Accurate Working with the Chuck

By " Boggler "

THE model enthusiast who has just purchased a brand new three-jaw self-centring chuck, removed the various layers of greasy paper and sat gazing at the handsome and shiny piece of mechanism, will no doubt be thinking that at last here is the answer to really getting on with the model in hand; after all, the makers have guaranteed it to hold round stock concentric to within one thousandth of an inch, and for the first time, it will be possible to chuck hexagon bar to get those bolts made in real luxurious comfort. Three cheers for three-jaws !

Doubtless, after the chuck has been carefully fitted to its backplate, the anticipated results will -be obtained, but after a period, which will vary from a few months to a few years, according to the amount of work and use to which the chuck is put, certain undesirable errors will make themselves apparent: First, usually on assembly of a piece of work which has been made with the help of the chuck, whilst later the chuck will be so far " out " that there will be a noticeable wobble or eccentric motion imparted to work held in the chuck.

The writer has suffered from these chucking troubles, but has been able to find a cure for most of them.

First, it is reasonable to say that these faults which develop are very rarely due to bad workmanship during manufacture, most working chuck parts being made from special hard wearing alloy-steel, to very close limits.

One method of approach to the problem, adopted by the writer, may come as rather a surprise to those not already familiar with the idea. in that it consists primarily, in the removal of the register from the backplate.

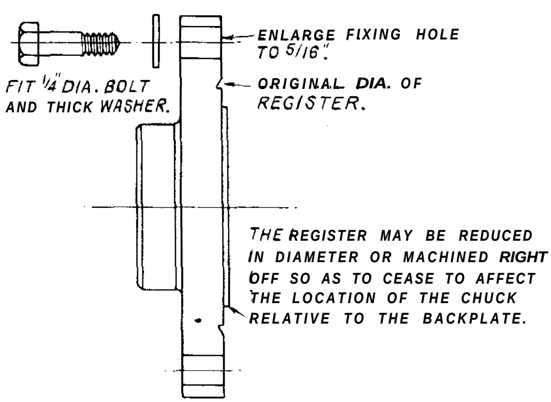

Fig. 1. *Backplate, showing treatment required*

Reference to Fig. 1 will give an idea as to what the backplate should look like after treatment. The-register should be machined away, or reduced in diameter. so as to have no further effect in the location of the chuck relative to the backplate. The usual three fixing holes should be enlarged so as to allow for a small movement of the fixing bolts within the holes, and a fairly thick washer should be provided for each fixing-bolt, so that the washers do not get "dished" into the holes, which might happen to a thin washer, as the holes are oversize.

If the chuck has been fitted with hexagon socket-head cap screws, it would be an advantage to change these for ordinary hex. heads, since, if it is desired to adopt the system being described, these screws will have to be frequently adjusted, and owing to their location it is easier to use an ordinary spanner.

Assuming the above alteration to the backplate has been carried out, the backplate can be re-attached to the chuck, leaving the fixing-bolts a little more than finger-tight, and the whole screwed on to the lathe spindle nose, whereupon, in order to re-set the chuck to the best advantage for average work,. a piece of, say 3/4 in. diameter bright mild-steel (do not use silver-steel, as it is seldom truly circular) may be gripped in the jaws (Fig. 2) and the dial indicator mounted on the cross-slide, or top-slide, so as to obtain a reading from the test-piece; then, by rotating the work, the clock needle will indicate in which direction the chuck body needs to be tapped to get the test-piece to revolve concentrically, after which the chuck fixing-bolts can be tightened with the spanner.

To set the chuck in cases where some sort of test indicator is not available, a piece of steel which

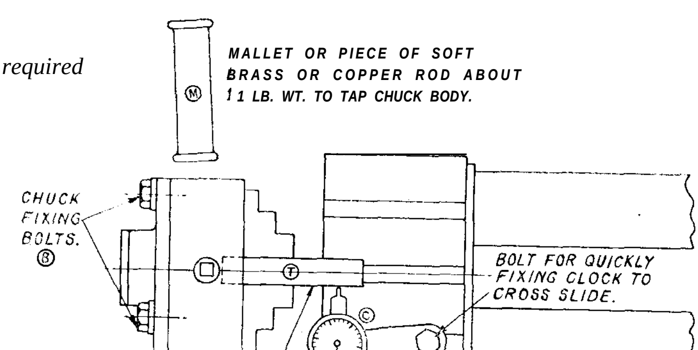

Fig. 2. Set-up for setting chuck for average work. With B just over finger tight, rotate chuck by pulling belt. Read error on clock C, correct by tapping chuck with M. Tighten B

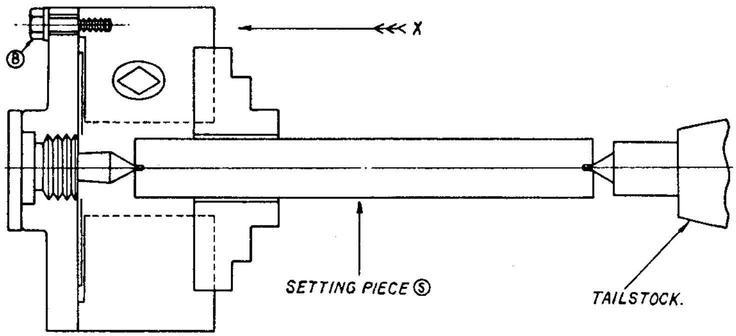

Fig. 3. To set chuck for average work without " clock." Mount setting bar S between centres, with bolts B slack, push chuck in direction of arrow X, tighten jaws on to bar S. Body of chuck will move to suit position taken up by jaws. Tighten bolts B

has been previously machined between centres, may be mounted between centres (Fig. 3) and the chuck jaws closed down on to that; in this case the fixing screws being barely finger-tight to allow the body of the chuck to move rather more freely, as it will when the jaws are closed. When the chuck has been set by either of the above means, the fixing-bolts should be tightened, and the chuck will be ready for a variety of work where only moderate accuracy is required.

Of course, the method of setting shown in Fig. 3 presupposes that the headstock centre is already true. If there is any doubt about this, it would be as well to set the top-slide and take a truing cut.

In special cases, as for example, where it may be desired to re-chuck a number of fully machined bushings, all of the same outside diameter, with a view to opening out the bore whilst maintaining concentricity with the outer surface, the chuck fixing-screws should be slackened as before, the bush gripped in the chuck, and the outer surface " clocked " true (see the set-up in Fig. 2) when,. after re-tightening the chuck fixmg-screws, the proposed boring may be safely carried out. Where a number of bushings require such treatment, this method will be found to be quicker than working with the four-jaw independent chuck, although, if accuracy in the region of plus or minus 0.00025 in. is required, the independent chuck had better be used.

It should here also be remarked that to set the chuck for the boring of the bushings, when an indicator is not available, a mandrel or setting-bar may be turned between centres, this bar to carry a step, about 2 in. in length, of the same diameter as the outside diameter of the bushings. This may then be used to set the chuck as in Fig. 3.

Thus, it will be seen that, essentially, the idea is to allow the work to revolve truly, any error in the chuck being transferred to the chuck body, where, unless the chuck is badly " out," or very high speeds are used (speeds in excess of 1,000 r.p.m.) the eccentric movement of the chuck body will do no harm.

Objection has been raised that the chuck might slip or move relative to the backplate under cutting conditions. The writer has had two 4 in. three-jaw self-centring chucks (to eliminate time otherwise wasted in reversing jaws) in use for about 13 years, and the only time the chuck moved relative to the plate, was when a final spanner tightening had been overlooked, and the fixing-bolts were left just a little more than finger-tight ; even then, considerable work had been carried out on a component before the chuck shifted. After all, if due consideration is given to the matter, there is available quite a large frictional area of contact between the backplate and a 4 in. chuck, and the alteration can be made with every confidence.

In many cases, an apparent error in a chuck can be traced to turnings, brass and cast-iron dust being especially liable to get inside to the scroll when the jaws have been opened far enough to expose part of the latter, as for boring a bushing of fairly large diameter; therefore, the chuck should be frequently taken to pieces and cleaned. It is appreciated that the model engineer, with his limited spare time, is not keen on holding up production to clean chucks, but it does pay dividends in the end.

If the gripping surfaces of the

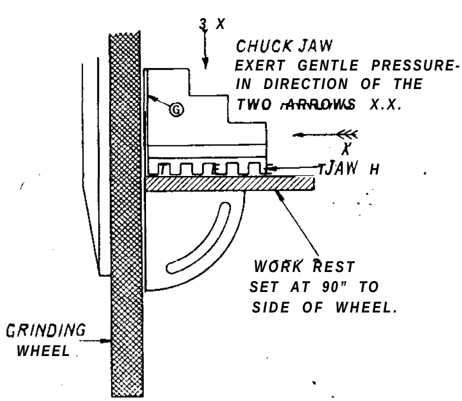

Fig. 4. Truing chuck jaw by very lightly grinding the normal gripping surface G on side of wheel

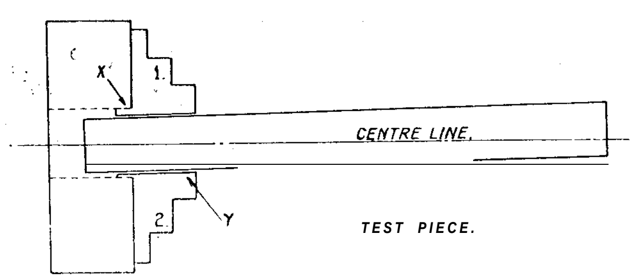

Fig. 5. Exaggeration illustrated of one type of 3-jaw chuck fault. Jaw No. 1 needs more grinding off at X than in front. Jaws 2 and 3 need more off front ends Y. A cigarette paper placed under jaw teeth (Fig. 4) would tip the jaw forward or back in order to remove metal from the desired point

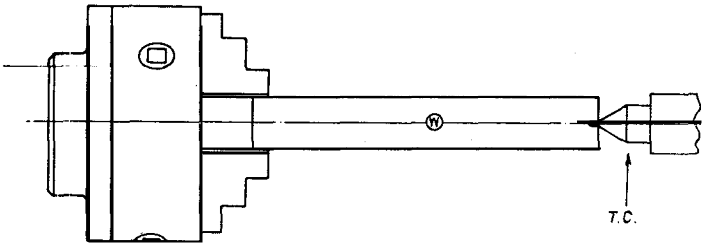

Fig. 6. " Chuck and Centre " working. To obtain the best results, first lock tailstock centre in approx. position, place oiled centre hole of work W on to T.C. Pass other end of W between chuck jaws and, pushing W towards T.C., tighten chuck jaws

chuck jaws are badly worn, they may be removed, and with the off-hand tool grinder work-rest set at right-angles to the side of the wheel, Fig. 4, the worn gripping surface of each jaw may be ground on the side of the wheel, until, by repeated trial, the chuck is again gripping work in a reasonable manner. It must be said, however, that this latter operation is not one that should be undertaken by the in-experienced, in that there *is* more than one way in which the jaws can be at fault.

For instance, whilst the jaws may be treated so that a short test-piece might show only a small permissible error on the clock, substitution of a piece about 12 in. in length might, on rotation, indicate a conical stirring motion, the work, in fact being held as in Fig. 5, but unhurried inspection and careful thought will indicate which jaw or jaws require further treatment. Of course, great caution should be taken when grinding the jaws in this manner, only very light " sparking " cuts being made; it is surprising how little usually need be ground from the jaws to make an improvement.

Should the jaws need correction for the fault shown in Fig. 5, where jaw No. 1 requires the removal of metal from point "X," the work rest (Fig. 4) should not be re-adjusted but a cigarette paper should be placed underneath the jaw teeth at the end nearest to the wheel, this will have the effect of tipping up the jaw so that the bottom left-hand portion gets ground first. Before undertaking this grinding treatment, the chuck should be taken to pieces and cleaned, otherwise you are liable to be correcting errors caused by dirt, whereupon, when the chuck is finally cleaned *at* some later date, it will be found to be " out " !

Having carried out the above corrective treatment on his own chuck, the writer feels that it is in many ways a better method of approach than the more usual one of locking the jaws in some way and internally grinding with a grinding attachment. The chief reason for thinking this being that, with the individual jaw treatment, the chuck is corrected under working conditions.

In cases where the chuck is very old, the corrective treatment detailed in Figs. 4 and 5 will probably do some good, but it will be found that the chuck will have to be -set, or re-set, concentrically for each job, the average setting being of no use unless errors of plus or minus 0.004 in. to 0.008 in. are not objected to, over a range.

It will be found to be very convenient to arrange some means whereby the dial indicator can be readily and quickly mounted on the cross-slide, or top-slide (if you use the latter, I seldom do) with the indicator point at exact centre height. This encourages its use on almost every job, with very beneficial results.

In conclusion,, whilst on the subject of self-centrmg chucks, perhaps a few words on " chuck and centre " working (Figs 6 and 7) would not be out of place. A fact which does not seem to be generally appreciated is that when working with the three-jaw self-centring chuck, and tailstock support has to be given owing to the length of the component, the work is best mounted as in Fig. 6 where it will be noticed that the chuck jaws are only gripping a small length of the work. This is important, in that it minimises any error, such as that in Fig. 5, and relieves the component of possible strain. In setting up the work *W* as in Fig. 6, the tailstock should first be adjusted and locked in the approximate position required, after which the centre hole in the work should be pushed against the tail-stock centre, and the chuck jaws opened out sufficiently to allow the work to pass sideways between them, then, whilst holding the work against the tailstock centre, the chuck jaws may be closed. As, under these conditions, the closing of the chuck jaws tends to force the work more tightly against the tailstock centre, this should be slackened and re-adjusted, not forgetting the oil. Finally adjust the chuck as in Fig. 2.

Fig. 7 illustrates a similar " chuck and centre " job, but here, as heavy cuts are anticipated, it is a good idea to arrange some sort of work-stop inside the chuck. The writer uses a No. 2 Morse taper threaded 1/4 in. B.S.F. into which can be threaded suitable lengths of screwed rod, locked by a nut. This form of stop very 'effectively prevents the work working its way into the chuck and leaving the tailstock centre, under pressure of the cut.

It is appreciated that we are " not supposed " to work between chuck and centre, but the writer prefers it for many jobs, as, for one thing it is safer, in that no carrier is required, and these are always a source of danger; however, now that you can " bash " your chuck true, what matter ?

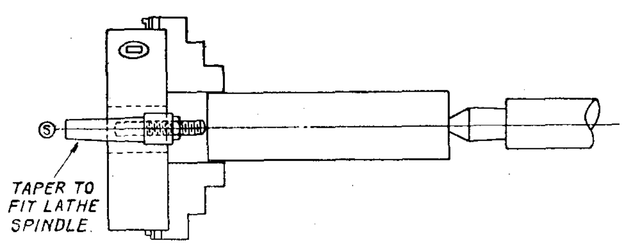

Fig. 7. " Chuck and Centre " working. Where heavy cuts are anticipated, a stop S is useful in that it prevents the work moving into the chuck, and leaving the tailstock centre, under the pressure of the cut