BARLEY TWIST PRINTOUT PAGE

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INTRODUCTION

Barley-twist and fluting has been used for over 350 years in Britain, as a way of decorating furniture and stairways. They continue to add to the attraction of many pieces, and the KFE and King attachments of the Hapfo lathes make the whole process straightforward and remarkably attractive.

Originally the process was entirely hand made and took a considerable time to complete. Now, with the aid of our machines, a method that would have taken about four hours to complete, say, a stair baluster, takes no more than ten minutes. What is more, the finished results are every bit as attractive, and so much more can be accomplished which was beyond the expertise of the hand turner.

The following pages give the basic information about twisting (the generic term the Americans call roping) and fluting, followed by details on how to use the Hapfo KFE and King units.

MODERN ROUTERS

Modern routers and their various specialised form bits have superseded handwork. This allows the production of considerably more complicated designs than were originally available and presents the operator of a Hapfo lathe the opportunity to design and produce unique pieces.

Barley-twist gets that name from the English confection barley sugar. Sweet makers simply took a cylinder of barley sugar and twisted it to make it appear more attractive and since this then looked like the twisted furniture parts made by cabinetmakers from the middle of the 17th. Century it hence took the name barley-twist

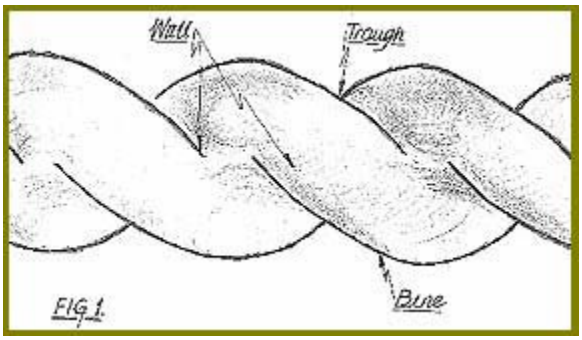
FLUTING

Fluting, as the name suggests, takes a flute and reproduces this over the length required and around the circumference of the piece in the number desired to produce a fluted column or whatever, and this, on the Hapfo machine, may be done on either dowelled or contoured pieces, giving classic designs of great beauty.

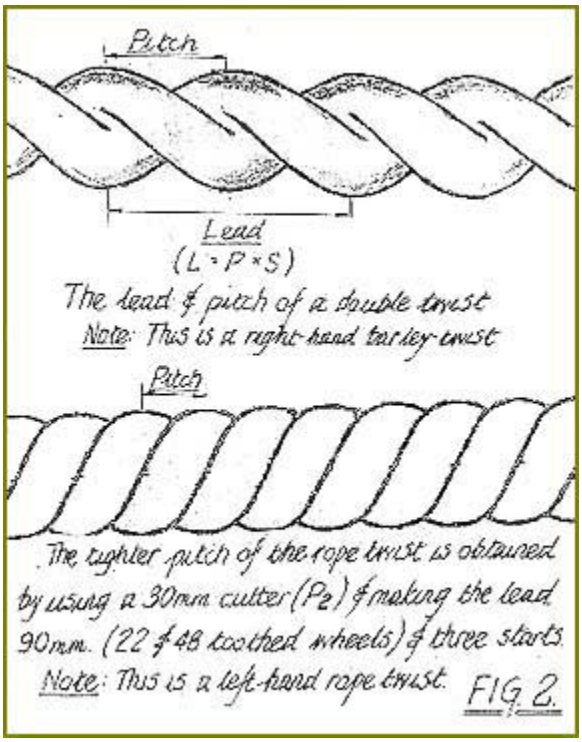
There are many kinds of barley-twist, and when done by hand, laying them out over the work piece causes confusion and considerable concern for those who are not experienced in this difficult process. However, on the Hapfo twist attachment all the hard work for the operator has been done and what follows are the straightforward instructions to complete that part or parts required by the customer.

TWISTING TERMS

Firstly, however, are just a few terms so that we all talk the same language, and when discussing some points, understand the issue concerned. In **Fig 1** below, the prominent round ridge of the twist is known as the **bine**. Between the bines are the hollows, known as **troughs**, and the rise and fall between bine and trough is called the **wall**.



Each bine must have a trough, and the distance a bine (or trough) takes to complete one revolution of the work piece is called the **lead** –see **Fig 2**. below.



WORKING OUT THE LEAD

As a rough guide, the lead is normally about twice the diameter of the work piece, since this looks about right – see **Table 1** below.

TABLE 1

Suggested ratio between work piece diameter and the number of starts when doing twist barley and rope twist work

Dia. of workpiece	Number of Starts
2 inch	two
3 inch	three
4 inch	four
6 inch	six
8 inch	eight
12 inch	twelve

It can be seen that for the same lead, the apparent angle of the lead line will change with the diameter of the work piece. To correct this, the above table is of help, and the diagram gives an indication as to the function involved. See also **Fig 7**.

The distance between bines, and measured along the axis of the work piece, is called the pitch, and using a router (not hand done as was originally the case) is the same as the width of the cutter, or router bit.

DOING THE TWIST

We now consider the operation used when employing either the Hapfo KFE or King unit, and initially we shall give instructions for producing a two start barley-twist using a 40mm cutter. The configuration and dimensions for a router bit to re-produce a

traditional barley-twist is shown in **Fig 3**

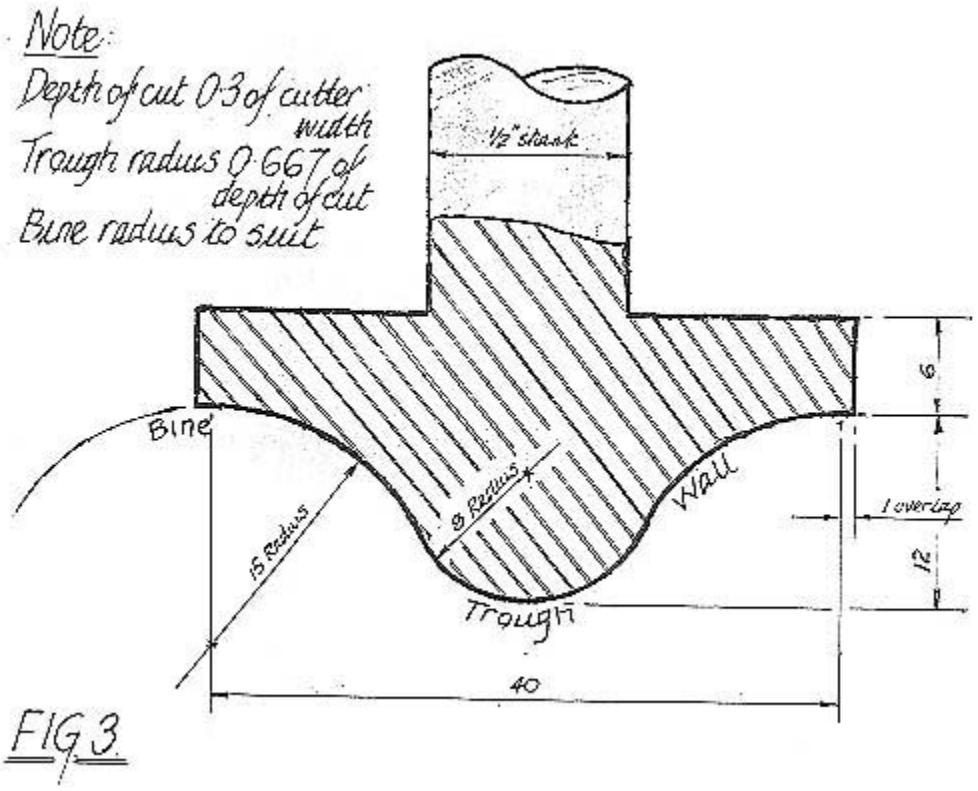


FIG 3.

Since there is a formula to give the correct lead when both the pitch (or width of cutter) and number of starts is known this is given and is:- lead = pitch x number of starts (L = P x S). This is outlined in more detail in **Table 2** (below), and gives information on how to obtain leads to suit the original in, for example, restoration work, when the operator is asked to reproduce handwork of considerable age and made years before the advent of mechanical methods.

TABLE 2 Method used to establish LEAD:-
Lead (L) = Pitch (P or Width of Cutter) x Number of Starts (S)
L = P x S (Note: with fixed router cutters, the pitch and cutter width is the same)
Now : using the lead table (on the twist toothed wheel cover)
the lathe coefficient (Cf) must be found.
(Use leads for 14 & 28 toothed wheels).

Thus:

L	Gt	Gb	L = Lead
100	14	28	Gt = Top toothed wheel
400	28	14	Gb = Bottom toothed wheel
and:			
100 =	14/28 =	0.5	(0.5 x 200 = 100)
400 =	28/14 =	2	(2 x 200 = 400)

Therefore: Twist/lathe coefficient (Cf) = 200

and using twist table for specific lathe, we have

L	Gt/Gb	x Cf	
100 =	14/28	x 200	= 100 (QED)

Hence: Gt = L/200 x Gb 400/200 x 14 = 28

Gb = Gt x 200 / L 28 x 200 / 400 = 14

Thus it follows that two toothed wheels of equal size (say 28), will give a lead equal to the twist/lathe coefficient - eg.

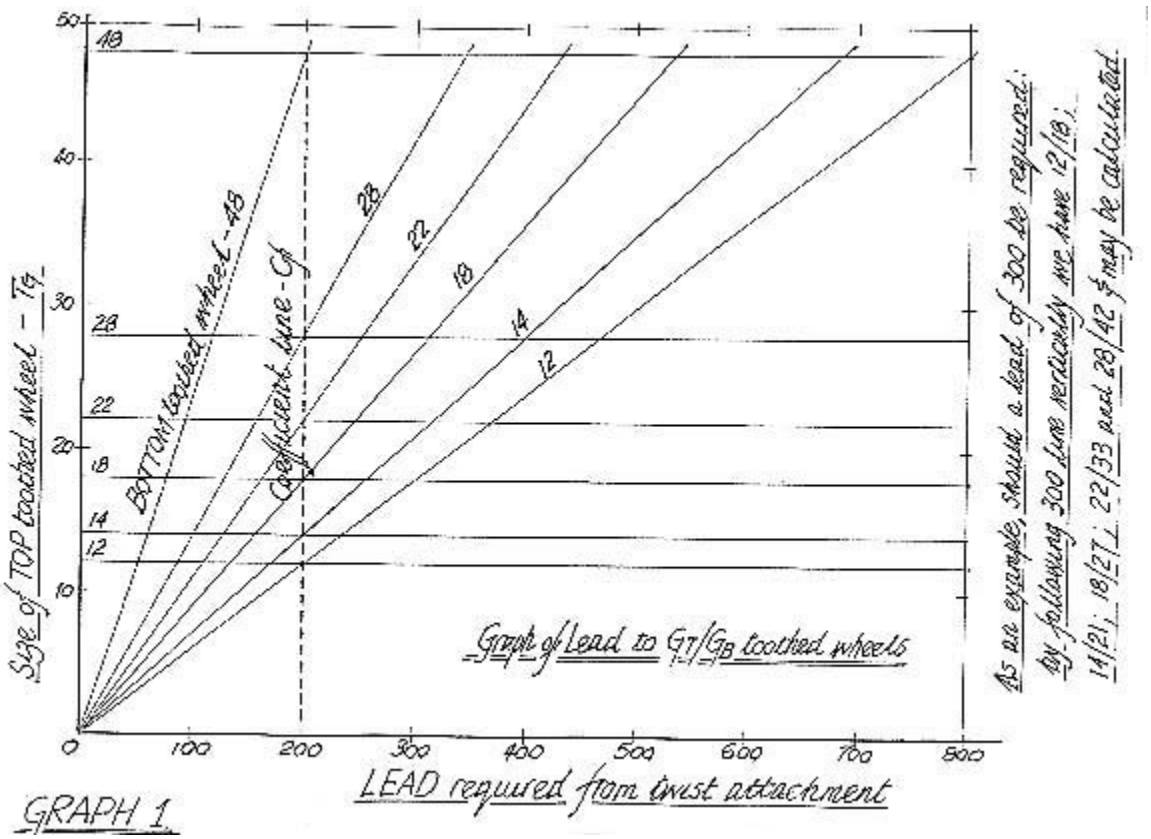
L = 28/28 x 200 = 200

Finally, as an example, for a 50 mm. lead:-

Gt = 50/200 x 48 (say) = 12

(**Thus**, the toothed wheels required are 12 and 48)

Graph 1 shows an alternative way of obtaining the required toothed wheels that may be required for specialised work



GRAPH 1

The following stages in the completion of our barley-twist, are to do specifically with the Hapfo 5000 Hydro King lathe, and although they differ only slightly from the operation employed on other models, that slight difference will be highlighted and explained in due course

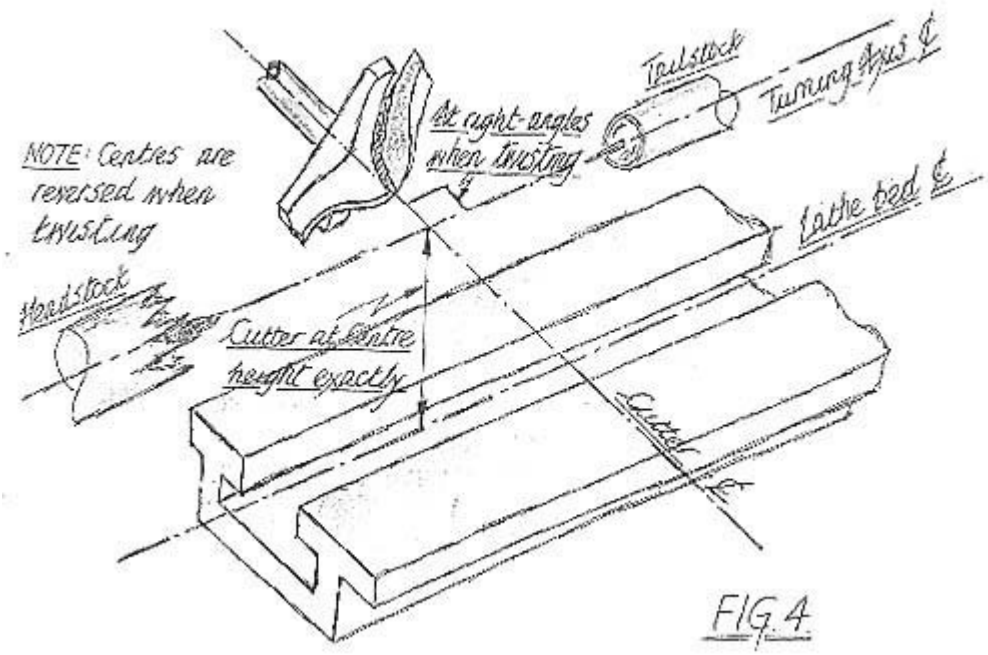
USING THE 5000 HYDRO KING

Decide upon the length and diameter of the work piece and mark upon it a reference to locate the position of the twist. It should be stated at this point that the diameter is not a function of the actual twist being employed (the cutter has no knowledge of the depth of timber behind the timber face, only that a timber edge is being presented to it), but does help decide the number of starts/width of cutter being used.

Select the type of twist required – in this case, barley-twist – and the number of starts – again, in this case, two. For the sake of

our example, the diameter of our baluster, for that is what we are making, is 57 mm.

Ensure that the King unit is correctly set up with the centre height of the cutter at centre height of the lathe **Fig 4** – the centre height of the King unit is adjustable over about 150 mm. – and at right angles to the centre line of the lathe between headstock and tailstock **Fig 4**, as the actual unit is able to be revolved around 360 degrees.



The speed of the router should, at this point, be checked, and for all cutters up to, and including 60 mm, it is safe to operate the unit at maximum speed – 17,000 rpm. The other speeds available are 6,000, 8,500 and 12,000 rpm.

SETTING THE LEAD

Since our cutter is 40-mm. diameter and we have decided upon two starts the lead required is 80 mm. (P x S). Remember, the width of the cutter and the pitch are the same! The lead is obtained by selecting the appropriate toothed wheels as indicated on the twist gearbox table, and assembling them accordingly. With a set of six toothed wheels (four are supplied as standard with the machine) a wide range of 30 leads is available - from 50 to 800 mm.

TABLE 3

Selection of LEADS available using top and bottom toothed wheels.
Sizes 14, 18, 28 and 48 provided as standard; sizes 12 and 22 available as extras.

NOTE: This table and/or Graph 1 enables the operator to quickly find the toothed wheels required for any particular job, without the need to calculate them, thus saving time. Other toothed wheels are available, in a wide range of sizes, and give a complete set of leads to the Hapfo user.

L	Gt	Gb	L	Gt	Gb
50	12	48	235	14	12
60	14	48	245	22	18
75	18	48	255	28	22
85	12	28	260	18	14
90	22	48	300	18	12
100	14	28	310	28	18
110	12	22	315	22	14
115	28	48	350	48	28
125	14	22	365	22	12

130	18	28	400	28	14
135	12	18	435	48	22
155	14	18	465	28	12
160	22	28	530	48	18
165	18	22	685	48	14
170	12	14	800	48	12
200	28	28			

Now put the speed selector switch into the zero position, and reverse the drive dog and live centre from head/tail stocks to enable the twist drive to take place via the traverse motor through the primary gearbox, the twist gear box (set to "left"), the drive bar (on a metalwork lathe this would be known as the lead screw), and finally the toothed wheels to enable the lathe axis to rotate at such a speed to produce a helix. It is essential that the tailstock barrel locking star wheel is loosened, to allow the indexing head assembly to freely rotate.

ALTERNATE TWISTS

Every Hapfo lathe with twist attachment has a coefficient, which means that by altering the toothed wheels different leads may be obtained. The coefficient also means that for two identical toothed wheels at each position – one at the top and one at the bottom – the drive bar and the work piece between centres rotate at the same speed. This therefore enables the operator to change the helix generated by changing the ratio of the toothed wheels and hence giving us **Table 3** (above). The coefficient on the AP5000 Hydro King is 200 as defined in **Table 2**.

The twist gearbox allows both left and right handed twists to be generated, and it should be noted that the convention is that a twist that travels up to the left when held vertically in front of one is left-handed and when travelling up to the right is right-handed see **Fig 5**

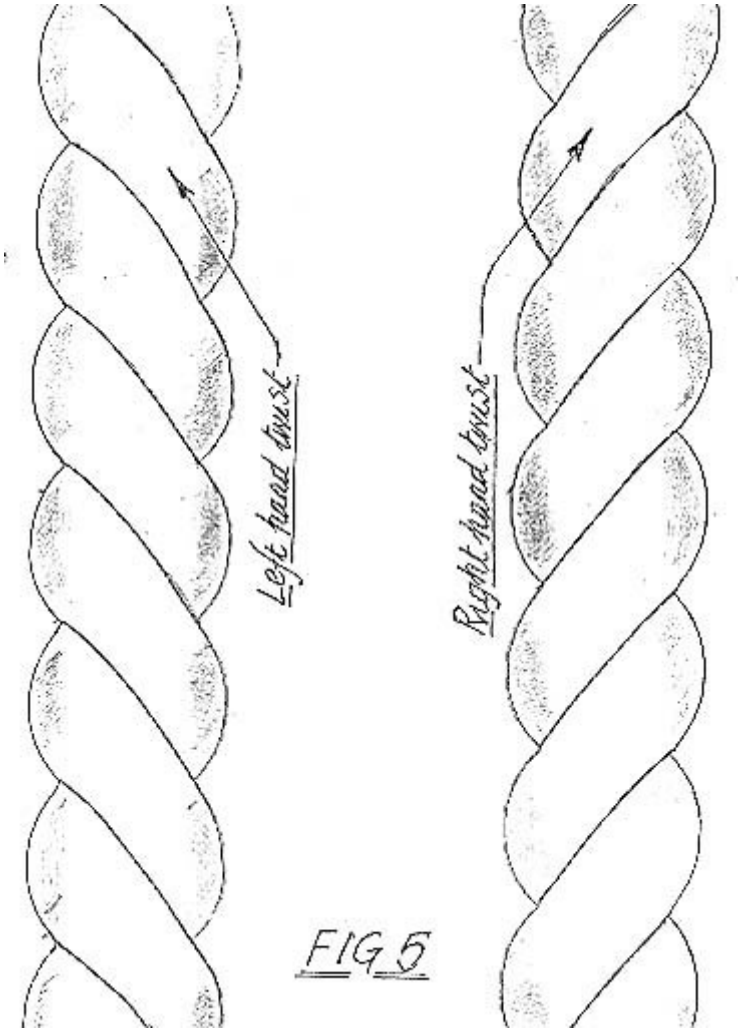
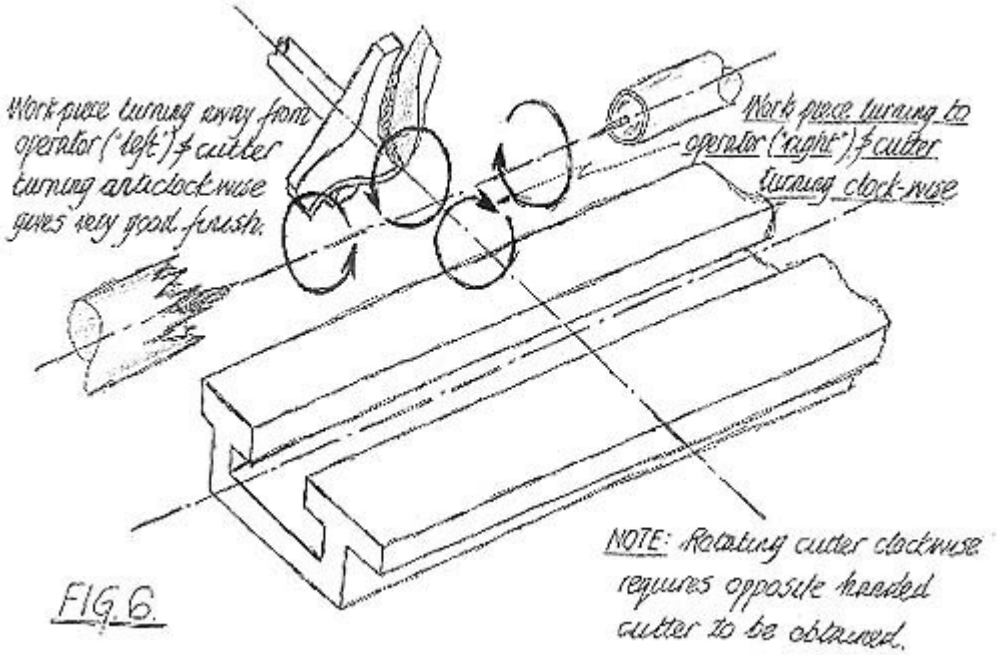


FIG 5

The King unit has the ability to turn both clock-wise and anti clock-wise, but with the work piece turning away from the operator, and the cutter turning anti clock-wise, it follows that this cuts the timber with the grain and gives a smooth finish. Cutting a right hand twist by having the work piece rotating towards the operator, but the cutter still rotating anti clock-wise, it follows that this then cuts against the grain, giving a less than reasonable finish. This may be overcome by obtaining a right-handed cutter and reversing the King unit to cut in a clock-wise fashion see **Fig 6**.

The cutter is now presented to the work piece by adjusting the depth stop and allowing the point of the cutter to be within, say, one mm. of the timber. A lead in and a lead out are then positioned appropriately and with the overall depth of the cutter known, the decision taken as to the number of passes to be made. The stops are set, again in the appropriate position, and the operation set in motion. Should one pass be made, the traverse speed needs to be about 4 or 5 – too fast and the finish is less than desirable, too slow and the timber can start to burn (particularly on hard woods); if more than one pass is to be used, say two, the traverse speed may be increased. The depth of our cutter in this instance is 12mm, see **Fig. 3 & Fig 7**.



CUTTING COMMENCES

The twisting operation is now commenced, and the first of the two passes made with the dividing head being in the zero position – 24 on the actual wheel. The second pass on the first cut is not done until after the first pass on the second cut is completed, since it is important to ensure as much stability in the timber as possible. It is important to state at this juncture that in order to obtain the most accurate twist, the timber needs to be as straight as is possible.

With the indexing pin now moved through 180 degrees to the 12 position, the first pass of the second cut is made. The index head (or dividing head as engineers call the device) does just that, and divides a circumference into equal segments. Thus, on a 24 hole indexing head – as ours is – one divides the number of starts required into 24 and moves the indexing pin around that number of holes. For example, for a two start, divide 2 into 24 and move the pin round 12 holes to the 12 position. Likewise, for four starts, divide 4 into 24 and then move the pin round into the 6, 12 and 18 position holes thus giving four starts. It follows that this is four 90-degree segments, giving a total of 360 degrees equally divided. See **Fig 7**.

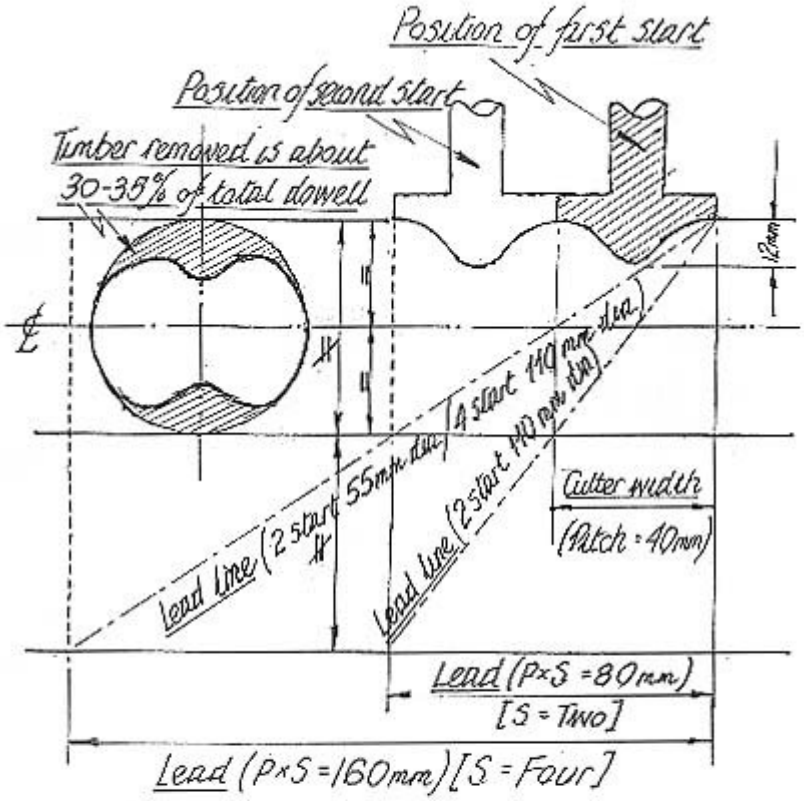


Diagram showing relationship between number of starts & diameter of work piece. (See table 1) Angle of lead line important!

FIG. 7.

FINISHING OFF

The final passes are now made and the completed twist produced. To finish, it may be necessary to do some minimal sanding, but this may be done on the completion of all the twist work, and by resetting the lathe into the turning mode and at slow speed, say, 800 rpm applying the required paper. It may be possible to present a rotating sanding wheel (similar to a "star" wheel) during twisting, as this will save time.

THE KFE LATHE VERSION

When using the KFE version, the cutter point is basically captive, since unlike the King unit, the operator cannot raise or lower the unit, nor rotate it through 360 degrees. It can only rotate anti-clockwise and has the single speed of 18,000 rpm. Other than these restrictions, the operation is identical. Hollow twist (or more correctly, open bine) work is not possible with the KFE unit and this delightful, and highly profitable, procedure is described in complete detail in another section.

With the Hapfo 5000M lathe – the more basic model using cantilever arms with spring retention – the arc involved as the cutter comes into contact with the work piece, means that certain restrictions come into force. It is also a little more difficult to adjust the router position in relation to the cutter due to the geometry employed, hence hollow twist work is not possible.

One disadvantage with the KFE accessory is the noise of the router (a fact with all such machines), and contrasts significantly with the low level of noise enjoyed with the King unit.

HOW TO DO FLUTING

It is now reasonable to briefly describe the fluting operation. This is in many ways similar to the above method of twisting, except the tail-stock barrel locking star wheel is tightened (as already mentioned, this must be released for the twisting operation) and the twist gear box lever is in the zero position.

SELECT THE CUTTER

The appropriate fluting box cutter is selected – say ¼" diameter – and as before presented to the timber. Lead ins and stops are also set up as previously and the depth of cut established with the depth stop adjusted to suit.

The circumference of the work piece is obtained, and the number of flutes worked out accordingly. If the circumference is 160 mm. (a diameter of approx 50 mm.) twelve flutes will take up 78 mm. (6.5 mm. x 12) leaving 82 mm. allowing the "landing" – the distance between flutes – to be approximately the same width as each flute and this, when completed, looks most pleasing.

It follows that individual taste and appreciation dictate a customers requirements, but experience of the operator, very quickly acquired, will tend to help him or her, design very pleasing components.

CUTTING THE FLUTES

The required number of flutes are then cut by operating the traverse speed at maximum, moving the indexing pin every two holes (24 divided by 12 gives 2) and repeating the process.

One considerable advantage with the later Hapfo 5000 Hydro lathes is the option of reverse cutting. This allows flutes to be cut on a return pass, thus speeding up the operation considerably. It is not good practice however, to cut twists on the return pass, since the inevitable slack present in any gear train, is likely to produce slight inaccuracies.

It again follows that straight timber is essential for such work, but should this prove difficult to arrange, a series of steadies and restraints are available, or can be developed, to ensure a reasonable job is achieved.

TAPERED WORK

Although parallel work has been described so far, it is possible to do tapered twist work by adjusting the King unit to present the cutter at right angles to the face of the work being done, and contoured fluting to be carried out by allowing the tracer to follow a template of appropriate shape.

Also, reeding can be carried out by adjusting the height of the cutter to cut over the top of the work piece, in the same way that flat sides may be cut using a long plunge router cutter, but these are more complicated procedures that are described under other headings.