WOODTURNERS

Practical Advice for Balancing Rotary Knife Hexagonal Tooling.

To obtain good results all applicable elements should be correct.

Elements:-

1. **Machine.**
2. **Hexagon Sleeve.**
3. **Holders.**
4. **Bolts and washers.**
5. **Cutters.**
6. **Build up.**

1. Machine

a) Machine should be level and grouted to floor, if bolts are fitted they should have no force on the machine.

b) Main spindle should be in good order, spindle should be clean and using a DTI should show a maximum run out reading of .0015 inches.

c) Originally cutter spindles at W.A. Fell Ltd were manufactured from EN24 which is about a 60 tonne tensile steel, occasionally you come across machines which has been re-spindled with a poorer grade material.

d) Removable bearing housing and components i.e. taper etc., should be in a good clean condition.

e) Longer machines are far more susceptible to balance problems than shorter machines.

2) Hexagon Sleeve

a) It is extremely important that when a hexagon sleeve is clamped on the main spindle it does not deflect the shaft. This can be checked by placing the sleeve in the middle of the machine spindle, and clamping the brass pads. Take a DTI reading with the sleeve loose and note any difference in reading with the sleeve clamped (it should be minimal).

b) Brass clamp pads are not a good idea, as when the brass is clamped to the shaft they stretch the metal at the point of contact, for this reason you should only tighten the clamp pads to hold the sleeve firm (do not over tighten).

c) If the sleeve is distorting the shaft it should be "bedded in", to do this you require a mandrel to substitute for the cutter spindle preferably hardened and ground.

Proceedure to bed in sleeve
Blue up mandrel and slide into sleeve, tighten brass pads so that you can still turn mandrel in sleeve, oscillate sleeve to and fro on mandrel approximately 10 times, slacken off clamps and scrape high spots until you get an even bedding area over a minimum of 150 degrees of the bore roughly opposite the clamping brass pads. This block is now ready to be statically balanced. Scraping procedure should be repeated until clamping does not distort shaft.

Special note: The secret of good balance with rotary knife machines is attention to detail. Pure and simple, there should be no compromise. This also improves the machinery from the point of view of safety.

Choice of balancing skills, this is very important. The scales need to be sensitive but also able to stand a little bit of abuse i.e. weight of holders and the grinding environment,

I would only ever use balancing scales i.e. comparing the weight of two components, modern direct measuring digital scales are very accurate but if they were giving slight false readings you would not know. At least with the old fashioned scales you can reverse the components being balanced and compensate for any error.

3. Holders

a) If holders are out of balance when grinding off excess material try and do it so that the holder does not loose its shape.

b) It should also be checked that holders sit flat down on the surface of the sleeve, this is best checked with a .0015" feeler gauge.

4. Bolts and Washers

a) T bolts complete with nuts should be balanced in pairs.

b) Cutter bolts complete with washers should be balanced in pairs.

c) Fell washers were always a little bit thin, I have found that machined washers .25" thick from EN8 are far superior.

5. Cutters

Cutters should be balanced keeping their shape and size identical.

6. Build Up

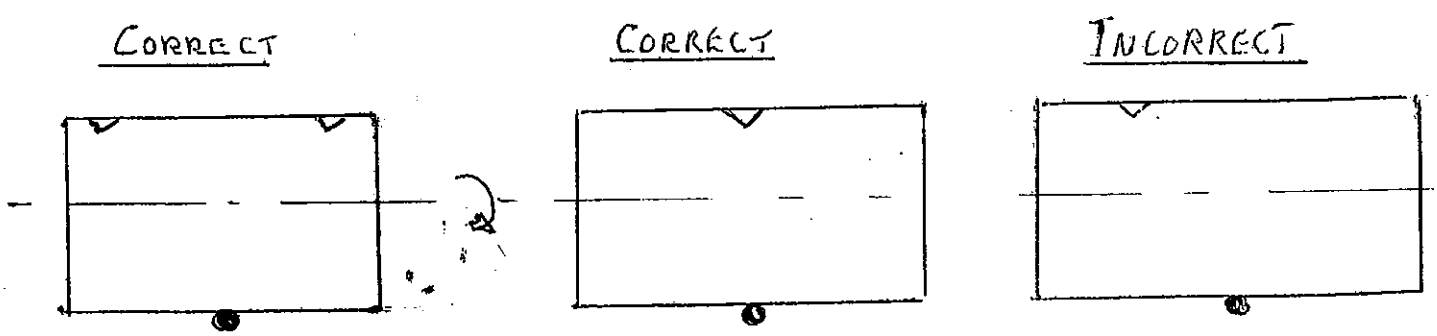
Where possible you should always try and use cutter holders in proper pairs i.e. a left hand matching a left hand, and a right hand matching a right hand. In practise you sometimes have to balance a right hand to a left hand (this should be avoided if possible).

7. Static Balance of Cutter Head

a) Static balancing is a very simple. Equipment required is as follows:-

i) Hardened balancing knives.
ii) A good quality hardened and ground mandrel.
iii) Engineers precision level.
iv) Precision straight edge.

b) To balance a sleeve by itself, place it on the mandrel and secure, find the heavy point and drill opposite until the assembly is stationary at any point. If you have to drill the sleeve to balance it it should be drilled symmetrically over the length of the sleeve, see sketch below.



c) Theoretically because all built up components have been balanced prior to assembly the cutter head should be in perfect static balance. From experience sometimes they are and sometimes there are not.

I always check a cutter head for static balance prior to fitting it to a machine. If you have to re-balance a whole head this is usually a very small amount, I usually put a T bolt either side of the block, i.e the light side and the heavy side, 3 bolts if it does not fall easily. I then add thin washers until the static balance is corrected. These balancing bolts should be positioned symmetrical on the block along the length, but this is usually not possible as cutter holders are in the way. But the amount of error you are trying to correct is so little it doesn't matter.

I have worked with cutter heads for 33 years and have never had any problems using static balancing.

Although a cutter head maybe in static balance it maybe (almost certainly not) in dynamic balance. See drawing below, this is a perfect simplified example of why a rotating component can be in static balance but not in dynamic balance, by dynamic it means inbalanced whilst rotating.

When setting up a cutter head it is often easier to move over a holder out of line with its partner, but this is the type of fault that causes dynamic errors.

Assuming we have done our best with the static balance we now put to cutter head on the machine

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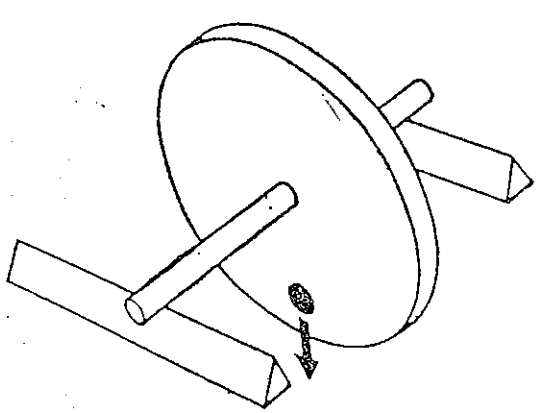

Fig. 89. System with static unbalance.

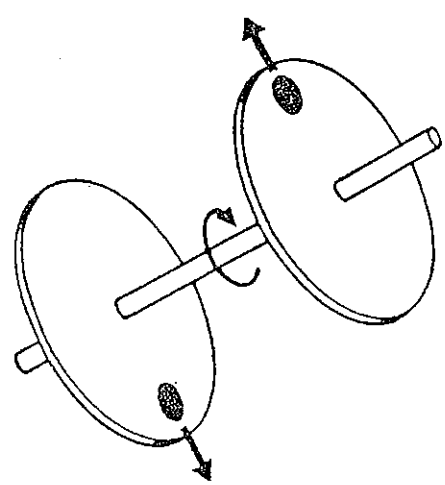

Fig. 90. System with dynamic unbalance.

25. Balancing Machines. As shown in §24, a rotating body can be balanced by the addition or removal of mass in any two convenient transverse planes. It is the function of the balancing machine to determine the magnitude of the correcting weight in each plane and its angular position.

Unbalance in rotating parts is usually measured in the ounce-inch unit, which represents an unbalance of one ounce at a radius of one inch from the axis of rotation. The amount of unbalance

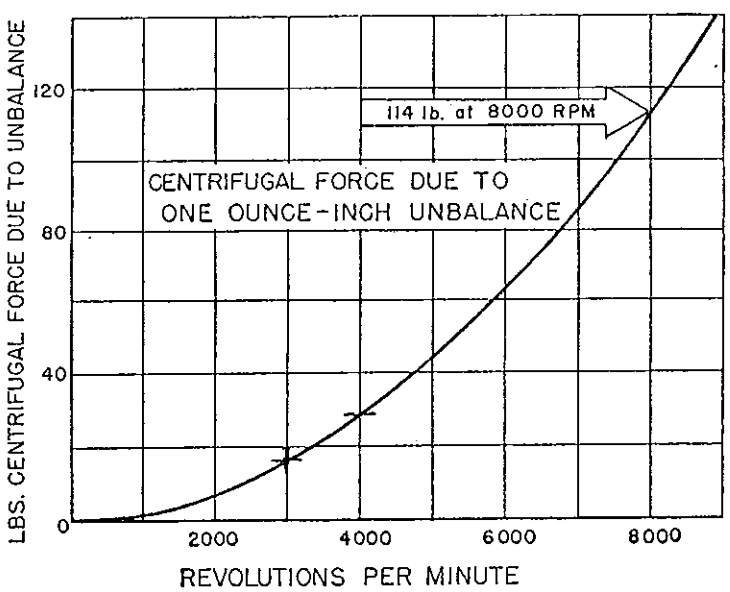

Fig. 93.

that can be tolerated depends on the speed at which the part is to be operated. Since the centrifugal force increases as the square of the speed, high-speed machines must be balanced more accurately than low-speed machines. Figure 93 shows the pounds of centrifugal force at various speeds due to an unbalance of 1 oz. in.

To appreciate the significance of such unbalance forces, consider an electric motor weighing 100 lb. and running at a speed of 8000 r.p.m. From Fig. 93, 1 oz. in. of unbalance in the rotating armature would cause a rotating force of 114 lb. This unbalance force is sufficient to lift the motor off its base 8000 times each minute.