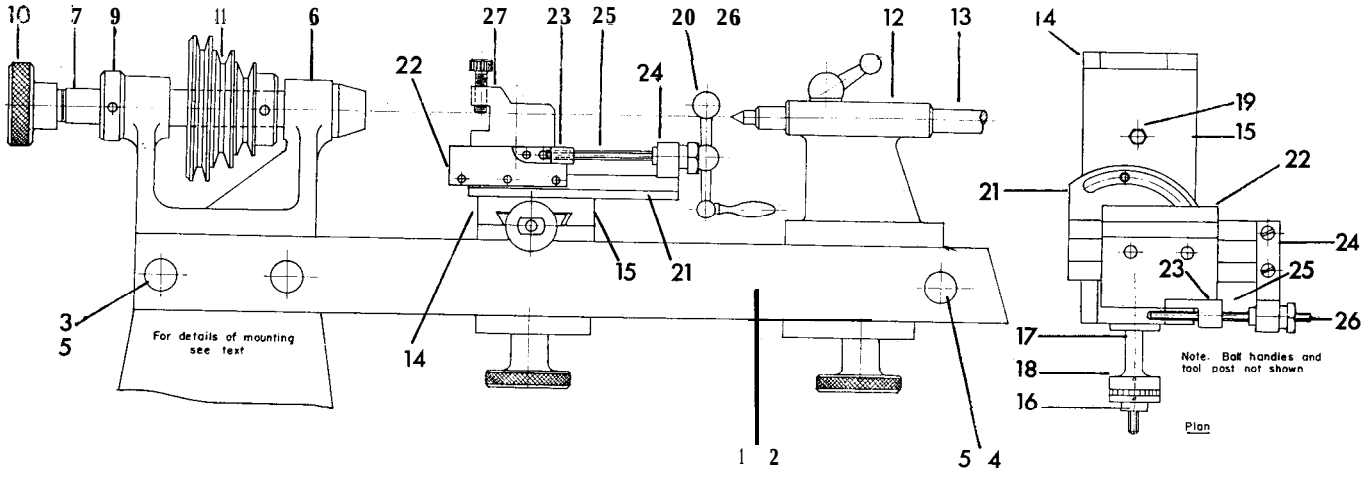
A lathe you can build

Continuedfrom August 1

John K. Mold



Headstock Assembly

THE headstock assembly consists of a simple casting (6), a spindle (7), a key (8), a collar (9) and a cone pulley (11). A suitable drawbar (10) is also shown.

The function of the drawbar is to pull the collet back into the cone in the spindle nose, so closing the collet on to the work. This method of chucking is in the precision class and should be of immediate interest to model engineers. You can finish engine pistons on their rods by it and concentricity of piston and rod is assured.

A separate collet for each size of rod to be chucked is, of course, necessary but this does not mean that one must buy a large number. For model work I would recommend the following sizes : 1/4 in., 3/16 in., 5/32 in., 1/8 in. 3/32 in. and1/16 in. I built up my small set of collets gradually, adding to them as the need arose. They cost only a few shillings each.

The spindle as drawn is designed to take collet No. 2807, manufactured by Crawford Ltd. of Whitney, and I specify this only because I have used it for many years and found it satisfactory. Other collets can be employed but they would entail alteration to the sizes of the spindle nose. So far as I am aware, the 2807 is interchangeable with the 8 mm. collet used on the German Lorch precision lathe and this explains why the drawbar (10) has a Lowenherz thread on its business end. This thread was tapped for me by Crawfords Ltd. and the cost was negligible. I strongly recommend the amateur lathe maker to follow this procedure.

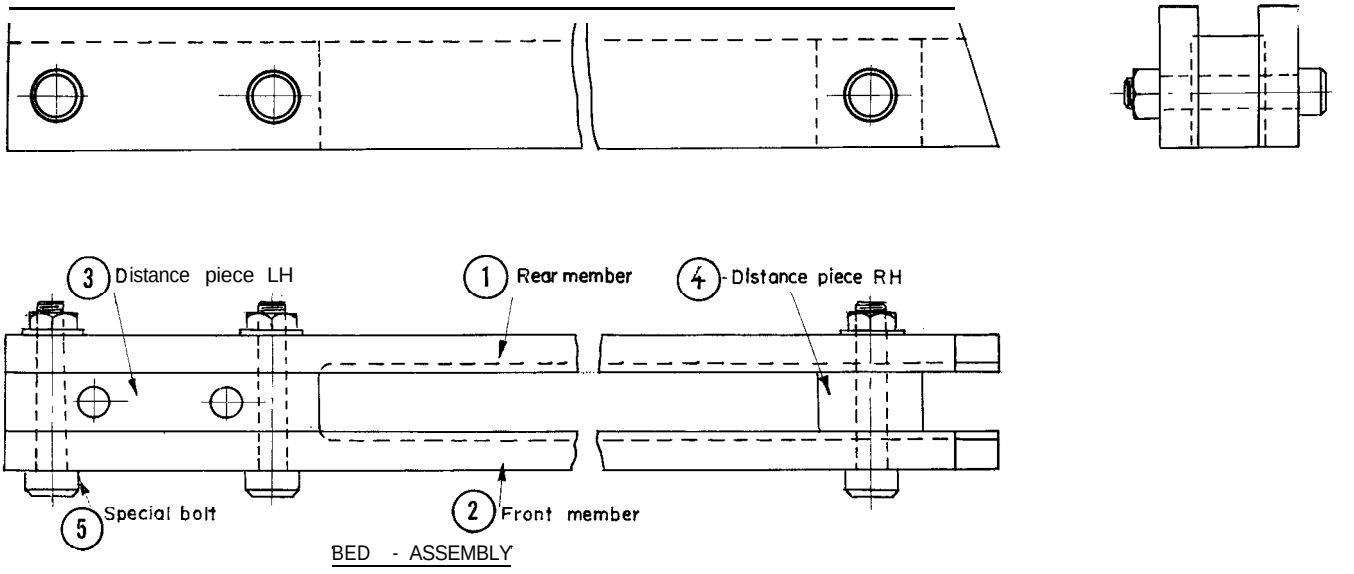
To return to our headstock, the casting (6) should be made first. Make a pattern allowing a little on the dimensions for machining and get it cast in soft grey iron. If possible, machine the base flat and scrape it true. I had no ready means of machining mine and in a case like this I always start the attack by bringing up heavy armament in the form of a I4 in. flat file. The next stage is to bore the bearings, using a boring bar with the casting clamped to the top slide of the lathe.

The holes should be drilled out as large as possible first; if you can drill them 9/16 in. dia. a 1/2 in. boring bar will pass through nicely. I like to hold the boring bar in the chuck with its outer end supported on the tailstock. This is a more rigid set-up than revolving the bar between centres. Arrange the feed to be as slow as the lathe will allow and engage backgear to obtain a cutter speed of about 100 r.p.m. If the cutter is correct and properly honed before the final cut you will get a smooth finish and the inherent accuracy of the bar-boring method will give you bearings which are truly circular and parallel.

It will be seen from the drawing (6) that the right-hand bearing is 1/32 in. larger than the other. It is not easy to obtain a precise dimension with a simple boring bar and so, any dimensional errors which creep into the work should be on the plus side. After the bores are finished put a facing cutter in the bar and machine the two outer faces.

Before removing the casting there is a most important point to watch. If parallel packing has been used to locate the casting on the boring table, this same packing must be carefully preserved and used when locating the tailstock for similar operations. If you do not attend to this, alignment of the two components will be difficult.

The holes for the bearing adjusting screws can now be drilled and tapped but we will leave the slitting until further work has been done. Before starting on the spindle it will help greatly if you know precisely the diameters of the holes you have just bored. One way of doing this is to turn two steel plugs to fit very closely in the



BED - ASSEMBLY

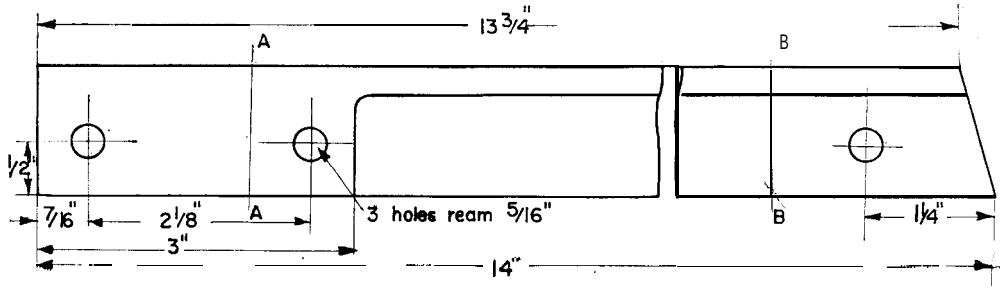
bores. They can then be measured with a micrometer and the results recorded for further reference.

Make the circular collar (9) by holding the blank in the chuck and boring until the end of a 7/8 in. X 26 t.p.i. taper tap will just enter. Support the end of the tap on the tailstock centre and turn it with a spanner on the squared end. Face both sides and after drilling and tapping the radial hole 2BA, run the large tap through again to remove burrs. You now have a gauge as well as item (9), for this can be used to obtain a close fit when screw-cutting the spindle (7). It will be appreciated that the collar controls the end float of the spindle in its bearings and will be locked in position by a 2BA screw. To avoid damage to the thread, a little copper button should be dropped down the 2BA hole before the screw is tightened up.

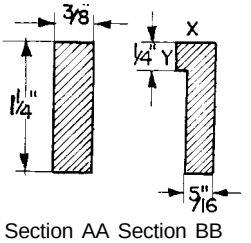
Before you make the spindle (7) consider the drawing. On the right is the conical hole to mate with the cone on the collet. The 0.318 in. dimension lets the body of the collet in freely but allows the cone to centralize the collet with great accuracy. The radial hole 13/16 in. from the nose is for the small key (8) which engages with a keyway in the collet and prevents its turning when the drawbar is used to pull in the collet. The right-hand journal bearing is given as 21/32 in. dia. but you will substitute for this the diameter you have written in the workshop notebook and, you will of course do the same with the left-hand journal, which I give as 0.625 in. The 0.635 in /0.645 in. dimension is for the cone-pulley (11). The bore 23/64 in. dia. through the spindle is to allow the drawbar (10) to enter and reach the inner, threaded end of the collet. The thread for the nut (9) should be screw-cut and the 0.575 in. dia. is added on (so to speak) in case at some future time you would like to fit a division plate or other accessory.

First, look to your lathe centres. True up the 'live' centre if necessary and if you keep a tailstock centre for special work this, surely, is an occasion to use it. Mount the steel bar between centres and rough out all diameters leaving them about 0.010 in. oversize. Then screw-cut 7/8 in. dia. X 26 t.p.i. This is a reasonably fine thread and if your sight is not what it was, or if the workshop lighting could be better, do not be ashamed to use a magnifying glass when setting the screw-cutting tool. Even if you have keen eyesight you may discover alarming discrepancies between the profile of the tool and the gauge. These can be rectified with a small oilstone or a carborundum slip.

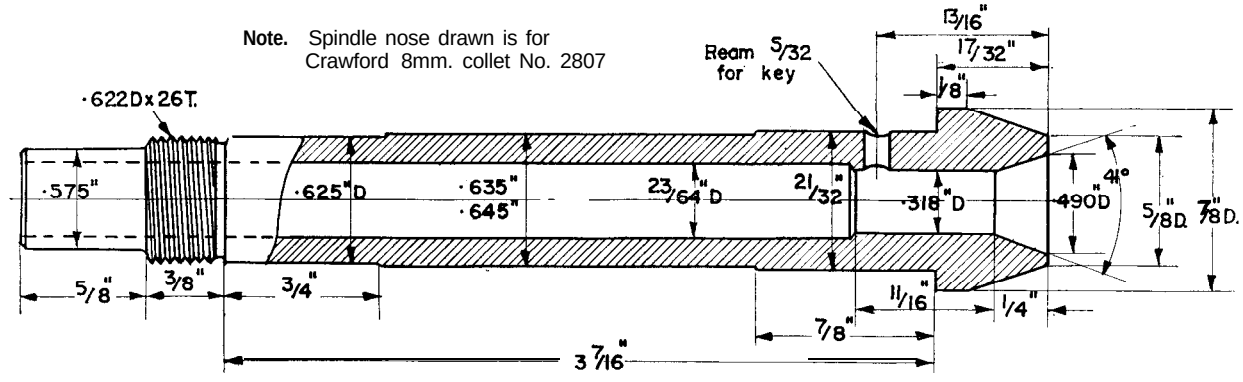
Try the collar (9) on the thread and when it will screw on stiffly, finish-face both sides of the nut. Now, finish-turn all diameters and, if possible, leave the journals about 0.0005 in. larger than they should be. Try the spindle in the headstock. If, due to errors, it will assemble but is a loose fit, scrap the work and try again. If the spindle will enter the bearings part way only, return the work to the lathe and polish the journals with fine emerycloth until a close-running fit is obtained. Some craftsmen disapprove of the use of emerycloth for this kind of work. I think a good deal depends on the circularity and finish of the surfaces in



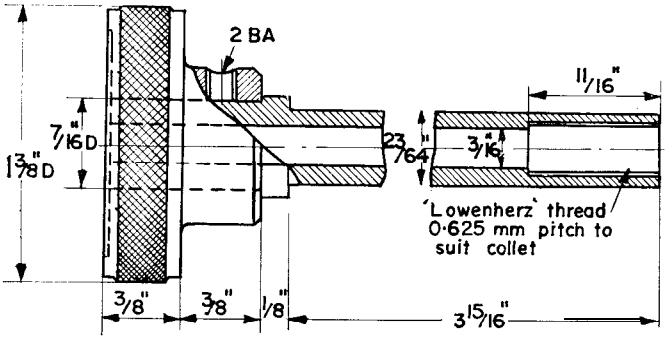
BED MEMBER M S



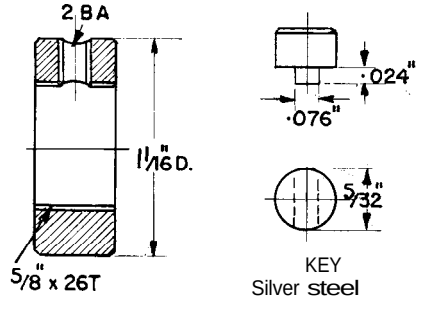
Section AA Section BB



SPINDLE MS



DRAW BAR MS



NUT MS

the first place. My lathe must have run for many hundreds of hours and no adjustment of the bearings has so far been necessary.

The spindle may now be bored, the important part being the **41** deg. cone and the 0.3 18 in. dia. You should obtain a collet first and use it to check your work as you go along. First we will attend to the 23/64 in. hole. Wrap paper or copper foil around the spindle and set it up in a four-jaw chuck, holding on the 0.635/0.645 in. dia. and adjust it to run true. You do not need elaborate clock gauges for this. I have a Verdict Junior indicator which will reach in places where a regular dial gauge will not go because of its size.

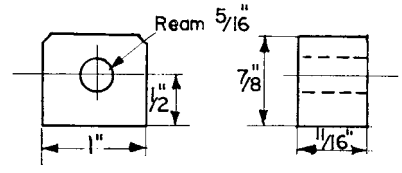
With the lathe running at top speed drill 3/16 in. for a depth equal to the overall length of the spindle minus 15/16 in. Start the hole off with the drill protruding from the chuck as little as possible and then change over to a long series drill. Withdraw frequently to clear the chips. If you do not possess one of these useful tools, sweat a 3/16 in. drill into a length of 1/4 in. steel rod. Now open out the hole with a standard length drill 23/64 in. dia. Reverse the work in the chuck, again testing for true running. Have the little ball of the indicator touching the 21/32 in. journal and do not proceed until the job revolves with no recorded error.

Of course there will be some error, but it will be less than your indicator can detect. Take great care with this operation. Anyone can make a hole in a piece of metal, even if the only tools available are a heavy hammer and a light heart! It takes care and patience to produce a hole of the right size in the right place.

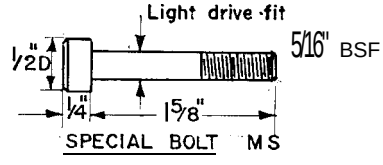
First, drill through with a 3/16 in. drill and open up with a 19/64 in. drill. Now bore out to 0.318 in. dia. with a little boring tool. Try the body of the collet in the bore-it should slip in easily. Next, set the topslide to 20-1/2 deg. and bore the taper, testing the fit with the collet itself. Marking blue lightly smeared on the collet will soon reveal whether the taper is correct.

The only remaining item is the drilling of the 5/32 in. hole for the key (8). You may be tempted to do this by eye on the drilling machine, and it can be done this way, but I do not advise it. A foolproof method is as follows:

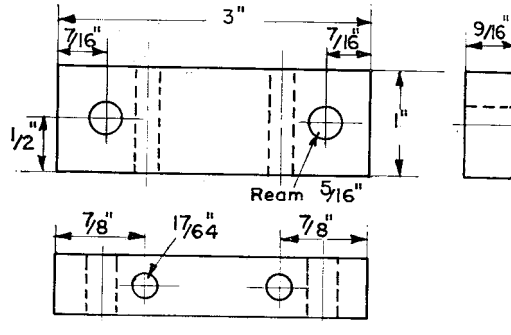
Chuck a piece of bar and turn it to



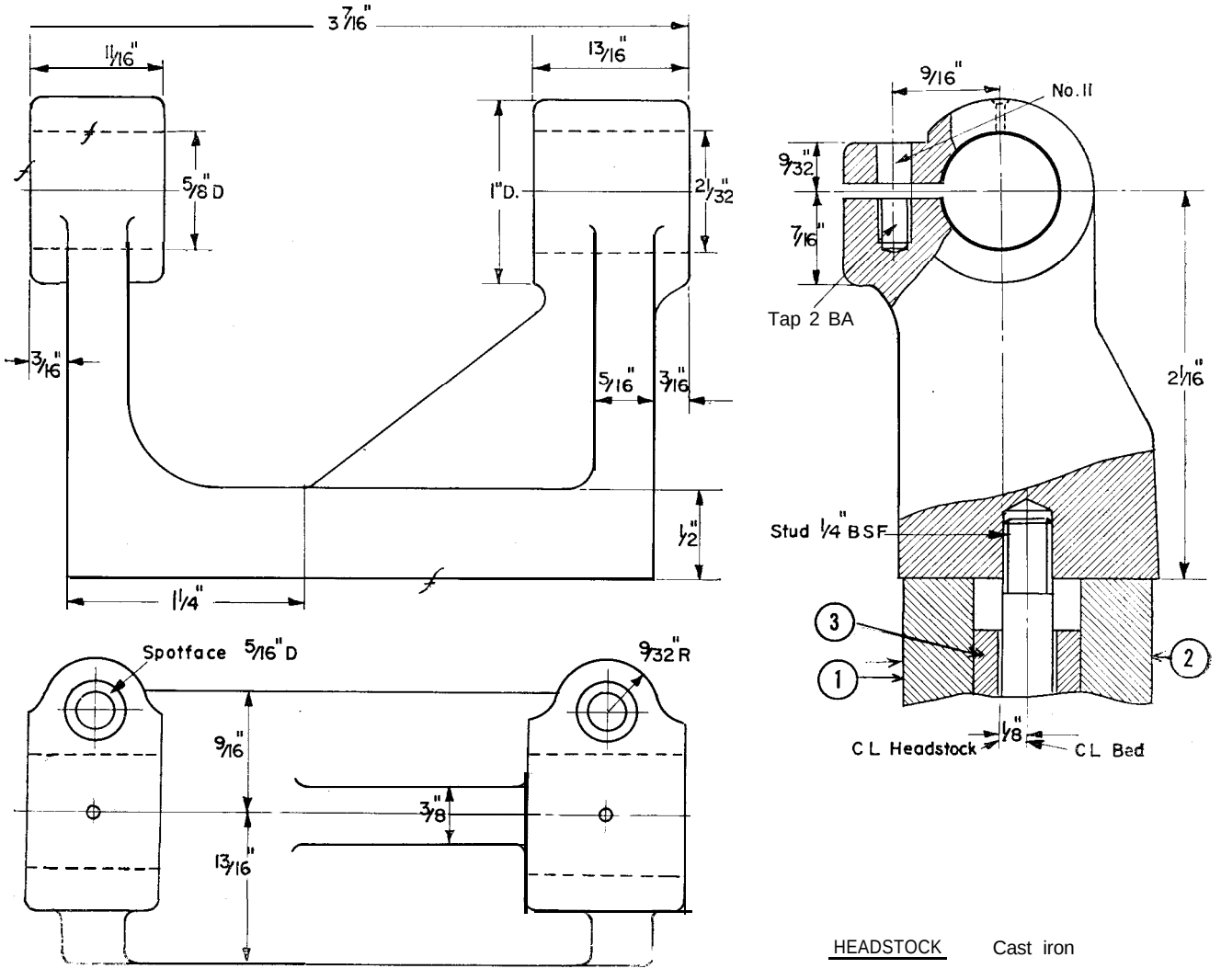
DISTANCE PIECE RH MS



SPECIAL BOLT MS



DISTANCE PIECE MS



0.40 in. dia. and about I in. long. Set up the spindle truly in the vertical slide and arrange matters so that as the slide is fed upwards the front journal of the spindle is underneath the bar in the chuck. Feed upwards until a cigarette paper is gently trapped between the spindle and the 0.40 in. dia. bar. A further upward movement (equal to **0.201** in. plus half the diameter of the front journal) will position the work correctly. Lock all slides, remove the bar from the chuck, use a Centre drill first, and finally drill and ream 5/32 in.

The key should be made on the end of a piece of 5/32 in. silver steel and can be cut off when finished. Chuck the rod and file it slightly; taper with a Swiss file. Try it in the hole in the spindle. It should go in tightly. File the little tongue, testing the fit in the collet keyway. Saw it off, using your own judgement as to the length. When tapped home it should not, of course, protrude above the surface of the journal. A light tap with a 4 oz. hammer (via a piece of brass rod to act as a punch) is all that should be necessary. Your spindle is now complete.

Assemble it in the headstock with a little thin oil and put the collar (9) on the tail end. The spindle should revolve with that silky feeling which is difficult to describe in words but which is indicative of a satisfactory assembly. If the spindle proves to have slight play in its bearings, you will bear in mind that we have not slit them yet and all will be well when this operation is carried out.

The drawbar (10) should be made next and after making the spindle you will find this easy. The long 3/16 in. drill will be needed again here. Although I have indicated that mild steel should be used for this component, the knob could 'be made in a suitable plastic. The pulley also is a straightforward piece of work but a special tool should be ground-up to machine the grooves. This is indicated in the drawings. Feed the tool in a little at a time, moving it from side to side to give clearance. It is a severe operation for a light lathe and you should avoid a situation where the tool is cutting on both faces at once, i.e. avoid a plunge cut. In service the pulley may have to revolve at **2,000** r.p.m. or more, and so it should be a nice push fit on the spindle and only light pressure on the grubscrew will be needed to make it secure.

This completes the headstock assembly and erection on the bed can follow. Before dealing with this, I would add that the dividing gear can be made later, when the lathe is operational, and I will discuss this when I deal with accessories.

To be continued