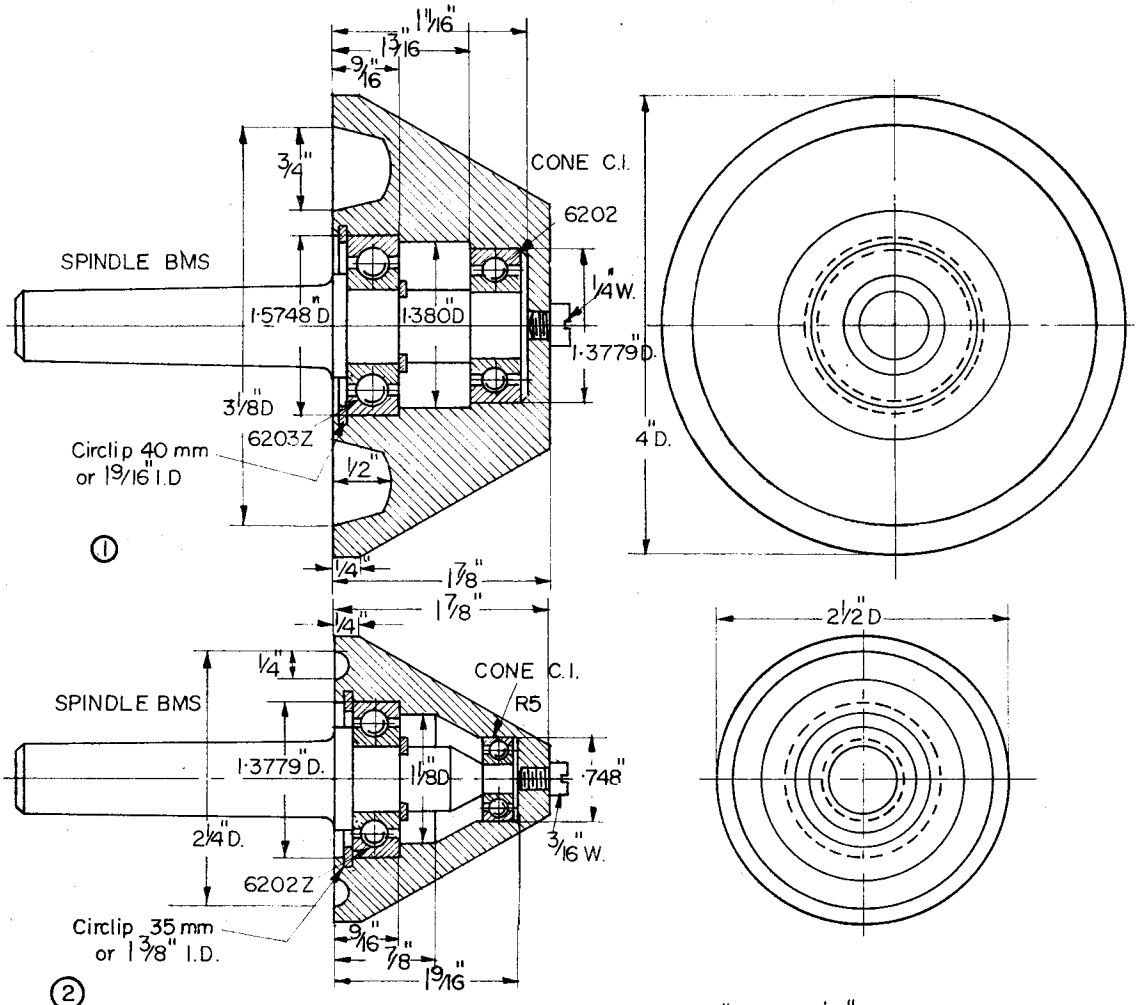
Ball-bearing Cone Centres

by J. A. Radford of New Zealand

THE TWO BALL BEARING Cone Centres described here will be found very useful for turning work which has been bored or for tubing, or for setting up hollow work to run true on the faceplate or in the four-jaw chuck. They will take any internal bore where the ordinary centre leaves off, up to 4 in. dia., and save the necessity to plug up the end or make end covers to take an ordinary centre.

Start by making the two patterns. These are simple turning jobs and the core print can be turned in one piece with the pattern or could be glued on true afterwards. The 3 in. dia. shoulder on the larger one and the 1½ in. dia. shoulder on the smaller one are for holding the casting for boring. The castings should be made in grey iron.

It is possible to obtain two stock pieces from most foundries which will save the trouble of making patterns, but it is necessary to obtain solid pieces with no cored hole in this case and I think it is easier by far to make the patterns. The core print in the larger pattern is 1 in. dia. and 1⅝ in. long and the core should be specified as being 3¼ in. long. The smaller pattern core print is ⅝ in. dia. and the core should be specified as being 3 in. long, the print itself being 1½ in. long.



BALL BEARING CONE CENTRES 4" AND 2½"

Set up the castings in the four-jaw chuck by the largest diameters and turn true the 3 in. dia. and 1½ in. dia. shoulders so that these will grip truly in the chuck. Each casting is now held truly in the four-jaw chuck on these turned shoulders and the boring is carried out after first facing off the large diameter face. In the case of the larger casting, bore first to 1.3779 to a depth of 1 11/16 in. to a light tap fit on the 6202 rigid ball race; the tool can have a small radius as the ball race does not bottom on this hole, all side thrust being taken by the outer 6203Z ball race. Next bore to a depth of 1 3/16 in. to 1.380 in. dia. to clear the 6202 ball race. Finally bore to a depth of 5/16 in. to 1.5748 to a LIGHT tap fit on the 6203Z ball race. The small groove for the circlip, whether 40 mm. or 1 9/16 in. internal type, should be made to clear the width of the ball race which is .4724. The 6203Z ball race is the type with one shield which should of course be fitted with the shield outside to hold in the grease and to keep out swarf.

Finally a centre is drilled in the bottom face of the hole and this is drilled 13/64 in. and tapped ¼ in. Whit. for a ¼ in. Allen cap screw, the purpose of which will be explained later. The outer 4 in. dia. is now turned, not to a good finish necessarily as this and the cone face is later turned in position on its own bearings. The lightening recess is next turned, approx. ¾ in. wide by about ½ in. deep, which improves the appearance.

The smaller casting is now set up on the turned shoulder in the same manner as the larger one, and the cored hole bored out to fit the R-5 ball race which is .7480 in. dia., to a depth of 1 9/16 in. with small radius as before. Bore to 1⅛ in. dia., to a depth of 1 3/16 in., but leave the end face to an angle of about 30 deg. as drawing. Then bore to fit the 6202Z ball race, leaving a square shoulder to a depth of 9/16 in., the diameter being 1.3779, making it a very light tap fit as before. The little groove for the circlip is now bored to either a 35 mm. or 1⅜ in. internal circlip, leaving a space to fit the width of the ball race which is .4331 in. The shielded side of this race goes to the outside as before. The end of the hole is now centred and drilled and tapped 5/16 in. Whit. for an Allen cap screw. The outer diameter is turned to just over 2½ in. and again a small recess in the back face can be turned as in the drawing for appearance' sake.

Now set this trued up edge of each casting in the four-jaw chuck so that the turned shoulder runs true and also the machined face runs true against the chuck jaws; the machined shoulder can be turned off with the top-slide set to 30 deg. and the turning taken to as close to the chuck jaws as possible. Do not bother about a good finish at this stage as this 30 deg. face and also the large diameter edge is finish machined in place on its own bearings as will be explained later. At this setting face off the outer or smaller face to a good finish to a width of 1⅞ in. for both of the castings.

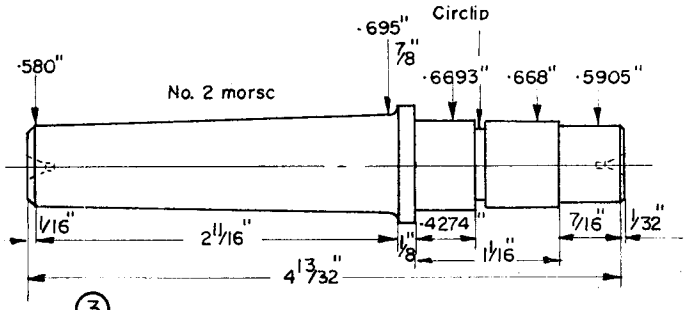
The two spindles are both made from ⅞ in. b.m.s. Face off the larger one to 4 13/32 in. long and the smaller one to 4 5/32 in. and centre each end. Shoulder down the longer to square face 1 17/32 in. long to diameter of .6693 a medium press fit on the 6203Z ball race and at .4724 groove for the 17 mm. (or 21/32 in.) external type circlip. Turn up to this groove .668 in. which will clear the 6203Z ball race and then turn to .5905 to a shoulder at 1 11/16 in. from the ⅞ in. shoulder for the 6202 ball race; the 5/32 in. surplus on the end is for bevelling the edge.

The shorter spindle is machined in the same way to .5905 for a length of 1 13/32 in. and groove for circlip cut at .4331 in. from the shoulder to fit the 6202Z ball race; then turn to .589 dia. up to this groove, then to a diameter of .1968 in. up to 1⅛ in. from the ⅞ in. shoulder for the R-5 ball race. Turn the shoulder down at 30 deg. to leave a small shoulder on the .1968 in. dia. Bevel the end. All that remains now is to turn the other ends of the spindles to No. 2. Morse taper leaving the ⅛ in. wide shoulder at full ⅞ in. dia. Grip the shafts in a carrier with soft pad on the .668 in. dia. and the .589 in. dia. in each case to prevent burring on the ball race journals.

I have given the diameters at the small and large ends which apply in my case, but check these dimensions with a truly fitting centre of your own, so that the shoulder protrudes from your tailstock barrel about ¼ in. Three or four pencil lines along the length of the tapers and twisting the tapers no more than a quarter turn will check your angle setting in the tailstock barrel. Mark your tailstock centre on the top before removing for checking so that it is returned in the same position each time, as it could be out a little on the point, which would upset your angle setting.

When the spindles are completed to a good finish and accurate fitting, assemble the ball races and pack with light grease; do not forget the circlip. The assembly should now tap gently into place in the cones and the internal type circlip is then inserted to hold all securely.

Now cut off a ¼ in. Whit. Allen cap screw to a length to clear the end of the spindle for the large cone and the same but 5/16 in. less for the smaller one and fit these two screws securely. Cut off a short piece of an Allen key to fit each screw say about 1½ in. long and grip the piece in the three-jaw chuck to protrude sufficiently to engage the Allen screw the full depth of the hexagon hole in screw head. Knock the larger of the cone centres into place in the tailstock barrel firmly and bring



Ball races SKF Nos.

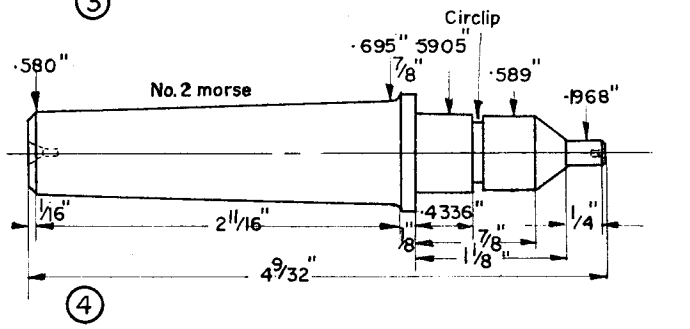
6203 Z

d	D	w
17	40	12
·6693	1·5748	·4724

6202

d	D	w
15	35	11
·5905	1·3779	·4331

Circlip 17mm or 2 1/32" O.D



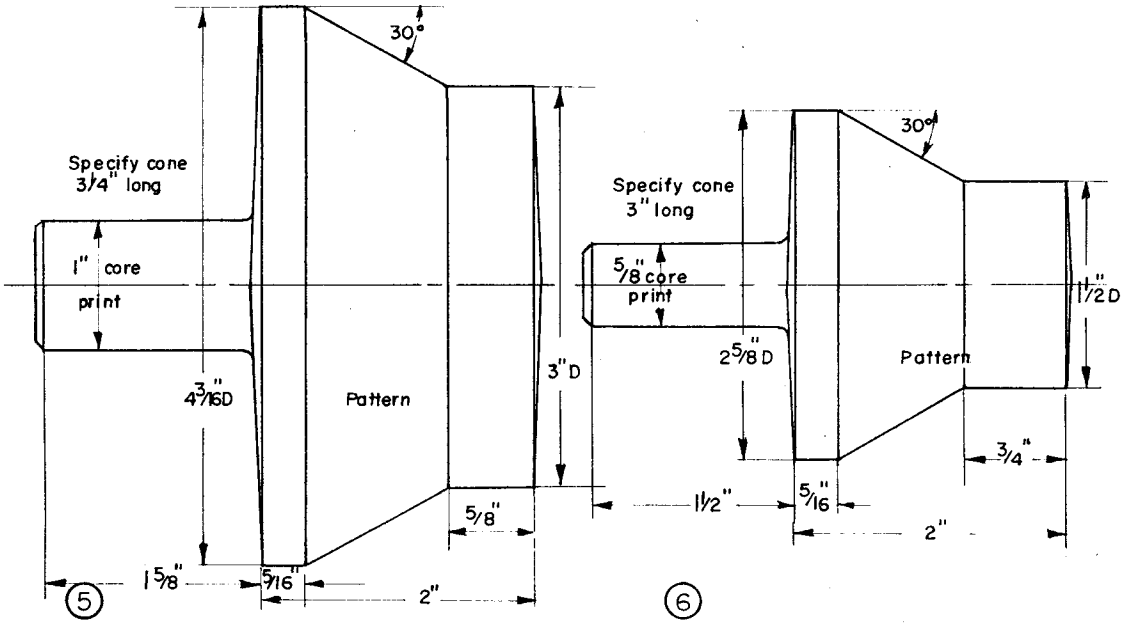
6202 Z

d	D	w
15	35	11
·5905	1·3779	·4331

R5

d	D	w
5	19	6
·1968	·7480	·2362

Circlip 15mm or 9/16" O.D.



up to and engage the Allen screw over the piece of key in the chuck. The top-slide can now be set over to 30 deg. which will clear the tailstock easily and the cone can be finished turned on the angle and on the outer shoulder to a good finish and with perfect accuracy. The same procedure is followed for the smaller cone centre. If during use the face becomes damaged at any time, it is a simple matter to return the angle to true it up and the ¼ in. wide shoulder width on the outer diameters will provide ample material for many true-up skims.

Drawings Nos. 1 and 2 are general assembly drawings with the cast-iron cone shown in section. Drawings Nos. 3 and 4 show the dimensions of the spindles only with a chart of the ball races dimensions. Drawings 5 and 6 show the pattern dimensions which show a slight taper on the faces of the cones for drawing from the sand. The cones are cast horizontally so that there will be no tendency for the cores to float upwards or move sideways. Consequently no taper is required on the core prints, which should be parallel and accurate.

These two cone centres will be found quick and simple to make and are quite inexpensive. ▣