts. For example, if the headstock is adjusted so as to turn parallel a piece of bar held in the chuck, a cylinder bored immediately afterwards will be found to be most unaccountably large at the back end. The error may not be great if the mandrel is a stiff one, and the work rigid, but it will be there all the same, and repeated attempts to get things just right by this method generally end in the unfortunate owner wishing he had left well alone.

Setting a headstock in perfect alignment is a slow job at the best of times, and the advice sometimes given to raise the headstock on packing so as to be able to swing an outsize job is most unwise. It is a long and tedious process getting it lined up again, and once correctly set, it should not be disturbed lightheartedly.

To check up a lathe reliably and speedily, a test indicator of some sort is almost essential, and if this most useful instrument is not in the workshop kit, perhaps one can be borrowed to do the job.

I need hardly say that before any testing is begun, the lathe should be carefully cleaned, all slides adjusted and oiled to work smoothly but without any slackness, as it is easy to get false readings due to swarf and grit.

The main requirements are not many,



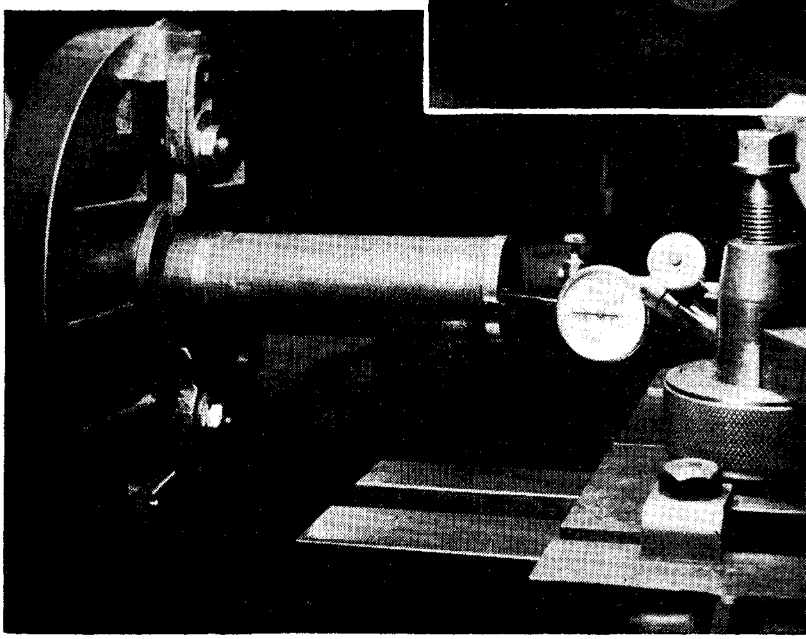


Fig. 2. Testing the cross-slide for accuracy of facing

Left : Fig. 1. Testing the alignment of the headstock

and can be summarised as follows:

(1) The headstock spindle should be parallel with the ways of the bed.

(2) The cross-slide should move at right-angles to the headstock spindle.

(3) The axis of the tailstock spindle and centre should be in line with the axis of the headstock when set in any position on the bed.

(4) If a boring table is fitted, its surface must be parallel to the bed and to the cross-slide:

(5) The taper holes for the centres should be concentric with their respective spindles.

The first item is much the most important, as on this depends the parallelism of all work done in the chuck, which probably covers 95 per cent. of all the model engineering done in a small lathe. Years ago, this was not the case, and between centre work was almost the rule, but nowadays a good chuck seems to cover nearly everything.

Assuming then that you have the use of an indicator, a test bar is needed to check the headstock. For a lathe of 3-1/2 in. centres, a convenient length is about 6 or 7 in.. and about 2 in. dia. It should have a'flange on one end so that it can be bolted to the faceplate; a piece of steam pipe with a flange screwed or welded to it makes an excellent bar, or it may be possible to find something suitable from the junk box. The bar shown in Fig. 1 is a piece of cast iron scrap of unknown origin, which shows the sort of thing wanted.

The advantage of a flange to bolt to the faceplate is that the bar can have the maximum of length for the minimum of overhang from the front headstock bearing. But if nothing with a flange can be obtained, a piece of stout pipe held in the chuck can be used instead.

Having got your bar, and set it up to run reasonably true, turn two bands on it about 3/8 in. wide, smooth and parallel, so that they can be sized with a micrometer. The bands should be as far apart as possible, consistent with being able to measure the inner one properly.

In the bar shown in the photograph, the two bands or collars stand proud from the surface, and this is an advantage, but is not essential. What is important is that the diameter of the two bands should be as nearly the same as your skill in turning and measuring will allow. The exact size does not matter a hoot, but they must be the same diameter.

If you have no micrometer, you must use calipers, but the stiff frame of a micrometer makes it much easier to detect a small difference in size. Owing to the overhang, only very light cuts can be taken when turning the outer band, and, if thesurface is at all rough to start with,, it may be advisable to support it with the tailstock until a smooth surface is obtained. However, the final cuts must be made without any support from the back centre.

Having completed all this to the best of your ability, fix the indicator in the toolpost as shown in Fig. 1, so that by racking the saddle along the bed, it can be brought into contact with each band in turn. The advantage of having the bands raised above the surface of the bar now becomes obvious, as the saddle can be moved to and fro to try each end of the bar, without having to wind back the cross-slide each time. If the cross-slide has to be moved, it must be brought back to the same position each time by means of the index on the screw.

There are some precautions that must be taken to ensure correct readings. It will probably be found that when the indicator is in contact with the bar, and the saddle is moved slightly, a small variation in the reading occurs, this may be due to a small fault in the gauge, but is more likely to be caused by the saddle rocking slightly on the bed, magnified perhaps by the fact that the gauge may have to stick out quite a bit in order to reach the band near the headstock. This can be avoided by always moving the saddle in the same direction along the bed when bringing the indicator into position. If these precautions are observed, and the readings on both bands exactly agree, then the headstock is perfectly lined up and you can rest content.

However, it is more than likely that there will be some discrepancy, and the question arises as to what is a reasonable result.

To begin with, it will be realised that any error found will be doubled in actual work, in the same way that feeding in a turning tool 0.001 in. takes 0.002 in. off the diameter of the job. At the same time, if the bands on the bar are 6 in. apart, any errors found will be proportionally less over a shorter distance, and most jobs turned or bored in the chuck are likely to be very much shorter than 6 in. on a 3-1/2 in. lathe, so, if you are careful, the test is a revealing one. However, something must be allowed for errors in testing, and it is probable that few will be able to get the diameters of the bands on the bar identical to better than a tenth; some who have to work with calipers only will have a hard job to get within half a thou. Then there may be further small errors in the test indicator, or in setting the cross-slide screw if the slide has had to be moved back. All these small errors may tend to cancel each other out, or they may be cumulative.

Personally, I would say that if the indicated difference over a length of 6 in. was less than a thousandth of an inch, I would be very satisfied, but if it was a good deal more than this, I would think that it would be worth while to try and correct it by setting over the headstock with the adjusting screws usually provided.

Before dismantling the test bar, a further check should be made to find out whether the spindle is parallel with the bed in a vertical direction. This is carried out in the same way, but with the indicator contacting the top side of the bar.

Any error here is not nearly so important as in the first test, as it has only a small effect on the narallelism of the work, but, if it is much out, it may cause trouble when drilling deep holes from the tailstock.

Our next test is to find out whether the cross-slide is at right angles to the headstock. and this is easily carried out without making up anything special. First find out the full travel of the cross-slide; it will be at least half the diameter that can be swung in the gap, and is generally much more.

Put on the big faceplate, set the cross-slide to mid travel, and mount the test indicator on the toolpost of the top-slide so that the contact point is opposite the centre of the mandrel. Now wind out the cross-slide to its full travel, or to the extreme edge of the faceplate if the slide is a long one and will reach that distance. Then bring the indicator forward with the top-slide until it makes contact with the faceplate, and note the reading; also, note the reading of the

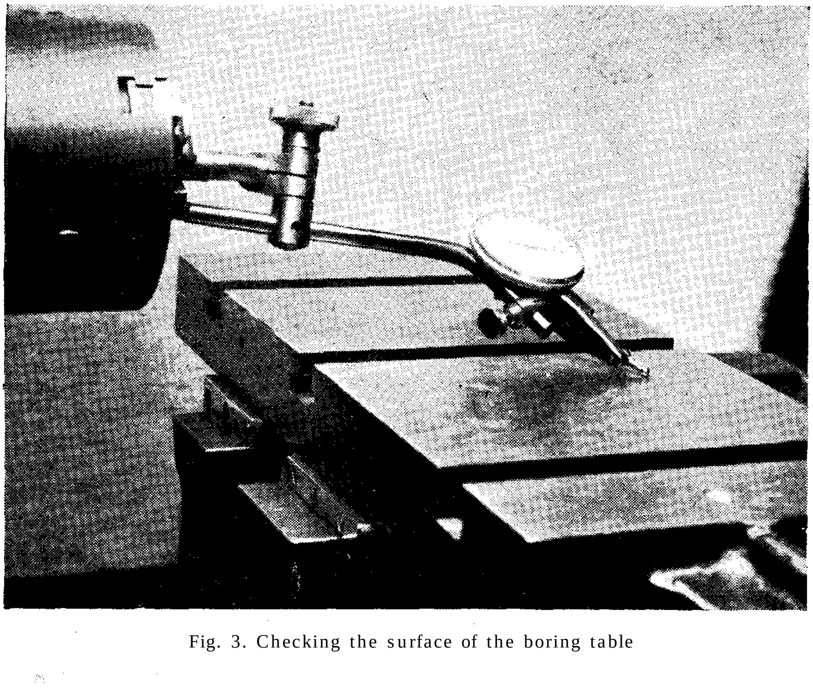


Fig. 3. Checking the surface of the boring table

index of the top-slide screw. Make a small circle in pencil or chalk around the point where the indicator made contact with the plate. Now wind back the top-slide a trifle so that the indicator is clear of the plate, and then move the cross-slide right over so that the gauge can make contact within the pencil circle when the faceplate is given half a turn.

If the reading here is the same as the first one, the cross-slide is at right-angles to the mandrel. This is a very accurate test, and does not depend on the true running of the faceplate, provided the same marked spot on the plate is used to take both the readings. Fig. 2 shows this test being carried out, and it will be noted that in this case the top-slide is not used, the saddle being brought up by the leadscrew instead.
should be repeated with the saddle locked, to make sure that the locking arrangement provided does not twist the saddle slightly; this may happen if the pinch bolt is not quite in the centre of the gib. Check also the effect of locking and unlocking the saddle when the indicator is touching the faceplate. There should be no appreciable movement ; if there is, then the saddle is slack on the bed, or the locking screw is badly positioned, and pulls the saddle out of line when it IS tightened.

It is usual to have a lathe adjusted so that it faces work slightly hollow rather than convex, but it should only be very slight, and not more than a thousandth of an inch over the full travel of the slide.

The next on the list for checking is the tailstock. Usually the surfaces on the bed which position this are separate from those which guide the saddle, but in some cases they are the same, e.g. the 3-1/2in. Drummond. Where the guides for the tailstock are not the same as for the saddle, wear may put them out of line with the rest of the bed, so that there is trouble when turning parallel between centres with the tailstock set in different positions.

However, it is very seldom that there is much wrong here, and what mostly happens is that the tenon or other guide gets slack through wear, and no longer positions the tailstock accurately, and in most cases there is no means of adjustment. It can be checked by clamping the tailstock to the bed in various positions, and bringing up the indicator held in the toolpost, to some fixed point each time, say the side of the barrel, and noting the reading of the cross-slide index.

It is equally important to make sure that the barrel itself is in line with the bed, and this can be tried by running the indicator along the side of the fully extended barrel, by racking the saddle to and fro. The test should be repeated with the barrel clamp tightened, when it is usually discovered that this throws it out of line slightly, even on a new lathe. Not much can be done about this beyond sorrowfully noting the error, but sometimes it can be made use of when turning between centres, to bring the centre over a trifle, by extra tightening of the clamp.

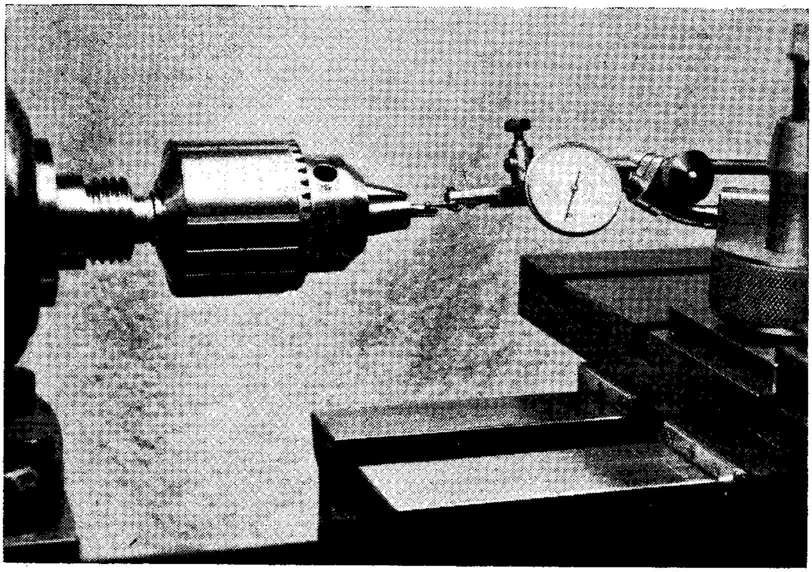


Fig. 4. Testing the truth of the centre hole in the mandrel

Alignment of the barrel with the bed in a vertical direction can be checked in the same way, but using the indicator over the upper side of the barrel. Needless to say, the barrel itself must be parallel and free from bruising if these tests are to mean anything.

On a lathe which has had a lot of use, or perhaps misuse, the base of the tailstock, where it slides on the bed, may have worn sufficiently to drop the centre height quite a bit, so that it no longer meets the headstock centre on terms of equality,. so to speak. Unless this is very serious, it will not affect parallel turning to any great extent, but it will affect drilling from the tallstock, and sometimes accounts for the otherwise inexplicable breakage of small centre drills, no matter how gingerly they may be advanced to work held in the chuck.

The extent of the fault is not difficult to discover. Mount a centre or a Morse taper peg having a short parallel portion in the headstock spindle; check that it runs quite true, then mount the indicator on a surface gauge seated on the ways of the bed, and try the indicator over the top of the peg. Remove the peg from headstock, put it into the tailstock, and repeat the performance; the difference in the two readings shows the extent of any error.

I have found very few small lathes that could be relied on to turn work dead parallel between centres every time, because there are too many small sources of error, and fortunately a good adjustable tail centre will take care of the few occasions hen accuracy in this respect is really vlt 1. However, to get it as near as you can, a long bar should be obtained, carefully centred at each end, and a spot marked on it a short distance from one end, so that when it is mounted between centres, theindicator mounted on the saddle can be brought opposite the marked place when the bar is reversed end for end. The bar need not be parallel, or even run quite true, provided care is taken to make the reading on exactly the same spot each time.

Checking the Boring Table

So much for the tailstock, and you can now proceed to check up the boring table, if the lathe has one. This is quite a simple job, and Fig. 3 shows the method of making this test. The procedure is self-evident. The slide is moved in all directions under the indicator, so as to completely explore the whole surface. It is reasonable to expect an accuracy of within a thousandth. If the error is greater than this, and you don't feel man enough to correct the surface by file and scraper, at any rate make a note of the deviations, so that you will know where to place a paper packing under the corner of the next job which needs to be " spot on."

The last item is to check the truth of the centre hole in the headstock spindle, and Fig. 4 shows how this is done. A small piece of rod is held in the drill chuck, and a short length turned true with light cuts. The relative positions of the taper peg and the mandrel are then marked with pencil, the chuck knocked out, given half a turn, and reinserted in the mandrel. If the test indicator is then brought into contact with the turned part of the piece of rod, and shows no wobble when the mandrel is revolved, the centre hole is true, and the

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tumbler reverse is fitted and hailed as a valuable asset, everyone being happy until people like " Jed " spoil the fun by rocking the boat.

I prefer the steadier action of a screwcutting train without the interposition of a flimsy tumbler reverse cluster which is, as " Jed " says, unnecessary.

Actually it is quite reasonably possible to have a 5/8-in. hole through a lathe spindle whilst retaining the use of 20 d.p. gears without a tumbler reverse: interchangeable spigots at the left-hand end of the lathe spindle being used, one to carry a 20-tooth wheel for normal use, and one with a 5/8-in. bore and 7/8 in. o.d. for use with a 30-tooth first driver and slightly modified screw-cutting gear train (if required) when it is desired to pass 5/8-in. dia. stock right through the lathe spindle.

Yours faithfully,
St. Leonards on Sea. MARTIN CLEEVE.

SECONDARY ELECTRIC CLOCKS

DEAR SIR,-In the June 16th issue of THE MODEL ENGINEER, you answer a query regarding secondary or slave clocks. I work for a large steel company which uses time circuits, consisting of master- clocks (four in all) controlling some 600 clocks, time recorders and time switches. The wall and panel clocks are manufactured by Messrs. Gents Ltd.,, Leicester. These consist of a solenoid, ratchet wheel and gears with a half-minute impulse of approx. 220 m/a current. For panel mounting, the firm purchase the movements, which consist of a plastic face plate with spindles protruding through for hands, and a plastic box-like cover. May I suggest if this is the type L.E.P. is wanting? he should contact the makers who definitely supply movements without cases and faces.

Messrs. Erricson make impulse converters and one-minute time recorders, but I can't say if they make one-minute clock units.

Yours faithfully,
Scunthorpe. B. TOMBLIN.

PORTABLE ENGINE DETAILS

DEAR SIR,-To Mr. Hughes' most interesting notes on portable engines I think might be added one on exhaust pipes. Until well into the '60's these were neatly led through the boiler barrel: the Ransomes engine was I think, the only one at the 1862 exhibition to have a external pipe along the top of the boiler.

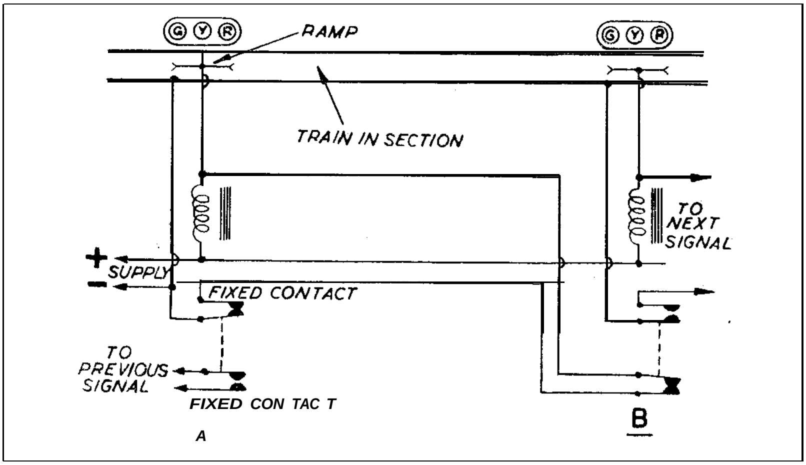
This Ipswich firm issued " Instructions to Drivers," which contained two points of interest. The first concerned governors: the balls were to be removed to avoid damage when travelling. The other related to the Salter spring-loaded safety-valves. Before raising steam the valve was to be taken out and replaced, thus ensuring it was not stuck. The spring balance was to be screwed down to about 5 lb. per sq. in.: as soon as steam began to blow off, the spring could be screwed down to the desired pressure. The R.A.S.E. believed in no higher pressure than 45 lb. In practice, the spring was loaded to suit the work, always the lowest pressure possible being selected, though there were instances of the lowest pressure being rather on the high side for the strength of the boiler !

Mr. Hughes does not mention the very small flywheel of the Turner engine: it suggests, and he may be able to confirm, that the normal speed was much greater than the usual practice. This may have been adopted on account of the crankshaft governor, though I have seen Turner engines with the Hartnell governor which to the best of my recollection had flywheels comparable to other makes.

Yours faithfully,
Ruardean, Glos. R. C. STEBBING.

OUTDOOR SIGNALLING

DEAR Sir,-If anyone is thinking of taking up " L.B.S.C.'s " signalling system, might I suggest the following modification for tracks where there is permanent electrical contact between running rails ? It obviates the continuous contact strip and uses instead a short contact ramp located near each signal.



Two extra pairs of contacts are used, and their function is as follows: The train makes contact at *A* and operates the light sequence as in " L.B.S.C.'s " circuit. As soon as the relay closes, however, it switches itself directly on to the supply, and thus does not fall out again when the train has passed over the ramp. When relay B is operated, however, this supply to *A* is broken and relay *A* returns to its normal position. Even when this supply line is energised again after the train passes beyond section B this does not have the effect of operating relay *A until the ramp at A is passed over again by the train.*

Yours faithfully,
Rugby. R.P.
(Engineering Apprentice).

GALVANOMETERS

DEAR SIR,-In your issue of March 31st, H.L.H. of Grays, asks for advice concerning a sensitive galvanometer.

" Science Masters' Book " (published by Messrs. J. Murray), Part I, Series 2, Article 176, will be of assistance to him. A desirable modification of the data given there is to use " Alnico " magnets and high-permeability pole-pieces. I have done this with success.

Yours faithfully,
Liverpool. LEONARD M. DOUGHERTY.

TESTING; A LATHE

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centre can be replaced in any position with the certain knowledge that it will run truly. However, it is most unlikely that no error will be found, thus emphasising the oft repeated advice to always replace the headstock centre to a marked position.

If this test reveals a gross error, it is probable that there is some dirt m the centre hole, and careful inspection may show a small chip embedded in the bore.

These tests will cover all requirements as regards the general run of work done on a lathe, and if carefully carried out will give a very fair idea of what faults exist. Whether they can be corrected depends on what means of adjustment are provided, and the skill of the owner.

It is worth mentioning, as a final word, that many a good lathe has been pulled out of truth by bolting it down firmly to an uneven bench. So make sure that you are blameless in this respect, before you blame the machine or the maker.